802.16e™

IEEE

# IEEE Standard for
# Local and metropolitan area networks

# Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems

## Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands

***and***

## Corrigendum 1

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**IEEE Computer Society**
and the
**IEEE Microwave Theory and Techniques Society**

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LAN/MAN Standards Committee

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**IEEE Microwave Theory and Techniques Society**

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**Abstract**: This document updates and expands IEEE Std 802.16-2004 to allow for mobile subscriber stations.
**Keywords**: fixed broadband wireless access network, metropolitan area network, microwave, mobile broadband wireless access network, WirelessMAN® standards

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# Introduction

This introduction is not part of IEEE Std 802.16e-2005 and IEEE Std 802.16-2004/Cor 1-2005, IEEE Standard for Local and Metropolitan Area Networks Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems—Amendment 2: Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands and Corrigendum.

This amendment updates and expands IEEE Std 802.16 to allow for mobile as well as fixed (stationary) subscriber stations. As of the publication date, the current applicable version of IEEE Std 802.16 is IEEE Std 802.16-2004, as amended by IEEE 802.16f-2005 and IEEE 802.16e-2005. The published amendment includes additional material developed not as part of the IEEE 802.16e project but instead as part of the corrigendum project IEEE 802.16-2004/Cor 1, applicable only to fixed systems. Because the work was completed at nearly the same time, the two approved documents were merged prior to publication. Additional standards projects to further develop IEEE Std 802.16 are underway.

### Conformance test methodology

The multipart conformance test documents for IEEE Std 802.16 by "IEEE Standard 802.16/ConformanceXX". For example, the first part of the conformance specification for IEEE 802.16 is designated “IEEE Standard 802.16/Conformance01.”

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# IEEE Standard for
## Local and metropolitan area networks

# Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems

# Amendment 2:Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands

# *and*

# Corrigendum 1

NOTE—The editing instructions contained in this amendment/corrigendum define how to merge the material contained herein into the existing base standard IEEE Std 802.16™-2004.

The editing instructions are shown ***bold italic.*** Four editing instructions are used: ***change***, ***delete***, ***insert***, and ***replace***. ***Change*** is used to make small corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using strike through (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make large changes in existing text, subclauses, tables, or figures by removing existing material and replacing it with new material. Editorial notes will not be carried over into future editions because the changes will be incorporated into the base standard.

## 1. Overview

### 1.1 Scope

This document provides enhancements to IEEE Std 802.16-2004 to support subscriber stations moving at vehicular speeds and thereby specifies a system for combined fixed and mobile broadband wireless access. Functions to support higher layer handover between base stations or sectors are specified. Operation is limited to licensed bands suitable for mobility below 6 GHz. Fixed IEEE 802.16 subscriber capabilities are not compromised. In addition to mobility enhancements, this document contains substantive corrections to IEEE 802.16-2004 regarding fixed operation

## 1.2 Purpose

This standard will increase the market for broadband wireless access solutions by taking advantage of the inherent mobility of wireless media. It will fill the gap between very high data rate wireless local area networks and very high mobility cellular systems. It will support fixed and mobile services for both enterprise and consumer markets.

## 1.3 Frequency bands

### 1.3.3 License-exempt frequencies below 11 GHz (primarily 5–6 GHz)

***Change the subclause as indicated:***

The physical environment for the license-exempt bands below 11 GHz is similar to that of the licensed bands in the same frequency range, as described in 1.3.2. However, the license-exempt nature introduces additional interference and co-existence issues, whereas regulatory constraints limit the allowed radiated power. In addition to the features described in 1.3.2, the PHY and MAC introduce mechanisms ~~such as dynamic frequency selection (DFS)~~ to facilitate the detection and avoidance of interference and the prevention of harmful interference into other users including specific spectrum users identified by regulation. This includes a mechanism for regulatory compliance called dynamic frequency selection (DFS).

It is recognized that some administrations require notification of terminal location for certain services in some license-exempt bands, which is a form of licensing. Conversely, it is possible to have uncoordinated usage within a licensed allocation. In these and other similar cases the pertinent issues for license-exempt usage remain as described in the preceding paragraph.

In the context of this standard, the use of the term “license-exempt frequencies” or “license-exempt bands” should be taken to mean the situation where licensing authorities do not coordinate individual assignments to operators, regardless of whether the spectrum in question has a particular regulatory status as license-exempt or licensed.

### 1.3.4 Air interface nomenclature and PHY compliance

***Delete the fourth column of Table 1 and make additional changes as indicated:***

**Table 1—Air interface nomenclature**

| Designation | Applicability | PHY specification | Options | Duplexing alternative |
|---|---|---|---|---|
| WirelessMAN-SC™ | 10–66 GHz | 8.1 | — | TDD<br>FDD |
| WirelessMAN-SCa™ | Below 11 GHz licensed bands | 8.2 | AAS (6.3.7.6)<br>ARQ (6.3.4)<br>STC (8.2.1.4.3)<br>mobile | TDD<br>FDD |
| WirelessMAN-OFDM™ | Below 11 GHz licensed bands | 8.3 | AAS (6.3.7.6)<br>ARQ (6.3.4)<br>Mesh (6.3.6.6)<br>STC (8.3.8)<br>mobile | TDD<br>FDD |
| WirelessMAN-OFDMA | Below 11 GHz licensed bands | 8.4 | AAS (6.3.7.6, 8.4.4.6)<br>ARQ (6.3.4)<br>HARQ (6.3.17)<br>STC (8.4.8)<br>mobile | TDD<br>FDD |
| WirelessHUMAN™ | Below 11 GHz license-exempt bands | [8.2, 8.3 or 8.4] and 8.5 | AAS (6.3.7.6)<br>ARQ (6.3.4)<br>Mesh (6.3.6.6) (with 8.3 only)<br>STC (8.2.1.4.3/8.3.8/8.4.8) | TDD |

***Change the last paragraph as indicated:***

Implementations of this standard for license-exempt frequencies below 11 GHz (such as those listed in B.1) shall comply with the WirelessMAN-SCa PHY as described in 8.2, the WirelessMAN-OFDM PHY as described in 8.3, or the WirelessMAN-OFDMA PHY as described in 8.4. They shall further comply with the DFS protocols (6.3.15) (where mandated by regulation) and with 8.5.

## 1.4 Reference model

***Insert the following new subclause into 1.4:***

### 1.4.1 Handover process

The handover (HO) process in which an MS migrates from the air-interface provided by one BS to the air-interface provided by another BS is defined in 6.3.22.2.

## 2. References

***Insert the following references:***

FIPS 197, Advanced Encryption Standard (AES).[1]

IEEE Std 802.16™-2004, IEEE Standard for Local and metropolitan area networks: Part 16: Air Interface for Fixed Broadband Wireless Access Systems.[2, 3]

IETF RFC 2373, "IP Version 6 Addressing Architecture," R. Hinden, S. Deering, July 1998. (http://www.ietf.org/rfc/rfc2373.txt)

IETF RFC 2462, "IPv6 Stateless Address Autoconfiguration," S. Thomson, T. Narten, December 1998. (http://www.ietf.org/rfc/rfc2462.txt)

IETF RFC 2789, "Mail Monitoring MIB," N. Freed, S. Kille, March 2000. (http://www.ietf.org/rfc/rfc2789.txt)

IETF RFC 3012, "Mobile IPv4 Challenge/Response Extensions," C. Perkins, P. Calhoun, November 2000. (http://www.ietf.org/rfc/rfc3012.txt)

IETF RFC 3095, "RObust Header Compression (ROHC): Framework and four profiles: RTP, UDP, ESP, and uncompressed," C. Bormann, et al, July 2001. (http://www.ietf.org/rfc/rfc3095.txt)

IETF RFC 3280, "Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile," R. Housley, W. Polk, W. Ford, D. Solo, April 2002. (http://www.ietf.org/rfc/rfc3280.txt)

IETF RFC 3315, "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)," R. Droms, et al, July 2003. (http://www.ietf.org/rfc/rfc3315.txt)

IETF RFC 3394, "Advanced Encryption Standard (AES) Key Wrap Algorithm," J. Schaad, R. Housley, September 2002. (http://www.ietf.org/rfc/rfc3394.txt)

IETF RFC 3545, "Enhanced Compressed RTP (CRTP) for Links with High Delay, Packet Loss and Reordering," T. Koren, S. Casner, J. Geevarghese, B. Thompson, P. Ruddy, July 2003. (http://www.ietf.org/rfc/rfc3545.txt)

IETF RFC 3748, "Extensible Authentication Protocol (EAP)," B. Aboba, L. Blunk, J. Vollbrecht, J. Carlson, H. Levkowetz, June 2004. (http://www.ietf.org/rfc/rfc3748.txt)

IETF RFC 3775, "Mobility Support in IPv6," D. Johnson, C. Perkins, J. Arkko, June 2004 (http://www.ietf.org/rfc/rfc3775.txt)

ITU-T Recommendation X.25—Interface between Data Terminal Equipment (DTE) and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit, October 1996.[4]

NIST Special Publication 800-38B—Recommendation for Block Cipher Modes of Operation: The CMAC Mode for Authentication.

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[1] FIPS publications are available from the National Technical Information Service (NTIS), U. S. Dept. of Commerce, 5285 Port Royal Rd., Springfield, VA 22161 (http://www.ntis.org/).

[2] IEEE publications are available from the Institute of Electrical and Electronics Engineers, Inc., 445 Hoes Lane, Piscataway, NJ 08854, USA (http://standards.ieee.org/).

[3] The IEEE standards or products referred to in this clause are trademarks of the Institute of Electrical and Electronics Engineers, Inc.

[4] ITU-T publications are available from the International Telecommunications Union, Place des Nations, CH-1211, Geneva 20, Switzerland/Suisse (http://www.itu.int/).

# 3. Definitions

***Change the following definitions as indicated:***

**3.4 bandwidth stealing**: The use, by a subscriber station (SS), of a portion of the bandwidth allocated in response to a Bandwidth Request for a connection to send ~~another~~ a Bandwidth Request ~~rather than sending data~~ or data for any of its connections. *See also* 6.3.6.

**3.12 connection**: A unidirectional mapping between base station (BS) and subscriber station (SS) medium access control (MAC) peers ~~for the purpose of transporting a service flow's traffic~~. Connections are identified by a connection identifier (CID). ~~All traffic is carried on a connection, even for service flows that implement connectionless protocols, such as Internet Protocol (IP)~~The MAC defines two kinds of connections: management connections and transport connections. *See also*: **connection identifier**.

**3.13 connection identifier (CID)**: A 16-bit value that identifies a transport connection or a uplink (UL)/ downlink (DL) pair of associated management connections (i.e., belonging to the same subscriber station (SS)) to equivalent peers in the MAC of the base station (BS) and subscriber station (SS). The connection identifier (CID) address space is common (i.e., shared) between UL and DL and Table 345 specifies how it is partitioned among the different types of connections. ~~It maps to a service flow identifier (SFID), which defines the Quality of Service (QoS) parameters of the service flow associated with that connection.~~ Security associations (SAs) also exist between keying material and CIDs. *See also*: **connection** ~~**service flow identifier**~~.

**3.21 dynamic frequency selection (DFS)**: The ability of a system to switch to different physical RF channels ~~between transmit and receive activity~~ based on channel measurement criteria to conform to particular regulatory requirements.

**3.27 initial ranging connection ~~identifier~~**: A management connection used by the subscriber station (SS) and the base station (BS) during the initial ranging process. The initial ranging connection is identified by a well-known connection identifier (CID) (see Table 345) ~~that is used by a subscriber station (SS) during the initial ranging process~~. This CID is defined as constant value within the protocol since an SS has no addressing information available until the initial ranging process is complete.

**3.36 payload header suppression index (PHSI)**: An 8-bit ~~mask that indicates which bytes in the Payload Header Suppression Field (PHSF) to suppress and which bytes to not suppress.~~ value that references the payload header suppression (PHS) Rule.

**3.45 BS receive/transmit transition gap (RTG)**: A gap between the last sample of the uplink burst and the first sample of the subsequent downlink burst at the antenna port of the base station (BS) in a time division duplex (TDD) transceiver. This gap allows time for the base station (BS) to switch from receive to transmit mode ~~and SSs to switch from transmit to receive mode~~. During this gap, the BS ~~and SS are~~ is not transmitting modulated data but simply allowing the BS transmitter carrier to ramp up~~,~~ and the transmit/ receive (Tx/Rx) antenna switch to actuate~~, and the SS receiver sections to activate~~. Not applicable for frequency division duplex (FDD) systems.

**3.60 transport connection**: A connection used to transport user data. It does not include any traffic over either the basic, primary or secondary management connections. A fragmentable transport connection is a connection that allows fragmentation of service data units (SDUs).

**3.61 transport connection identifier**: A unique identifier taken from the connection identifier (CID) address space that uniquely identifies the transport connection. All user data traffic is carried on transport connections, even for service flows that implement connectionless protocols, such as Internet Protocol (IP). An active or admitted service flow (identified by an service flow id (SFID)) maps to a transport connection identifier (transport CID) assigned by the BS.

**3.63 BS transmit/receive transition gap (TTG)**: A gap between the last sample of the downlink burst and the first sample of the subsequent uplink burst at the antenna port of the base station (BS) in a time division duplex (TDD) transceiver. This gap allows time for the base station (BS) to switch from transmit to receive mode ~~and SSs to switch from receive to transmit mode~~. During this gap, the BS ~~and SS are~~ is not transmitting modulated data but simply allowing the BS transmitter carrier to ramp down, the transmit/ receive (Tx/Rx) antenna switch to actuate, and the BS receiver section to activate. Not applicable for frequency division duplex (FDD) systems.

***Insert new subclauses under 3.5 as follows:***

**3.5 base station (BS):**

**3.5.1 neighbor BS:** For any mobile station (MS), a neighbor BS is a base station (BS) (other than the serving BS) whose downlink transmission can be received by the mobile station (MS).

**3.5.2 serving BS:** For any mobile station (MS), the serving BS is the base station (BS) with which the mobile station (MS) has most recently completed registration at initial network-entry or during a handover (HO).

**3.5.3 target BS:** The base station (BS) that a mobile station (MS) intends to be registered with at the end of a handover (HO).

**3.5.4 active BS:** An active BS is informed of the mobile station (MS) capabilities, security parameters, service flows and full MAC context information. For macro diversity handover (MDHO), the mobile station (MS) transmits/receives data to/from all active BSs in the diversity set.

***Insert new definitions as follows:***

**3.71 adjacent subcarrier allocation:** A permutation where the subcarriers are located adjacent to each other.

**3.72 anchor BS:** For macro diversity handover (MDHO) or fast BS switching (FBSS) supporting mobile station (MS)s, this is a base station (BS) where the mobile station (MS) is registered, synchronized, performs ranging and monitors the downlink (DL) for control information. For fast BS switching (FBSS) supporting mobile station (MS), this is the serving BS that is designated to transmit/receive data to/from the mobile station (MS) at a given frame.

**3.73 backbone network**: Communication mechanism by which two or more base station (BS)s communicate to each other, and may also include communication with other networks. The method of communication for backbone networks is outside the scope of this standard.

**3.74 broadcast connection**: The management connection used by the base station (BS) to send medium access control (MAC) management messages on a downlink to all subscriber station (SS). The broadcast connection is identified by a well-known connection identifier (CID) (see Table 345). A fragmentable broadcast connection is a connection that allows fragmentation of broadcast MAC management messages.

**3.75 diversity set:** The diversity set contains a list of active BSs to the mobile station (MS). The diversity set is managed by the mobile station (MS) and base station (BS). The diversity set is applicable to macro diversity handover (MDHO) and fast BS switching (FBSS).

**3.76 frequency assignment (FA) index:** A network specific logical frequency assignment (FA) index assignment. FA index assignment is used in combination with operator specific configuration information provided to the mobile station (MS) in a method outside the scope of this standard.

**3.77 fast BS switching (FBSS):** Base station (BS) switching that utilizes a fast switching mechanism to improve link quality. The mobile station (MS) is only transmitting/receiving data to/from one of the active BS (anchor BS) at any given frame. The anchor BS can change from frame to frame depending on the base station (BS) selection scheme.

**3.78 frequency assignment (FA)**: A frequency assignment (FA) denotes a logical assignment of downlink (DL) center frequency and channel bandwidth programmed to the base station (BS).

**3.79 handover (HO):** The process in which an mobile station (MS) migrates from the air-interface provided by one base station (BS) to the air-interface provided by another base station (BS). Two HO variants are defined:

1) **break-before-make HO:** A HO where service with the target BS starts after a disconnection of service with the previous serving BS.
2) **make-before-break HO:** A HO where service with the target BS starts before disconnection of the service with the previous serving BS.

**3.80 group key encryption key (GKEK):** The GKEK is a random number generated by the base station (BS) or a network entity (for example, an ASA server) used to encrypt the GTEKs sent in multicast messages by the base station (BS) to mobile station (MS)s in the same multicast group.

**3.81 macro diversity handover (MDHO):** The process in which an mobile station (MS) migrates from the air-interface provided by one or more base station (BS)s to the air-interface provided by one or more other BSs. This process is accomplished in the downlink (DL) by having two or more BSs transmitting the same MAC/PHY protocol data unit (PDU) to the MS such that diversity combining can be performed by the MS. In the uplink (UL) it is accomplished by having two or more BSs receiving (demodulating, decoding) the same PDU from the MS, such that diversity combining of the received PDU can be performed among the BSs.

**3.82 management connection**: A connection used for the purpose of transporting medium access control (MAC) management messages (*see:* basic connection, primary management connection, broadcast connection, initial ranging connection) or standards-based messages (*see:* secondary management connection) required by the MAC layer.

NOTE—Table 14 specifies which MAC management message is transmitted on which of the management connections.[5]

**3.83 mobile station (MS)**: A station in the mobile service intended to be used while in motion or during halts at unspecified points. An MS is always a subscriber station (SS) unless specifically excepted otherwise in the standard.

**3.84 multiple input multiple output (MIMO)**: A system employing at least two transmit antennas and at least two receive antennas to improve the system capacity, coverage or throughput.

**3.85 orderly power down procedure:** The procedure that the mobile station (MS) performs when powering down as directed by (e.g., user input or prompted by a automatic power down mechanism).

**3.86 payload header suppression mask (PHSM)**: A bit mask indicating which bytes in the payload header suppression field (PHSF) to suppress, and which bytes to not suppress.

**3.87 quality of service (QoS) parameter set:** Is associated with a service flow identifier (SFID). The contained traffic parameters define scheduling behavior of uplink or downlink flows associated with transport connections.

NOTE—See 6.3.14.1.

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[5] Notes in text, tables, and figures are given for information only, and do not contain requirements needed to implement the standard.

**3.88 scanning interval**: A time period intended for the mobile station (MS) to monitor neighbor base stations (BSs) to determine the suitability of the BS as targets for handover (HO).

## 4. Abbreviations and acronyms

***Insert the following abbreviations:***

| | |
|---|---|
| AES | advanced encryption standard |
| AMC | adaptive modulation and coding |
| ASA | authentication and service authorization |
| BWAA | bandwidth allocation/ access |
| CBC-MAC | cipher block chaining message authentication code |
| CCH | control subchannel |
| CCM | CTR mode with CBC-MAC |
| CQI | channel quality information |
| CQICH | channel quality information channel |
| CSIT | channel state information at the transmitter |
| CTC | convolutional turbo codes |
| CTR | counter mode encryption |
| dBi | decibels of gain relative to the zero dB gain of a free-space isotropic radiator |
| dBm | decibels relative to one milliwatt |
| DLFP | downlink frame prefix |
| EAP | extensible authentication protocol |
| FBSS | fast base station switching |
| FHDC | frequency hopping diversity coding |
| FUSC | full usage of subchannels |
| GKEK | group key encryption key |
| GMH | generic MAC header |
| GTEK | group traffic encryption key |
| HO | handover |
| MBS | multicast and broadcast services |
| MCS | modulation coding scheme |
| MDHO | macro diversity handover |
| MIMO | multiple input multiple output |
| MS | mobile station |
| PAK | primary authorization key |
| PAPR | peak to average power ratio |
| PMK | pairwise master key |
| PUSC | partial usage of subchannels |
| PUSC-ASCA | PUSC adjacent subcarrier allocation |
| SDMA | spatial division multiple access |
| SN | sequence number |
| SSID | subscriber station identification (MAC address) |
| STTD | space time transmit diversity |
| TUSC | tile usage of subchannels |
| UEP | unequal error protection |

# 5. Service-specific CS

## 5.1 ATM CS

### 5.1.2 Data/Control plane

### 5.1.2.2 Classification

### 5.1.2.2.1 VP-switched mode

***Change the first sentence of the first paragraph as indicated:***

For VP-switched mode, the VPI field, 12 bits for a network-to-network interface (NNI) ~~and~~or 8 bits for a user-to-network interface (UNI), is mapped to the 16-bit CID for the MAC connection on which it is transported.

### 5.1.2.2.2 VC-switched mode

***Change the first sentence of the first paragraph as indicated:***

For VC-switched mode, the VPI and VCI fields, 28 bits total for an NNI ~~and~~or 24 bits total for a UNI, are mapped to the 16-bit CID for the MAC connection on which it is transported.

## 5.2 Packet CS

***Change the first paragraph of the subclause as indicated:***

The packet CS resides on top of the IEEE Std 802.16 MAC CPS. The CS performs the following functions, utilizing the services of the MAC:

a) Classification of the higher-layer protocol PDU into the appropriate transport connection

***Change the last paragraph of the subclause as indicated:***

The packet CS is used for transport for all packet-based protocols ~~such as Internet Protocol (IP), Point-to-Point Protocol (PPP), and IEEE Std 802.3 (Ethernet)~~ as defined in 11.13.19.3.

### 5.2.2 Classification

***Change the first paragraph of the subclause as indicated:***

Classification is the process by which a MAC SDU is mapped onto a particular transport connection for transmission between MAC peers. The mapping process associates a MAC SDU with a transport connection, which also creates an association with the service flow characteristics of that connection. This process facilitates the delivery of MAC SDUs with the appropriate QoS constraints.

### 5.2.3 PHS

### 5.2.3.1 PHS operation

***Change the second paragraph as indicated:***

A packet is submitted to the packet CS. The SS applies its list of Classifier rules. A match of the rule shall result in an Uplink Service Flow, CID, and may result in a PHS Rule.

#### 5.2.3.2 PHS signaling

*Replace Figure 11 with the following figure:*

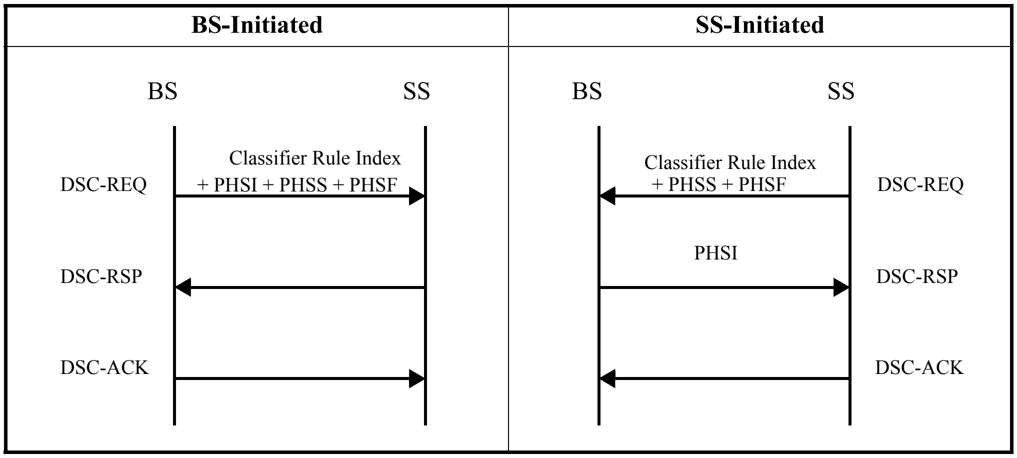


Figure 11—PHS signaling example

### 5.2.4 IEEE Std 802.3/Ethernet-specific part

#### 5.2.4.1 IEEE Std 802.3/Ethernet CS PDU format

*Change the first paragraph as indicated:*

The IEEE Std 802.3/Ethernet PDUs are mapped to MAC SDUs according to Figure 12 (when header suppression is enabled at the connection, but not applied to the CS PDU) or Figure 13 (with header suppression). In the case where PHS is not enabled, PHSI field shall be omitted.

The IEEE Std 802.3/Ethernet PDU shall not include the Ethernet FCS when transmitted over this CS.

#### 5.2.4.2 IEEE Std 802.3/Ethernet CS classifiers

*Change the second paragraph as indicated:*

~~Logical link control (LLC)~~IEEE Std 802.3/Ethernet header classification parameters—zero or more of the ~~LLC~~IEEE Std 802.3/Ethernet header classification parameters (destination MAC address, source MAC address, Ethertype/SAP).

*Insert the following text at the end of subclause 5.2.4.2:*

Compressed-IP-Header IP over IEEE 802.3/Ethernet encapsulation exists to deal with the case where a IP compression function (i.e., ROHC or ECRTP) is performed on an IP packet carried in an IEEE 802.3/Ethernet frame before its ingress to the convergence sublayer (note that the compression function shall not operate on the IEEE 802.3/Ethernet frame header so that the Ethernet frame header remains intact).

For IP-header compressed IP over IEEE 802.3/Ethernet, IP header compression and VLAN headers may be included in the classification. In this case, only the IEEE 802.3/IEEE 802.1Q (11.13.19.3.4.8 through 11.13.19.3.4.12) and Compressed IP header (11.13.19.3.4.16, 11.13.19.3.4.18) classification parameters are allowed.

***Change the titles of subclauses 5.2.5 and 5.2.5.1 as indicated:***

### 5.2.5 IEEE Std 802.1Q-~~1998~~2003 virtual local area network (VLAN) specific part

#### 5.2.5.1 IEEE Std 802.1Q-~~1998~~2003 VLAN CS PDU format

***Change the first paragraph as indicated:***

The format of the IEEE Std 802.1Q-~~1998~~2003 VLAN CS PDU shall be as shown in Figure 14 (when header suppression is enabled at the connection, but not applied to the CS PDU) or Figure 15 (with header suppression). In the case where PHS is not enabled, PHSI field shall be omitted.

#### 5.2.5.2 IEEE Std 802.1Q-~~1998~~2003 CS classifiers

***Change the subclause as indicated:***

The following parameters are relevant for IEEE Std 802.1Q-~~1998~~2003 CS classifiers:

~~LC~~IEEE Std 802.3/Ethernet header classification parameters—zero or more of the ~~LLC~~IEEE Std 802.3/Ethernet header classification parameters (~~D~~destination MAC address, source MAC address, Ethertype/SAP).

The IEEE Std 802.1Q-2003 VLAN PDU shall not include the FCS when transmitted over this CS.

IEEE Std 802.1D-~~1998~~2003 Parameters—zero or more of the IEEE classification parameters (IEEE Std 802.1D-~~1998~~2003 Priority Range, IEEE Std 802.1Q-~~1998~~2003 VLAN ID).

For IP over IEEE Std 802.1Q-~~1998~~2003 VLAN, IP headers may be included in classification. In this case, the IP classification parameters (11.13.19.3.4.2 through 11.13.19.3.4.7) are allowed.

### 5.2.6 IP specific part

#### 5.2.6.1 IP CS PDU format

***Change the first paragraph as indicated:***

The format of the IP CS PDU shall be as shown in Figure 16 (when header suppression is enabled at the connection, but not applied to the CS PDU) or Figure 17 (with header suppression). In the case where PHS is not enabled, PHSI field shall be omitted.

***Insert a new subclause 5.2.7:***

### 5.2.7 IP-Header-compression-specific part

The Convergence sublayer supports SDUs in two formats that facilitate robust compression of IP and higher layer headers. These formats are ROHC (RFC 3095) and ECRTP (RFC 3545) and are referred to as the IP-header-compression CS PDU format.

### 5.2.7.1 Compressed-IP-Header CS PDU

The formats of the Compressed-IP-Header CS PDU are mapped to MAC SDUs according to Figure 17a (when header suppression is enabled at the connection, but not applied to the CS PDU) or Figure 17b (with header suppression).

| | |
|---|---|
| PHSI = 0 | COMPRESSED-IP-Header + payload |

**Figure 17a—IP CS PDU format with Compressed-IP-Header and without header suppression**

| | |
|---|---|
| PHSI != 0 | COMPRESSED-IP-Header + payload |

**Figure 17b—IP CS PDU format with both Compressed-IP-Header and header suppression**

### 5.2.7.2 Compressed-IP-Header classifiers

Compressed-IP-Header classifiers operate on the context fields of the ROHC- and ECRTP-compressed packets. The IP header compression parameters (11.13.19.3.4.16, 11.13.19.3.4.18) may be used in Compressed-IP-Header classifiers.

# 6. MAC common part sublayer

## 6.1 PMP

***Change the subclause starting from the sixth paragraph as indicated:***

The MAC is connection-oriented. For the purposes of mapping to services on SSs and associating varying levels of QoS, all data communications are in the context of a transport connection. Service flows may be provisioned when an SS is installed in the system. Shortly after SS registration, transport connections are associated with these service flows (one connection per service flow) to provide a reference against which to request bandwidth. Additionally, new transport connections may be established when a customer's service needs change. A transport connection defines both the mapping between peer convergence processes that utilize the MAC and a service flow. The service flow defines the QoS parameters for the PDUs that are exchanged on the connection.

The concept of a service flow on a transport connection is central to the operation of the MAC protocol. Service flows provide a mechanism for uplink and downlink QoS management. In particular, they are integral to the bandwidth allocation process. An SS requests uplink bandwidth on a per connection basis (implicitly identifying the service flow). Bandwidth is granted by the BS to an SS as an aggregate of grants in response to per connection requests from the SS.

Transport ~~C~~connections, once established, may require active maintenance. The maintenance requirements vary depending upon the type of service connected. For example, unchannelized T1 services require virtually no connection maintenance since they have a constant bandwidth allocated ~~every frame~~ periodically. Channelized T1 services require some maintenance due to the dynamic (but relatively slowly changing) bandwidth requirements if compressed, coupled with the requirement that full bandwidth be available on demand. IP services may require a substantial amount of ongoing maintenance due to their bursty nature and due to the high possibility of fragmentation. As with connection establishment, modifiable connections may require maintenance due to stimulus from either the SS or the network side of the connection.

Finally, transport connections may be terminated. This generally occurs only when a customer's service requirements ~~contract~~ changes. The termination of a transport connection is stimulated by the BS or SS.

All three of these transport connection management functions are supported through the use of static configuration and dynamic addition, modification, and deletion of service flows~~connections~~.

## 6.3 Data/Control plane

### 6.3.1 Addressing and connections

### 6.3.1.1 PMP

***Change the subclause as indicated:***

Each air interface in SS shall have a 48-bit universal MAC address, as defined in IEEE Std 802$^{®}$-2001. This address uniquely defines the air interface of the SS ~~from within the set of all possible vendors and equipment types~~. It is used during the initial ranging process to establish the appropriate connections for an SS. It is also used as part of the authentication process by which the BS and SS each verify the identity of the other.

Connections are identified by a 16-bit CID. At SS initialization, two pairs of management connections (uplink and downlink) shall be established between the SS and the BS and a third pair of management connections may be optionally generated. The three pairs of management connections reflect the fact that there are inherently three different levels of QoS for management traffic between an SS and the BS. The basic connection is used by the BS MAC and SS MAC to exchange short, time-urgent MAC management messages. The primary management connection is used by the BS MAC and SS MAC to exchange longer, more delay-tolerant MAC management messages. Table 14 specifies which MAC Management messages are transferred on which of these two connections. In addition, it also specifies which MAC management messages are transported on the Broadcast Connection. Finally, the Secondary Management Connection is used by the BS and SS to transfer delay tolerant, standards-based [Dynamic Host Configuration Protocol (DHCP), Trivial File Transfer Protocol (TFTP), SNMP, etc.] messages. ~~These messages are carried in IP datagrams, as specified in 5.2.6~~. Messages carried on the Secondary Management Connection may be packed and/or fragmented. For the SCa, OFDM, and OFDMA PHY layers, management messages shall have CRC. Use of the secondary management connection is required only for managed SS.

The CIDs for these connections shall be assigned in the RNG-RSP and REG-RSP messages. The message dialogs provide three CID values. The same CID value is assigned to both members (uplink and downlink) of each connection pair.

For bearer services, the BS initiates the set-up of service flows~~connections~~ based upon the provisioning information distributed to the BS. The registration of an SS, or the modification of the services contracted at an SS, stimulates the higher layers of the BS to initiate the setup of the service flows~~connections~~. When admitted or active, service flows are uniquely associated with transport connections. MAC management messages shall never be transferred over transport connections. Bearer or data services shall never be transferred on the Basic, Primary, or Secondary Management connections.

~~The CID can be considered a connection identifier even for nominally connectionless traffic like IP, since it and serves as a pointer to destination and context information. The use of a 16-bit CID permits a total of 64K connections within each downlink and uplink channel.~~

### 6.3.2 MAC PDU formats

***Insert the following sentence to the last paragraph:***

All reserved fields shall be set to zero on transmission and ignored on reception.

### 6.3.2.1 MAC header formats

***Change the existing text in the first paragraph of 6.3.2.1 as shown below:***

There is one defined DL MAC header that is the generic MAC header, which begins each MAC PDU containing either MAC management messages or CS data. ~~Two MAC header formats are defined. The first is the generic MAC header that~~ There is one defined DL MAC header that is the generic MAC header, which begins each MAC PDU containing either MAC management messages or CS data. ~~The second is the bandwidth request header used to request additional bandwidth. The single-bit Header Type (HT) field distinguishes the generic MAC header and bandwidth request header formats. The HT field shall be set to zero for the Generic Header and to one for a bandwidth request header.~~ There are two defined UL MAC header formats. The first is the generic MAC header that begins each MAC PDU containing either MAC management messages or CS data, where HT is set to 0 as shown in Table 4a. The second is the MAC header format without payload where HT is set to 1 as shown in Table 4a. For the latter format, the MAC header is not followed by any MAC PDU payload and CRC.

*Insert new table into 6.3.2.1 as follows:*

**Table 4a—MAC Header HT and EC fields encoding**

| HT | EC[a] | MAC PDU type | Reference figure | Reference table |
|---|---|---|---|---|
| 0 | 0 | Generic MAC header for DL and UL. MAC PDU with data payload, no encryption, with a 6-bit type field, see Table 6 for its type field encodings. | 19 | 5 |
| 0 | 1 | Generic MAC header for DL and UL. MAC PDU with data payload, with encryption with a 6-bit type field, see Table 6 for its type field encodings. | 19 | 5 |
| 1 | 0 | DL: This encoding is not defined<br>UL: MAC signaling header type I. MAC PDU without data payload, with a 3-bit type field, see Table 5a for type encoding definitions. | 19a, 20, 20a-f | 5a, 7, 7a-f |
| 1 | 1 | DL: Compressed/Reduced Private DL-MAP[b]<br>UL: MAC signaling header type II. MAC PDU without data payload, with 1-bit type field, see Table 7g for type encoding definitions. | 20g-i | 7g, 7h |

[a] Headers with HT=1 shall not be encrypted. Thus the EC field is used to distinguish between Feedback MAC header (UL) / Compress MAP (DL), and all other type headers.

[b] Compressed DL-MAP and Reduced Private MAP do not use MAC headers as defined in 6.3.2.1; however, the first two bits of these maps overlay with HT/EC fields and are always set to 0b11 to identify them as such (see 8.3.6.3, 8.3.6.7, 8.4.5.6, and 8.4.5.8).

### 6.3.2.1.1 Generic MAC header

*Replace Figure 19 in 6.3.2.1.1 with the following figure:*

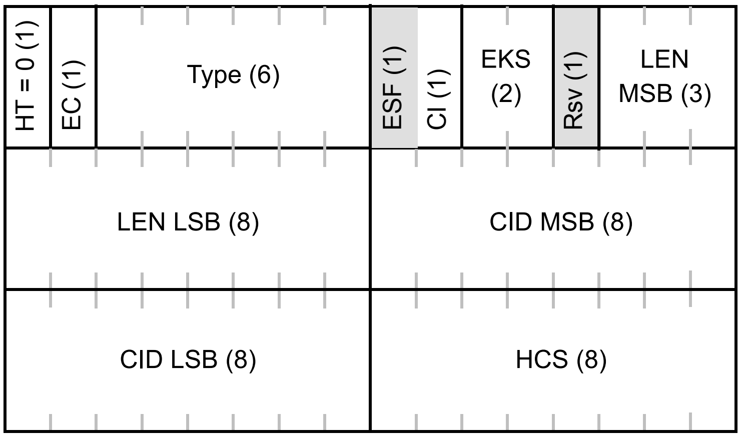


Figure 19—Generic MAC header format

*Insert the following row into Table 5:*

Table 5—Generic MAC header fields

| Name | Length (bits) | Description |
|---|---|---|
| ESF | 1 | Extended subheader field. If ESF = 0, the extended subheader is absent. If ESF = 1, the extended subheader is present and will follow the GMH immediately. (See 6.3.2.2.7). The ESF is applicable both in the DL and in the UL. |

*Insert the following to the end of 6.3.2.1.1:*

The ESF bit in the Generic MAC header indicates that the extended subheader is present. Using this field, a number of additional subheaders can be used within a PDU. The extended subheader shall always appear immediately after the Generic MAC header and before all other subheaders. All extended subheaders are not encrypted. (See 6.3.2.2.7.)

Table 5a— Type field encodings for MAC signaling header Type I

| Type field (3 bits) | MAC header type (with HT/EC=0b10) | Reference figure | Reference table |
|---|---|---|---|
| 000 | BR incremental | 20 | 7 |
| 001 | BR aggregate | 20 | 7 |
| 010 | PHY channel report | 20d | 7d |
| 011 | BR with UL Tx Power Report | 20a | 7a |
| 100 | Bandwidth request and CINR report | 20b | 7b |
| 101 | BR with UL sleep control | 20e | 7e |
| 110 | SN Report | 20f | 7f |
| 111 | CQICH allocation request | 20c | 7c |

*Change the text in Table 6 as indicated:*

Table 6—Type encodings

| Type bit | Value |
|---|---|
| #5<br>most significant bit (MSB) | Mesh subheader<br>1 = present, 0 = absent |
| #4 | ARQ Feedback Payload<br>1 = present, 0 = absent |
| #3 | Extended Type<br>Indicates whether the present Packing or Fragmentation Subheaders, is Extended, for non ARQ-enabled connections<br>1 = Extended<br>0 = not Extended. ~~Applicable to connections where ARQ is not enabled~~<br>For ARQ-enabled connections, this bit shall be set to 1. |

**Table 6—Type encodings** ***(continued)***

| Type bit | Value |
|---|---|
| #2 | Fragmentation subheader<br>1 = present, 0 = absent |
| #1 | Packing subheader<br>1 = present, 0 = absent |
| #0<br>least significant bit (LSB) | Downlink: FAST-FEEDBACK Allocation subheader<br>Uplink: Grant Management subheader<br>1 = present, 0 = absent |

***Renumber the current subclause 6.3.2.1.2 to 6.3.2.1.2.1.1. Insert the following text as the new subclause 6.3.2.1.2.***

### 6.3.2.1.2 MAC header without payload

This MAC header format is applicable to UL only. The MAC header is not followed by any MAC PDU payload and CRC.

#### 6.3.2.1.2.1 MAC signaling header type I

For this MAC header format, there is no payload following the MAC header. The MAC signaling header type I is illustrated in Figure 19a. Table 5a describes the encoding of the 3-bit type field following the EC field.

***Insert the following figure after Figure 19:***

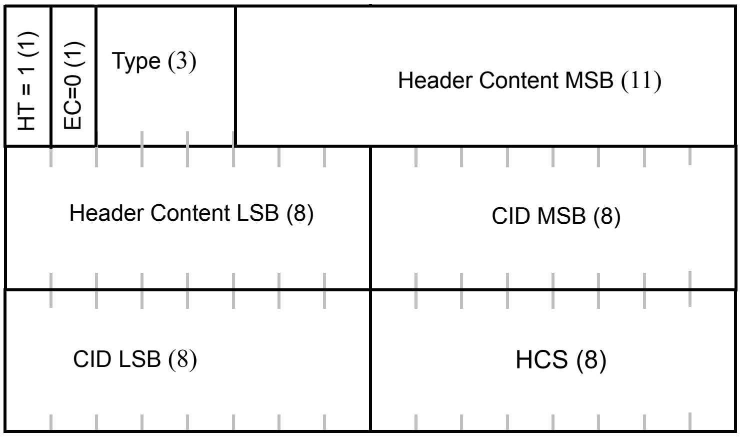


**Figure 19a—MAC signaling header type I format**

*Change 6.3.2.1.2 as indicated:*

### 6.3.2.1.2.1.1 Bandwidth request header

The Bandwidth Request PDU shall consist of bandwidth request header alone and shall not contain a payload. The bandwidth request header is illustrated in Figure 20. An MS receiving a bandwidth request header on the downlink shall discard the PDU.

The 'Bandwidth Request' header shall have the following properties:

a) It is a MAC signaling header type I.~~The length of the header shall always be 6 bytes.~~
~~b) The EC field shall be set to 0, indicating no encryption.~~
b) ~~c)~~The CID shall indicate the connection for which uplink bandwidth is requested.
c) ~~d)~~The Bandwidth Request (BR) field shall indicate the number of bytes requested.
~~e) The allowed types for bandwidth requests are "000" for incremental and "001" for aggregate.~~
d) The allowed types of bandwidth requests are defined in Table 5a.

The fields of the bandwidth request header are defined in Table 7.~~Every header is encoded, starting with the HT and EC fields. The coding of these fields is such that the first byte of a MAC header shall never have the value of 0xFX. This prevents false detection of the stuff byte.~~

*Insert new subclause 6.3.2.1.2.1.2:*

### 6.3.2.1.2.1.2 Bandwidth request and UL Tx Power Report header

The Bandwidth Request and UL Tx Power Report PDU shall consist of bandwidth request and UL Tx Power Report header alone and shall not contain a payload. The bandwidth request and UL Tx Power Report header is illustrated in Figure 20a.

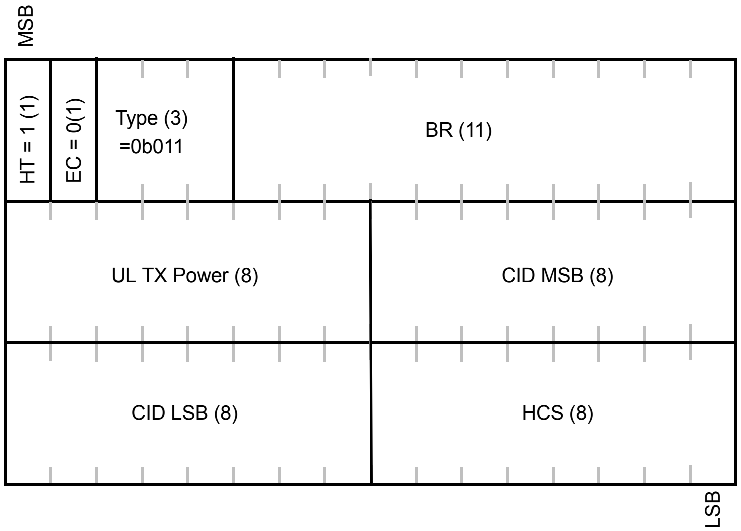


**Figure 20a—Bandwidth request and UL Tx Power Report header format**

The Bandwidth request and UL Tx Power Report header shall have the following properties:

a) This is a MAC signaling header type I.
b) The CID shall indicate the connection for which uplink bandwidth is requested.

c) The allowed type for Bandwidth request and UL Tx Power Report is defined in Table 5a. The requested bandwidth is incremental.

The fields of the Bandwidth request UL Tx Power Report header are defined in Table 7a.

**Table 7a—Description of fields BR and UL Tx Power Report header**

| Name | Size | Description |
|---|---|---|
| Type | 3 bits | The type of BR and UL Tx Power Report header is defined in Table 5a. |
| BR | 11 bits | Bandwidth Request: The number of bytes of uplink bandwidth requested by the MS. The bandwidth request is for the CID. The request shall not include any PHY overhead. It is incremental BW request. In case of the Extended rtPS, if the MSB is 1, the BS changes its polling size into the size specified in the LSBs of the this field. |
| UL Tx power | 8 bits | UL Tx power level in dBm for the burst that carries this header (as described in 11.1.1).<br>The value shall be estimated and reported for the burst. |
| CID | 16 bits | The CID shall indicate the connection for which uplink bandwidth is requested. |
| HCS | 8 bits | Header Check Sequence (same usage as HCS entry in Table 5). |

Support of this subheader shall be negotiated between the BS and MS as part of the registration dialog (REG-REQ/RSP).

***Insert new subclause 6.3.2.1.2.1.3:***

### 6.3.2.1.2.1.3 Bandwidth request and CINR report header

Bandwidth request and CINR report PDU shall consist of bandwidth request and CINR report header alone, and shall not contain a payload (see Figure 20b).

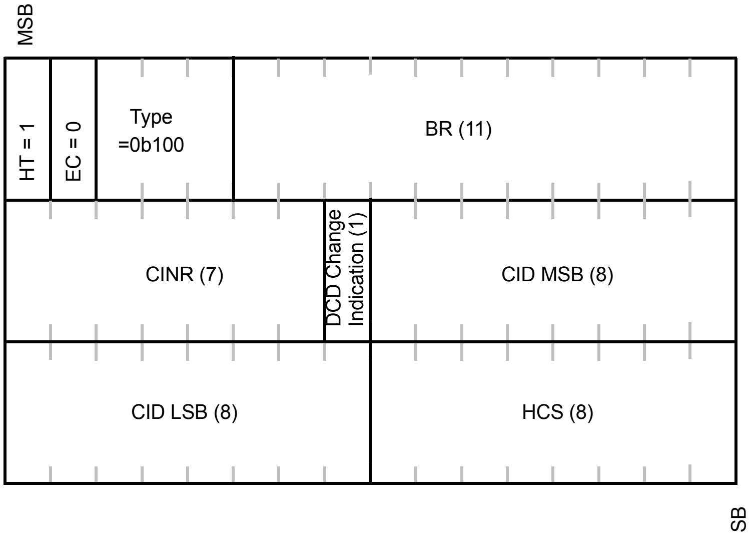


**Figure 20b—Bandwidth request and CINR report**

The Bandwidth request and CINR report header shall have the following properties:

a) This is a MAC signaling header type I.
b) The CID shall indicate the connection for which uplink bandwidth is requested.
c) The allowed type for Bandwidth request and CINR report header is defined in Table 5a. The requested bandwidth is incremental.

The fields of the Bandwidth request and CINR report header are defined in Table 7b.

Table 7b—Description of the fields of BR and CINR report header

| Name | Length (bits) | Description |
|---|---|---|
| Type | 3 | The type of Bandwidth request and CINR report header is defined in Table 5a. |
| BR | 11 | Bandwidth Request: The number of bytes of uplink bandwidth requested by the MS. The bandwidth request is for the CID. The request shall not include any PHY overhead. It is incremental BW request. |
| CINR | 7 | — |
| DCD Change Indications | 1 | — |
| CID | 16 | The CID shall indicate the connection for which uplink bandwidth is requested. |
| HCS | 8 | Header Check Sequence (same usage as HCS entry in Table 5). |

**CINR**
This parameter indicates the CINR measured by the MS from the BS. It shall be interpreted as a single value from –16.0 dB to 47.5 dB in units of 0.5 dB.

**DCD Change Indication**
This parameter is set to 1 if the DCD change count stored at MS is not equal to that in the received DL-MAP message. Otherwise, it is set to 0.

Support of this subheader shall be negotiated between the BS and MS as part of the registration dialog (REG-REQ/RSP).

***Insert new subclause 6.3.2.1.2.1.4:***

### 6.3.2.1.2.1.4 CQICH allocation request header

The CQICH allocation request PDU shall consist of CQICH allocation request header alone and shall not contain a payload. This header is sent by MS to request the allocation of CQICH. The CQICH allocation request header is illustrated in Figure 20c.

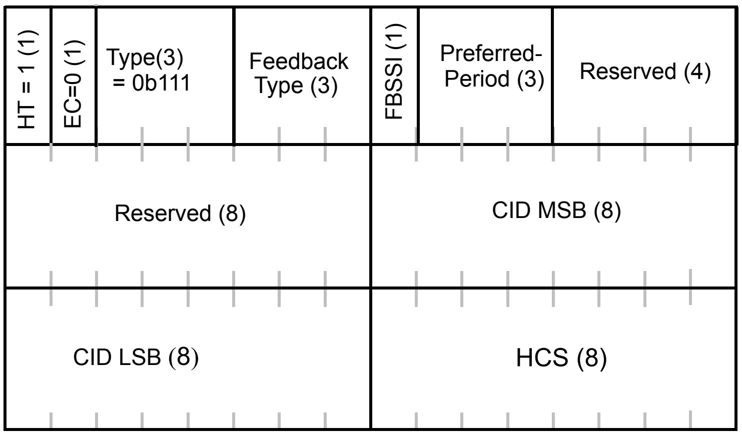


**Figure 20c— CQICH allocation request**

The CQICH allocation request header shall have the following properties:

a) This is a MAC signaling header type I.
b) The CID shall indicate the MS basic CID.
c) The allowed type for CQICH allocation request is defined in Table 5a.

The fields of the CQICH allocation request header are defined in Table 7c.

**Table 7c—Description of the fields of CQICH allocation request header**

| Name | Length (bits) | Description |
|---|---|---|
| Type | 3 | The type of CQICH allocation request header is defined in Table 5a. |
| Feedback Type | 3 | Set according to feedback type defined in Table 302a. When FBSSI is set to 1, this field is neglected. |
| FBSSI | 1 | FBSS Indicator: Set when MS request CQICH during FBSS handover. |
| Preferred-Period(=p) | 3 | CQICH allocation period MS prefers. The value is defined in units of frame.When FBSSI is set to 1, the value contained in this field shall be neglected. |
| *Reserved* | 12 | Shall be set to zero. |
| CID | 16 | MS basic CID. |
| HCS | 8 | Header Check Sequence (same usage as HCS entry in Table 5). |

Support of this subheader shall be negotiated between the BS and MS as part of the registration dialog (REG-REQ/RSP).

***Insert new subclause 6.3.2.1.2.1.5:***

#### 6.3.2.1.2.1.5 PHY channel report header

The PHY channel report PDU shall consist of a PHY channel report header alone and shall not contain a payload. The PHY channel report header is illustrated in Figure 20d.

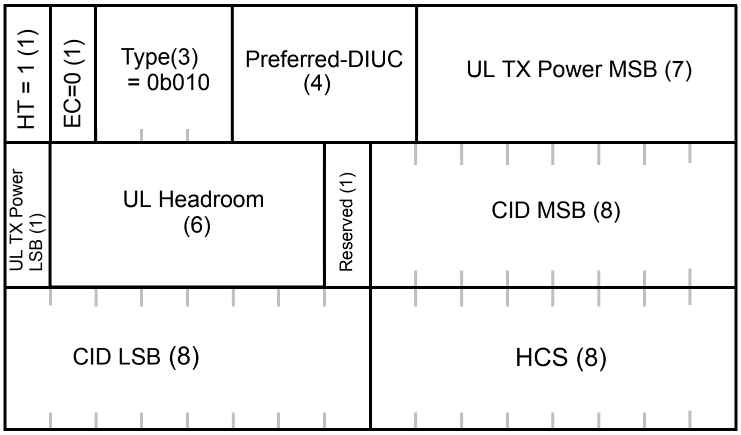


**Figure 20d—PHY channel report header**

The PHY channel report shall have the following properties:

a) This is a MAC signaling header type I.
b) The CID shall indicate the MS basic CID.
c) The allowed type for PHY channel report is defined in Table 5a.

An MS receiving a PHY channel report header on the downlink shall discard the PDU.

The fields of the PHY channel report header are defined in Table 7d.

**Table 7d—PHY channel report header fields**

| Name | Length (bits) | Description |
|---|---|---|
| Type | 3 | The type of PHY channel report header is defined in Table 5a. |
| PREFERRED-DIUC | 4 | Index of the DIUC preferred by the MS. |
| UL-TX-POWER | 8 | UL Tx power level in dBm for the burst that carries this header (11.1.1). The value shall be estimated and reported for the burst. |

**Table 7d—PHY channel report header fields *(continued)***

| Name | Length (bits) | Description |
|---|---|---|
| UL-HEADROOM | 6 | Headroom to UL maximum power level in dB, for the burst that carries this Header, from 0 to 63 in 1 dB steps. Should the headroom exceed 63 dB, the value 63 shall be used. The minimum value is shall be reported for the burst. |
| *Reserved* | 1 | Set to zero. |
| CID | 16 | MS basic CID. |
| HCS | 8 | Header Check Sequence (same usage as HCS entry in Table 5). |

Support of this subheader shall be negotiated between the BS and MS as part of the registration dialog (REG-REQ/RSP).

***Insert new subclause 6.3.2.1.2.1.6:***

### 6.3.2.1.2.1.6 Bandwidth request and uplink sleep control header

Bandwidth request and uplink sleep control header is sent by the MS to request activation/deactivation of certain Power Saving Class. The header also indicates incremental transmission demand. The Bandwidth request and uplink sleep control PDU shall consist of a Bandwidth request and uplink sleep control header alone and shall not contain a payload. The Bandwidth request and uplink sleep control header is illustrated in Figure 20e.

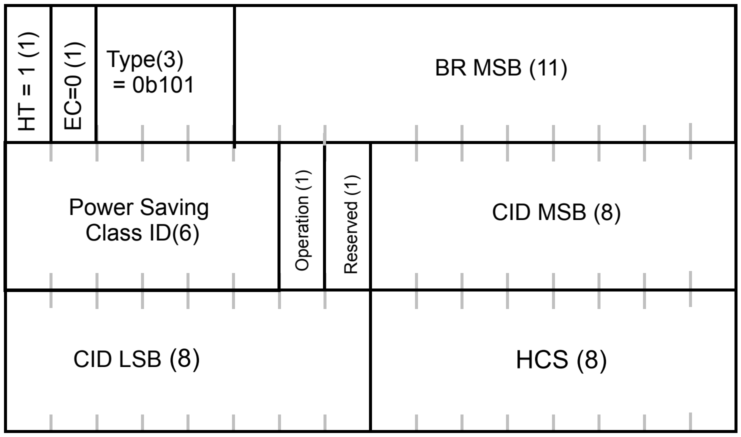


**Figure 20e—Bandwidth request and uplink sleep control header**

The Bandwidth request and uplink sleep control header shall have the following properties:

a) This is a MAC signaling header type I.
b) The CID shall indicate the MS basic CID.
c) The allowed type for Bandwidth request and uplink sleep control is defined in Table 5a.

An MS receiving a Bandwidth request and uplink sleep control header on the downlink shall discard the PDU.

The fields of the Bandwidth request and uplink sleep control header are defined in Table 7e.

**Table 7e—Bandwidth control and uplink sleep control header**

| Name | Length (bits) | Description |
|---|---|---|
| Type | 3 | The type of Bandwidth request and uplink sleep control header is defined in Table 5a. |
| BR | 11 | Bandwidth Request: The number of bytes of uplink bandwidth requested by the MS. The bandwidth request is for the CID. The request shall not include any PHY overhead. It is incremental BW request. |
| Power_Saving_Class_ID | 6 | Power Saving Class ID. |
| Operation | 1 | 1: to activate Power Saving Class.<br>0: to deactivate Power Saving Class. |
| *Reserved* | 1 | Shall be set to zero. |
| CID | 16 | Basic CID of the MS for which the bandwidth request and uplink sleep control header is sent. |
| HCS | 8 | Header Check Sequence (same usage as HCS entry in Table 5). |

Support of this subheader shall be negotiated between the BS and MS as part of the registration dialog (REG-REQ/RSP).

***Insert new subclause 6.3.2.1.2.1.7:***

#### 6.3.2.1.2.1.7 SN report header

The SN report header is sent by the MS to report the LSB of the next ARQ BSN or the virtual MAC SDU Sequence number for the active connections with SN Feedback enabled.

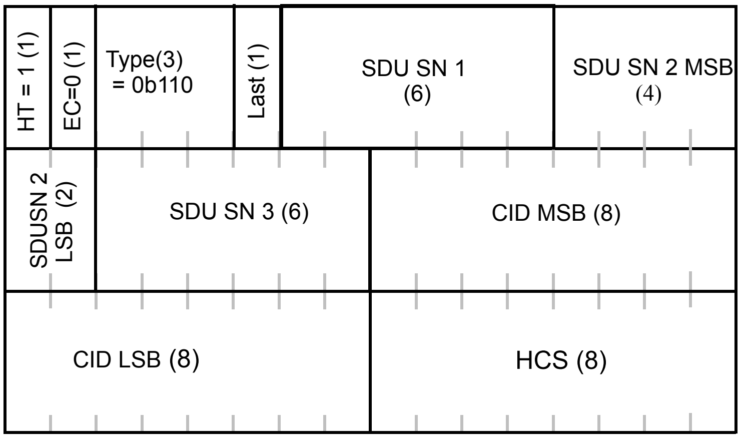


Figure 20f—SN report header format

The SN Report header shall be of the form illustrated in Figure 20f. The SN Report header shall have the following properties:

a) This is a MAC signaling header type I.
b) The CID shall indicate the basic connection of the MS for which the SN Report is being sent.
c) The allowed type for SN report header is defined in Table 5a.
d) The SDU SN field shall indicate the LSB of the next ARQ BSN or the virtual MAC SDU Sequence number for the active connections with SN Feedback enabled. The LSB of the ARQ BSN or virtual MAC SDU sequence number for each connection is provided. At most, three SNs can be provided in each SN report header in numerical ascending order of the SFID values of the connections with SN feedback enabled.
e) The last field may be used to indicate whether the SN Report header is the last header, thus accommodating up to six active connections.

An MS receiving a SN report header on the downlink shall discard the PDU.

The fields of the SN report header are defined in Table 7f.

**Table 7f—SN report header fields**

| Name | Length (bits) | Description |
|---|---|---|
| Type | 3 | Set to 0b110. Indicates that it is a SN Report header. |
| Last | 1 | If set to 0, this header contains the SDU or ARQ block sequence numbers of the first three connections with SN feedback enabled. If set to 1, this header contains the SDU or ARQ block sequence numbers of the fourth, fifth, and sixth connections with SN feedback enabled. SN feedback can be supported for up to six connections. |
| SDU SN 1 | 6 | The ARQ BSN (LSB) or MAC SDU SN (LSB) for the first Service Flow addressed in this header. The order of reporting the sequence numbers, SNs, for the connections is predetermined as indicated in 6.3.22.3.4.1. |
| SDU SN 2 | 6 | The ARQ BSN (LSB) or MAC SDU SN (LSB) for the second Service Flow addressed in this header. |
| SDU SN 3 | 6 | The ARQ BSN (LSB) or MAC SDU SN (LSB) for the third Service Flow addressed in this header. |
| CID | 16 | Basic Connection Identifier. |
| HCS | 8 | Header Check Sequence. |

Support of this subheader shall be negotiated between the BS and MS as part of the registration dialog (REG-REQ/RSP).

***Insert new subclause 6.3.2.1.2.2:***

### 6.3.2.1.2.2 MAC signaling header type II

This type of MAC header is UL specific. There is no payload following the MAC header. The MAC signaling header type II is illustrated in Figure 20g. Table 7g describes the encoding of the 1-bit type field following the EC field. The description of DL MAC header format with HT/EC = 0b11, defined as the Compressed DL-MAP, is not part of this subclause. The detailed description can be found in 8.4.5.6.1.

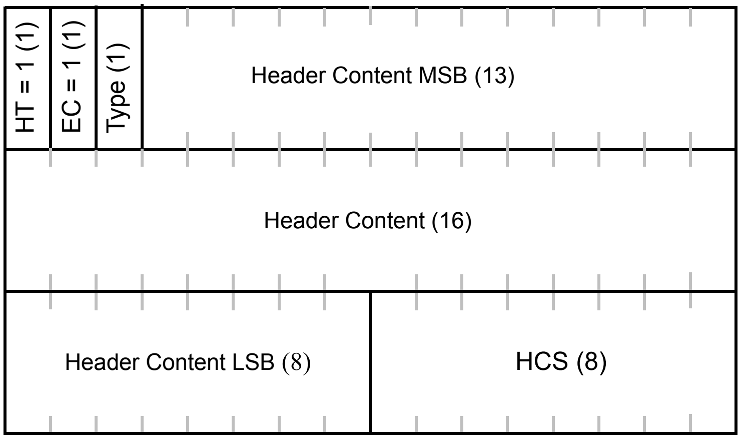


Figure 20g—MAC signaling header type II format

Table 7g—Type field encodings for MAC signaling header type II

| Type field | MAC header Type (with HT/EC=0b11) | Reference figure | Reference table |
|---|---|---|---|
| 0 | Feedback header, with another 4-bit type field, see Table 7i for its type encodings. | 20h, 20i | 7h |
| 1 | *Reserved* | — | — |

***Insert new subclause 6.3.2.1.2.2.1:***

### 6.3.2.1.2.2.1 Feedback header

The Feedback header is sent by an MS either as a response to Feedback Polling IE (see 8.4.5.4.28), or the Feedback request extended subheader (see 6.3.2.2.7.3) or as an unsolicited feedback. When sent as a response to the Feedback Polling IE or the Feedback request extended subheader, the MS shall send a Feedback header using the assigned resource indicated in the Feedback Polling IE or the Feedback request extended subheader. When sent as an unsolicited feedback, the MS can either send the Feedback header on currently allocated UL resource, or request additional UL resource by sending Indication flag on the Fast-feedback channel or the Enhanced Fast-feedback channel (refer to 8.4.5.4.10.11) or sending BW request ranging code.

The Feedback PDU shall consist of the Feedback header alone and shall not contain a payload. The Feedback header with and without CID field are illustrated in Figure 20h and Figure 20i. The Feedback header with CID field shall be used when the UL resource used to send the Feedback header is requested through BW request ranging. Otherwise, the Feedback header without CID field shall be used.

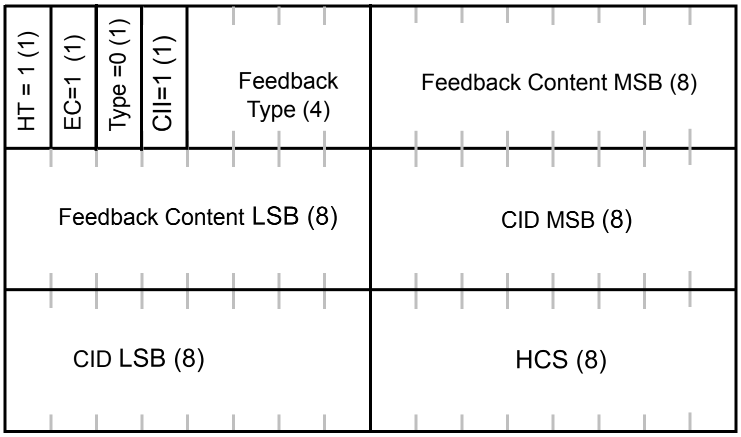

HT = 1 (1)
EC=1 (1)
Type =0 (1)
CII=1 (1)
Feedback Type (4)
Feedback Content MSB (8)
Feedback Content LSB (8)
CID MSB (8)
CID LSB (8)
HCS (8)

Figure 20h— Feedback header with CID field

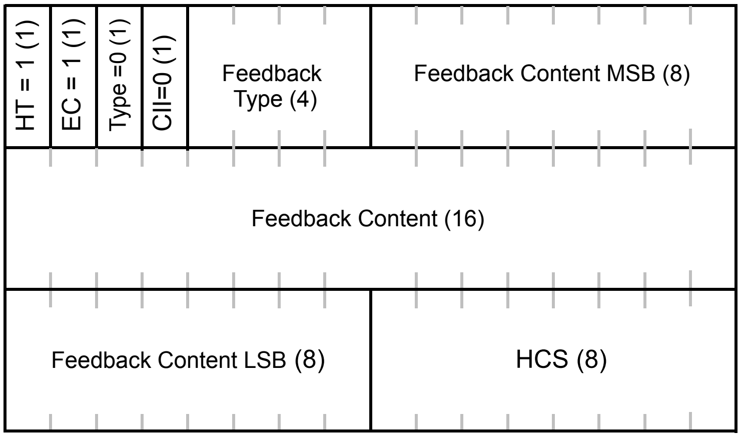

HT = 1 (1)
EC = 1 (1)
Type =0 (1)
CII=0 (1)
Feedback Type (4)
Feedback Content MSB (8)
Feedback Content (16)
Feedback Content LSB (8)
HCS (8)

Figure 20i—Feedback header without CID field

The Feedback header shall have the following properties:

a) This is a MAC signaling header type II. The length of the header shall always be 6 bytes.
b) The allowed type for Feedback header is defined in Table 7g.
c) The Feedback type field shall be set according to Table 7i.
d) The CII field (CID Inclusion Indication) shall be set to 1 for the header with CID field and set to 0 for the header without CID field.
e) The Feedback Content field shall be set accordingly based on the value of the feedback type field.

The Feedback header shall be used by the MS to provide its feedback(s). An MS receiving a Feedback header on the downlink shall discard the PDU.

The support of Feedback header is OFDMA PHY specific and shall be negotiated between the BS and the MS as part of the registration dialog (REG-REQ/RSP).

The fields of Feedback header are defined in Table 7h.

### Table 7h—Description of the fields of Feedback header

| Name | Length (bits) | Description |
|---|---|---|
| CII | 1 | CID Inclusion indication. Set to 1 for a Feedback header with CID field; set to 0 for a Feedback header without CID field. |
| Feedback Type | 4 | Set according to Table 7i. |
| Feedback Content | 16 or 32 | Set according to Table 7i. Length of 16 bits for a Feedback header with CID field and length of 32 bits for a Feedback header without CID field. |
| HCS | 8 | Header Check Sequence (same usage as HCS entry in Table 5). |

### Table 7i—Feedback type and feedback content

| Feedback Type (binary) | Feedback contents | Description |
|---|---|---|
| 0000 | MIMO feedback type (3 bits) + feedback payload (6 bits) | CQI and MIMO feedback. The definition of MIMO feedback type (3 bits) and the corresponding feedback payload (6 bits) are the same as that defined in Table 302a and subclauses 8.4.5.4.10.4, 8.4.5.4.10.5, 8.4.5.4.10.6, 8.4.5.4.10.7, 8.4.5.4.10.8, 8.4.5.4.10.9, 8.4.5.4.10.10 for the Enhanced Fast-feedback channel. |
| 0001 | DL average CINR (5 bits) | DL average CINR of the serving or anchor BS (for the case of FBSS), with 5-bit payload encoding as defined in 8.4.5.4.12. |
| 0010 | Number of index, *L* (2 bits) + *L* occurrences of Antenna index (2 bits) + MIMO coefficients (5 bits, see definition in 8.4.5.4.10.7) | MIMO coefficients feedback for up to four antennas. |
| 0011 | Preferred-DIUC (4 bits) + DCD change count (4 bits) | Preferred DL channel DIUC feedback. |
| 0100 | UL-TX-Power (8 bits) (see Table 7a for definition) | UL transmission power. |
| 0101 | PREFERRED DIUC (4 bits) + UL TX-POWER (8 bits) + UL-HEADROOM (6 bits) (see Table 7d for definitions) | PHY channel feedback. |
| 0110 | AMC band indication bitmap (12 bits, see 6.3.2.3.43.2) + N CQI (N × 5 bits). N is the number of ‘1’s in the AMC band indication bitmap. | CQIs of up to four best reception DL multiple AMC bands. |

**Table 7i—Feedback type and feedback content *(continued)***

| Feedback Type (binary) | Feedback contents | Description |
|---|---|---|
| 0111 | Life span of short-term precoding feedback (4 bits) according to Table 316i. | The recommended number of frames for which the short-term precoding feedback can be used. |
| 1000 | Number of feedback types, *0* (2 bits) + *0* occurrences of ‘feedback type (4 bits) + feedback content (variable)’ | Multiple types of feedback. |
| 1001 | Feedback of index to long-term precoding matrix in codebook (6 bits), rank of precoding codebook (2 bits) and FEC and QAM feedback (6 bits) according to Table 316h. | Long-term precoding feedback. |
| 1010 | Combined DL average CINR of Active BSs (5 bits). | Combined DL average CINR of all Active BSs within the Diversity Set, with 5-bit payload encoding as defined in 8.4.5.4.15. |
| 1011 | MIMO channel feedback (see Table 7j for description of feedback content fields) | MIMO mode channel condition feedback. |
| 1100 | CINR Mean (8 bits) + CINR Standard Deviation (8 bits) | CINR Feedback (values and coding defined in 8.4.11.3). |
| 1101 | CL MIMO type (2 bits)<br>If (CL MIMO type == 0b00 {<br>Antenna grouping index (4 bits) + average CQI (5 bits) }<br>Elseif ( CL MIMO type == 0b01{<br>Number of streams (2 bits) + Antennas selection option index (3 bits) + average CQI (5 bits) of the selected antennas}<br>Elseif (CL MIMO type == 0b10) {<br>Number of streams (2 bits)+Codebook index (6 bits) + average CQI (5 bits) } | Closed-loop MIMO feedback CL MIMO type:<br>0b00: antenna grouping<br>0b01: antenna selection<br>0b10: codebook<br>0b11: indication of transition from closed-loop MIMO to open-loop MIMO<br><br>Antenna grouping index: 0b0000~ 0b1001 = 0b101110 ~ 0b110110 in Table 298g<br>Antenna selection option index: 0b000 ~0b010 = 0b110000 ~ 0b110010 in Table 316f for 3 Tx antenna 0b000~0b101 = 0b110000~0b110101 in Table 316g for 4 Tx antenna<br><br>Codebook index: (See 8.4.8.3.6.) |
| 1100-1111 | Reserved for future use | — |

The feedback payload shall be placed at the first available bits of the feedback content field. Any unused bit in the content field shall be set to zero.

### 6.3.2.1.2.2.1.1 MIMO Channel Feedback header

The MIMO Channel Feedback header is used for MS to provide DL MIMO channel quality feedback to the BS. The MIMO Channel Feedback header can be used to provide a single or composite channel feedback. The MIMO Channel Feedback header with or without basic CID field is illustrated in Figure 20j and Figure 20k respectively.

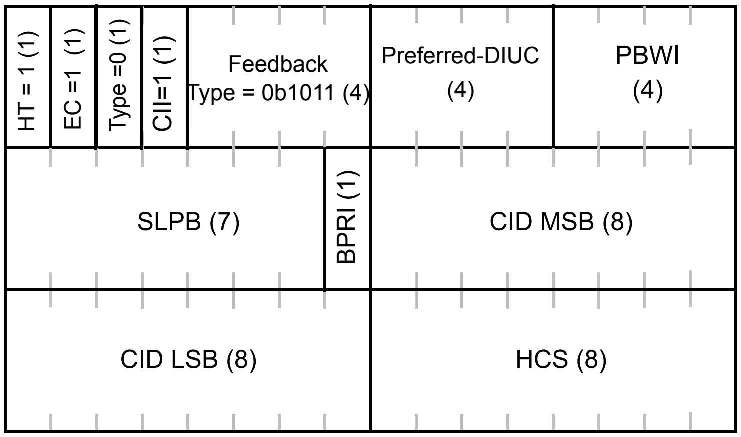

HT = 1 (1)
EC =1 (1)
Type =0 (1)
CII=1 (1)
Feedback Type = 0b1011 (4)
Preferred-DIUC (4)
PBWI (4)
SLPB (7)
BPRI (1)
CID MSB (8)
CID LSB (8)
HCS (8)

Figure 20j—MIMO Channel Feedback header with CID field

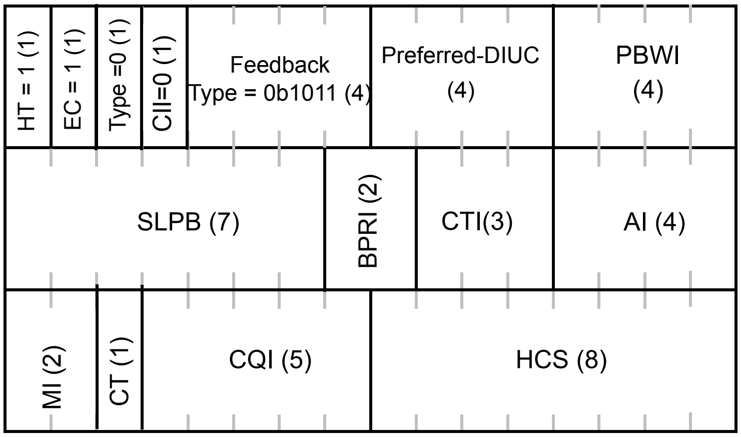

HT = 1 (1)
EC = 1 (1)
Type =0 (1)
CII=0 (1)
Feedback Type = 0b1011 (4)
Preferred-DIUC (4)
PBWI (4)
SLPB (7)
BPRI (2)
CTI(3)
AI (4)
MI (2)
CT (1)
CQI (5)
HCS (8)

Figure 20k—MIMO Channel Feedback header without CID field

The fields of MIMO Channel Feedback header are defined in Table 7j.

### Table 7j—Description of MIMO Channel Feedback header fields

| Name | Length (bits) | Description |
|---|---|---|
| Feedback Type | 4 | Feedback Type of MIMO Channel Feedback header is defined in Table 7i. |
| PREFERRED-DIUC | 4 | Index of the preferred DIUC suggested by the MS. |

### Table 7j—Description of MIMO Channel Feedback header fields *(continued)*

| | | |
|---|---|---|
| PBWI | 4 | This field provides the size of the preferred bandwidth, which can be used for DIUC transmission.<br>The Preferred Bandwidth Index indicates the ratio of the preferred bandwidth over used channel bandwidth:<br>0b0000: 1<br>0b0001: 3/4<br>0b0010: 2/3<br>0b0011: 1/2<br>0b0100: 1/3<br>0b0101: 1/4<br>0b0110: 1/5<br>0b0111: 1/6<br>0b1000: 1/8<br>0b1001: 1/10<br>0b1010: 1/12<br>0b1011: 1/16<br>0b1100: 1/24<br>0b1101: 1/32<br>0b1110: 1/48<br>0b1111: 1/64<br><br>Where<br>Ratio = $BW_{preferred}/BW_{used,}$<br>$BW_{preferred}$: Preferred bandwidth for DIUC transmission,<br>$BW_{used}$: Actual used channel bandwidth (excluding guard bands). |
| SLPB | 7 | This field points to the starting preferred bandwidth location. Combining with PBWI field, BS knows the exact size and location of the preferred bandwidth in the channel.<br>Starting Location of Preferred Bandwidth: 0-127<br>The effective bandwidth (used bandwidth) is divided into 1/128 interval, from 0 to 127 representing from lower to higher band. SLPB indicates the starting location of preferred bandwidth for the DIUC burst profile. |
| BPRI | 1/2 | This field can be used to rank up to four preferred burst profiles within the DL channel.<br>Burst Profile Ranking Indicator (without basic CID): BPRI indicates the ranking for DL channel condition of the preferred bandwidth as reported in the current header where 0 is the most preferred bandwidth)<br>0b00: 1st preferred burst profile<br>0b10: 2nd preferred burst profile<br>0b01: 3rd preferred burst profile<br>0b11: 4th preferred burst profile<br>Burst Profile Ranking Indicator (including basic CID):<br>0b0: 1st preferred burst profile<br>0b1: 2nd preferred burst profile<br><br>This field is 1 bit when CII is set to 1; otherwise, this field is 2 bits. |
| CTI | 3 | This field provides coherent time information.<br>Coherent Time Index: CTI indicates the estimated duration of the valid MIMO channel conditions<br>0b000: Infinite<br>0b001: 1 frame<br>0b010: 2 frames<br>0b011: 3 frames<br>0b100: 4 frames<br>0b101: 8 frames<br>0b110: 14 frames<br>0b111: 24 frames<br><br>This field is only present when CII is set to 0. |

### Table 7j—Description of MIMO Channel Feedback header fields *(continued)*

| | | |
|---|---|---|
| AI | 4 | This field is for Antenna Indication. It can support up to four antennas. This feedback header can report a composite channel condition, each bit represents for each antenna; “1” is applicable, “0” is not applicable.<br>Antenna Index:<br>Bit 0 (MSB)– Antenna 0<br>Bit 1 – Antenna 1<br>Bit 2 – Antenna 2<br>Bit 3 (LSB) – Antenna 3<br>This field is only present when CII is set to 0. |
| MI | 2 | This field suggests the preferred STC/MIMO Matrix for the MS<br>Matrix Indicator:<br>0b00: No STC<br>0b01: Matrix A<br>0b10: Matrix B<br>0b11: Matrix C<br>This field is only present when CII is set to 0. |
| CT | 1 | This field indicates the type of CQI feedback in the CQI field.<br>CQI Type: The type of CQI feedback in the CQI field<br>0: DL average CQI feedback<br>1: CQI feedback for the preferred bandwidth indicated in the current header<br>This field is only present when CII is set to 0. |
| CQI | 5 | CQI feedback<br>This field is only present when CII is set to 0. |
| CID | 16 | MS basic CID<br>This field is only present when CII is set to 1. |
| HCS | 8 | Header Check Sequence (same usage as HCS entry in Table 5). |

### 6.3.2.2 MAC subheaders and special payloads

***Replace the first paragraph of 6.3.2.2 with the following:***

Six types of subheaders may be present in a MAC PDU with generic MAC header. The per-PDU subheaders (i.e., extended subheader field, Mesh, Fragmentation, Fast-feedback allocation and Grant Management) may be inserted in MAC PDUs immediately following the Generic MAC header. If both the Fragmentation subheader and Grant Management subheader are indicated, the Grant Management subheader shall come first. If the Mesh subheader is indicated, it shall precede all other subheaders except for the extended subheader. In the downlink, the Fast-feedback allocation subheader shall always appear as the last per-PDU subheader. The ESF bit in the Generic MAC header indicates that the extended subheader is present. Using this field, a number of additional subheaders can be used within a PDU. The extended subheader shall always appear immediately after the Generic MAC header, and before all other subheaders. All extended subheaders are not encrypted. (See 6.3.2.2.7.)

### 6.3.2.2.2 Grant Management subheader

*Change Table 9 as indicated:*

**Table 9—Grant Management subheader format**

| Syntax | Size | Notes |
|---|---|---|
| Grant Management Subheader { | — | — |
| if (scheduling service type == UGS) { | — | — |
| **SI** | 1 bit | — |
| **PM** | 1 bit | — |
| **FLI** | 1 bit | — |
| **FL** | 4 bits | — |
| *Reserved* | ~~14~~9 bits | Shall be set to zero |
| } else if (scheduling service type == Extended rtPS) { | — | — |
| **Extended piggyback request** | 11 bits | — |
| **FLI** | 1 bit | — |
| **FL** | 4 bits | — |
| } else{ | — | — |
| **Piggyback Request** | 16 bits | — |
| } | — | — |
| } | — | — |

*Insert the following new fields into Table 10:*

**Table 10—Grant management subheader fields**

| Name | Size | Description |
|---|---|---|
| FLI | 1 bit | Frame latency indication<br>0 = Frame latency field disabled for this grant<br>1 = Frame latency field enabled for this grant |
| FL | 4 bits | Frame latency<br>The number of frames previous to the current one in which the transmitted data was available.<br>When the latency is greater than 15 then the FL field shall be set to 15. |
| *Reserved* | 9 bits | |
| Extended Piggy-back Request | 11 bits | The number of bytes of uplink bandwidth requested by the MS. The bandwidth request is for the CID. The request shall not include any PHY overhead. The request shall be incremental. In case of the Extended rtPS, if the MSB is 1, the BS changes its polling size into the size specified in the LSBs of this field. |

### 6.3.2.2.3 Packing subheader

*Insert the following text under the "Notes" column of the "Length" field:*

Length of the SDU fragment in bytes including the packing subheader.

*In Table 11, change the description of the 11-bit FSN in the Notes column as follows:*

Sequence number of the current SDU fragment. This field shall increment~~s~~ by one (modulo 2048) for each fragment, including unfragmented SDUs.

*In Table 11, change the description of the 3-bit FSN in the Notes column as follows:*

Sequence number of the current SDU fragment. This field shall increment~~s~~ by one (modulo 8) for each fragment, including unfragmented SDUs.

### 6.3.2.2.4 ARQ feedback

*Change the subclause as indicated:*

If the ARQ Feedback Payload bit in the MAC Type field (see Table 6) is set, the ARQ Feedback Payload shall be transported. If packing is used, it shall be transported as the first packed payload. See 6.3.3.4.3. Note that this bit does not address the ARQ Feedback payload contained inside an ARQ Feedback message.

### 6.3.2.2.6 FAST-FEEDBACK allocation subheader

*Change the description text of the "Allocation offset" field as indicated:*

**Allocation offset**
Defines the offset, in units of slots, from the beginning of the ~~FAST-FEEBACK~~ FAST-FEEDBACK uplink bandwidth allocation (8.4.5.4.9), of the slot in which the SS servicing the CID appearing in the MAC generic header, must send a~~n FAST-FEEBACK~~ FAST-FEEDBACK message ~~for the connection associated with the CID value~~. Range of values 0 to 63. The allocation applies to the UL subframe ~~of the next frame~~two frames after the frame including the fast- feedback allocation subheader.

*Insert new subclause 6.3.2.2.7:*

### 6.3.2.2.7 Extended subheader format

The extended subheader group (see Figure 20l), when used, shall always appear immediately after the Generic MAC header and before all subheaders, and PN number [if MAC PDU is protected (i.e., when EC=1)], as described in 6.3.2.2. The extended subheader group format is specified in Table 13a, Table 13b, and Table 13c. Extended subheaders shall not be encrypted.

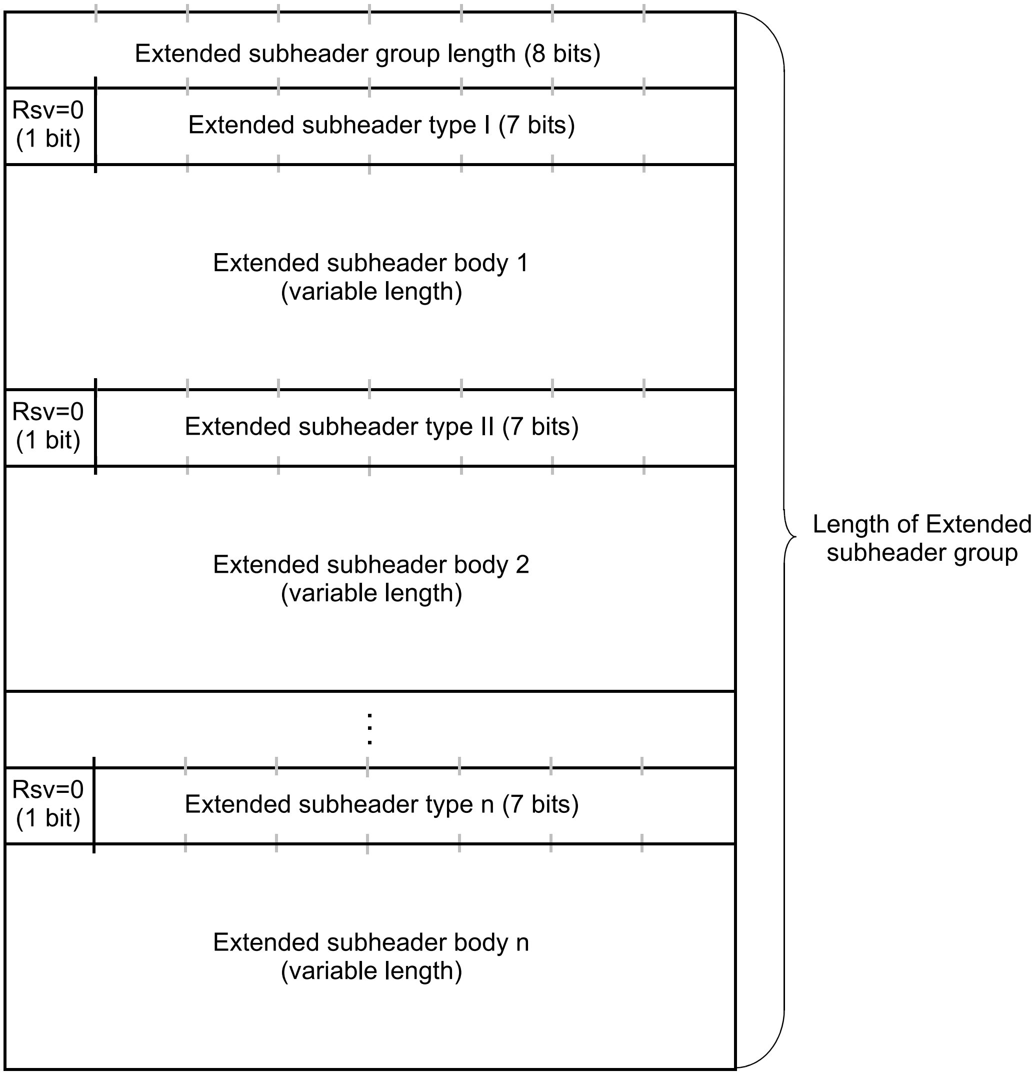

Extended subheader group length (8 bits)
Rsv=0
(1 bit)
Extended subheader type I (7 bits)
Extended subheader body 1
(variable length)
Rsv=0
(1 bit)
Extended subheader type II (7 bits)
Extended subheader body 2
(variable length)
⋮
Rsv=0
(1 bit)
Extended subheader type n (7 bits)
Extended subheader body n
(variable length)
Length of Extended subheader group

**Figure 20l—Extended subheader group format**

The fields of the extended subheader group structure are described in Table 13a.

The extended subheader group starts with an 8-bit length field that is followed by one or multiple extended subheaders. The length field specifies the total length in bytes of the subheader group, including all the extended subheaders and the length byte. Each extended subheader consists of a reserved bit, a 7-bit extended subheader type field, and a variable size extended subheader body. The size of each extended subheader is determined by the extended subheader type as specified in Table 13b.

**Table 13a—Extended subheader group format**

| Name | Size | Description |
|---|---|---|
| Extended subheader group length | 8 bits | The extended subheader Group Length field indicates the total length of the subheader group, including all the extended subheaders and the length byte. |
| Reserved | 1 bit | *Reserved* = 0 |
| Extended subheader type | 7 bits | Type of subheader as defined in Table 13b and Table 13c. |
| Extended subheader body | *variable* | The size of the extended subheader is determined by extended subheader type as specified in Table 13b and Table 13c. The size of the extended subheader body is byte aligned. |

The list of defined extended subheaders is given in Table 13b for the DL and in Table 13c for the UL. The support of each extended subheader shall be negotiated between the BS and the MS as part of the registration dialog (REG-REQ/RSP).

**Table 13b—Description of extended subheaders types (DL)**

| ES type | Name | ES body size | Description |
|---|---|---|---|
| 0 | SDU_SN extended subheader | 1 byte | See 6.3.2.2.7.1 |
| 1 | DL Sleep control extended subheader | 3 bytes | See 6.3.2.2.7.2 |
| 2 | Feedback request extended subheader | 3 bytes | See 6.3.2.2.7.3 |
| 3 | SN request extended subheader | 1 byte | See 6.3.2.2.7.7 |
| 4 | PDU SN(short) extended subheader | 1 byte | See 6.3.2.2.7.8 |
| 5 | PDU SN(long) extended subheader | 2 bytes | See 6.3.2.2.7.8 |
| 6–127 | *Reserved* | — | — |

**Table 13c—Description of extended subheaders types (UL)**

| ES type | Name | ES body size | Description |
|---|---|---|---|
| 0 | MIMO mode feedback extended subheader | 1 byte | See 6.3.2.2.7.4 |
| 1 | UL Tx Power Report extended subheader | 1 byte | See 6.3.2.2.7.5 |
| 2 | Mini-Feedback extended subheader | 2 byte | See 6.3.2.2.7.6 |
| 3 | PDU SN (short) extended subheader | 1 byte | See 6.3.2.2.7.8 |
| 4 | PDU SN (long) extended subheader | 2 bytes | See 6.3.2.2.7.8 |
| 5–127 | *Reserved* | — | — |

***Insert new subclause 6.3.2.2.7.1:***

### 6.3.2.2.7.1 SDU SN extended subheader

The SDU SN extended subheader shall only be sent by the BS if SDU SN extended subheader capability is supported (negotiated through REG-REQ/RSP) and if SDU_SN Feedback is enabled for a DL connection (negotiated through DSA-REQ/RSP). The SDU SN extended subheader shall contain the last virtual MAC SDU sequence number of current MAC PDU. The format of the SDU SN extended subheader is as described in Table 13d.

**Table 13d—SDU SN extended subheader format**

| Name | Size | Description |
|---|---|---|
| SDU sequence number | 8 bits | Last virtual MAC SDU sequence number in the current MAC PDU. |

***Insert new subclause 6.3.2.2.7.2:***

### 6.3.2.2.7.2 DL Sleep control extended subheader

The DL Sleep control extended subheader is sent by the BS to activate/deactivate certain Power Saving Class. The requested operation is effective from the next frame after the one where the message was transmitted. The format of DL Sleep control extended subheader is as described in Table 13e.

**Table 13e—DL Sleep control extended subheader format**

| Name | Size | Description |
|---|---|---|
| Power_Saving_Class_ID | 6 bits | Indicates the Power Saving Class ID to which this command refers. |
| Operation | 1 bit | 1 = activate Power Saving Class<br>0 = de-activate Power Saving Class |
| Final_Sleep_Window_Exponent | 3 bits | For Power Saving Class Type III only: assigned factor by which the final-sleep window base is multiplied in order to calculate the duration of single sleep window requested by the message. |
| Final_Sleep_Window_Base | 10 bits | For Power Saving Class Type III only: the base for duration of single sleep window requested by the message. |
| *Reserved* | 4 bits | — |

***Insert new subclause 6.3.2.2.7.3:***

### 6.3.2.2.7.3 Feedback request extended subheader

Feedback request extended subheader shall only be sent by the BS to provide a UL allocation for a Fast-feedback channel transmission (see 8.4.5.4.10). The BS shall indicate in the FAST-FEEDBACK request subheader transmission the applied frame for the UL allocation.

The format of the Feedback request extended subheader is as described in Table 13f.

**Table 13f—Feedback request extended subheader format**

| Name | Size | Description |
|---|---|---|
| UIUC | 4 bits | — |
| Feedback type | 4 bits | Shall be set according to Table 7i. |
| OFDMA Symbol offset | 6 bits | The offset is relevant to the Allocation Start Time field given in the UL-MAP message. |
| Subchannel offset | 6 bits | The lowest index subchannel used for carrying the burst, starting from Subchannel 0. |
| No. slot | 3 bits | The number of slots allocated for the burst. |
| Frame offset (F) | 1 bit | Indicate to start reporting at the frame. If F == 0, the allocation applies to the UL subframe two frames ahead of the current frame. If F==1, four frames ahead of the current frame. |

***Insert new subclause 6.3.2.2.7.4:***

### 6.3.2.2.7.4 MIMO mode Feedback extended subheader

An MS uses the MIMO Feedback extended subheader to provide its feedback in terms of MIMO mode feedback. When there is an UL MAC PDU payload to be transmitted at the same time. The format of the MIMO mode Feedback extended subheader is as described in Table 13g.

**Table 13g—MIMO mode Feedback extended subheader format**

| Name | Length | Description |
|---|---|---|
| Feedback type | 2 bits | 0b00: feedback type ‘0b000’ as defined in Table 302a<br>0b01: feedback type ‘0b001’ as defined in Table 302a<br>0b10: feedback type ‘0b010’ as defined in Table 302a<br>0b11: feedback type ‘0b011’ as defined in Table 302a |
| Feedback content | 6 bits | Feedback contents and the corresponding feedback payload (6 bits) are the same as that defined in Table 302a and subclauses 8.4.5.4.10.4, 8.4.5.4.10.5, 8.4.5.4.10.6, 8.4.5.4.10.7, 8.4.5.4.10.8, 8.4.5.4.10.9, 8.4.5.4.10.10 for the Enhanced Fastfeedback channel |

For each MS, if a MIMO mode Feedback extended subheader is present, it shall only appear in the first unicast PDU transmitted by that MS in that frame.

***Insert new subclause 6.3.2.2.7.5:***

### 6.3.2.2.7.5 UL Tx Power Report extended subheader

This subheader is sent from MS to BS to report the Tx power of the burst that carries this subheader. The format of the UL Tx Power Report extended subheader is as described in Table 13h.

**Table 13h—UL Tx Power Report extended subheader format**

| Name | Size | Description |
|---|---|---|
| UL Tx Power | 8 bits | Tx power level for the burst carries this header (11.1.1). The value shall be estimated and reported for the burst. |

*Insert new subclause 6.3.2.2.7.6:*

### 6.3.2.2.7.6 Mini-Feedback extended subheader

The format of the mini-feedback extended subheader is shown in Table 13i.

**Table 13i—Description of Mini-Feedback extended subheaders (UL)**

| Name | Size | Description |
|---|---|---|
| Feedback type | 4 bits | Type of feedback: see Table 7i |
| Feedback content | 12 bits | |

*Insert new subclause 6.3.2.2.7.7:*

### 6.3.2.2.7.7 SN request extended subheader

The SN request extended subheader is sent by the BS to request the MS to send the SN report header. The fields of the SN request extended subheader are defined in Table 13j.

**Table 13j—Description of SN request extended subheader**

| Name | Size | Description |
|---|---|---|
| SN report indication | 2 bits | Bit #0: set to 1 to request transmission of the first SN report header<br>Bit #1: set to 1 to request transmission of the second SN report header |
| *Reserved* | 6 bits | Shall be set to zero |

***Insert new subclause 6.3.2.2.7.8:***

#### 6.3.2.2.7.8 PDU SN extended subheader

Specify the PDU sequence number in a monotonic increasing manner. The format of the PDU SN extended subheader is as described in Table 13k and Table 13l.

**Table 13k—PDU (short) SN extended subheader**

| Name | Size | Description |
|---|---|---|
| PDU SN (short) | 8 bits | Specify the PDU SN number |

**Table 13l—PDU SN (long) extended subheader**

| Name | Size | Description |
|---|---|---|
| PDU SN (long) | 16 bits | Specify the PDU SN number |

### 6.3.2.3 MAC ~~M~~management messages

***Change the first paragraph as indicated:***

A set of MAC ~~M~~management messages are defined. These messages shall be carried in the Payload of the MAC PDU. All MAC ~~M~~management messages begin with a Management Message Type field and may contain additional fields. MAC ~~M~~management messages on the Basic, Broadcast, and Initial Ranging connections shall neither be fragmented nor packed. MAC ~~M~~management messages on the Primary Management Connection may be packed and/or fragmented. MAC management messages on the Fragmentable Broadcast connection may be fragmented. For the SCa, OFDM, and OFDMA PHY layers, management messages carried on the Initial Ranging, Broadcast, Fragmentable Broadcast, Basic, and Primary Management connections shall have CRC usage enabled. The format of the ~~M~~management message is given in Figure 21. The encoding of the Management Message Type field is given in Table 14. MAC management messages shall not be carried on Transport Connections. MAC management messages that have a Type value specified in Table 14 as "*Reserved,*" or those not containing all required parameters or containing erroneously encoded parameters, shall be silently discarded.

***Change Table 14 as indicated:***

**Table 14—MAC Management messages**

| Type | Message name | Message description | Connection |
|---|---|---|---|
| 0 | UCD | Uplink Channel Descriptor | ~~Broadcast~~<br>Fragmentable Broadcast |
| 1 | DCD | Downlink Channel Descriptor | ~~Broadcast~~<br>Fragmentable Broadcast |
| 2 | DL-MAP | Downlink Access Definition | Broadcast |
| 3 | UL-MAP | Uplink Access Definition | Broadcast |
| 4 | RNG-REQ | Ranging Request | Initial Ranging or Basic |
| 5 | RNG-RSP | Ranging Response | Initial Ranging or Basic |

### Table 14—MAC Management messages *(continued)*

| Type | Message name | Message description | Connection |
|---|---|---|---|
| 6 | REG-REQ | Registration Request | Primary Management |
| 7 | REG-RSP | Registration Response | Primary Management |
| 8 | — | *Reserved* | — |
| 9 | PKM-REQ | Privacy Key Management Request | Primary Management |
| 10 | PKM-RSP | Privacy Key Management Response | Primary Management or Broadcast [a] |
| 11 | DSA-REQ | Dynamic Service Addition Request | Primary Management |
| 12 | DSA-RSP | Dynamic Service Addition Response | Primary Management |
| 13 | DSA-ACK | Dynamic Service Addition Acknowledge | Primary Management |
| 14 | DSC-REQ | Dynamic Service Change Request | Primary Management |
| 15 | DSC-RSP | Dynamic Service Change Response | Primary Management |
| 16 | DSC-ACK | Dynamic Service Change Acknowledge | Primary Management |
| 17 | DSD-REQ | Dynamic Service Deletion Request | Primary Management |
| 18 | DSD-RSP | Dynamic Service Deletion Response | Primary Management |
| 19 | — | *Reserved* | — |
| 20 | — | *Reserved* | — |
| 21 | MCA-REQ | Multicast Assignment Request | Primary Management |
| 22 | MCA-RSP | Multicast Assignment Response | Primary Management |
| 23 | DBPC-REQ | Downlink Burst Profile Change Request | Basic |
| 24 | DBPC-RSP | Downlink Burst Profile Change Response | Basic |
| 25 | RES-CMD | Reset Command | Basic |
| 26 | SBC-REQ | SS Basic Capability Request | Basic |
| 27 | SBC-RSP | SS Basic Capability Response | Basic |
| 28 | CLK-CMP | SS network clock comparison | Broadcast |
| 29 | DREG-CMD | De/Re-register Command | Basic |
| 30 | DSX-RVD | DSx Received Message | Primary Management |
| 31 | TFTP-CPLT | Config File TFTP Complete Message | Primary Management |
| 32 | TFTP-RSP | Config File TFTP Complete Response | Primary Management |
| 33 | ARQ-Feedback | Standalone ARQ Feedback | Basic |
| 34 | ARQ-Discard | ARQ Discard message | Basic |
| 35 | ARQ-Reset | ARQ Reset message | Basic |
| 36 | REP-REQ | Channel measurement Report Request | Basic |
| 37 | REP-RSP | Channel measurement Report Response | Basic |
| 38 | FPC | Fast Power Control | Broadcast |

### Table 14—MAC Management messages *(continued)*

| Type | Message name | Message description | Connection |
|---|---|---|---|
| 39 | MSH-NCFG | Mesh Network Configuration | Broadcast |
| 40 | MSH-NENT | Mesh Network Entry | Basic |
| 41 | MSH-DSCH | Mesh Distributed Schedule | Broadcast |
| 42 | MSH-CSCH | Mesh Centralized Schedule | Broadcast |
| 43 | MSH-CSCF | Mesh Centralized Schedule Configuration | Broadcast |
| 44 | AAS-FBCK-REQ | AAS Feedback Request | Basic |
| 45 | AAS-FBCK-RSP | AAS Feedback Response | Basic |
| 46 | AAS_Beam_Select | AAS Beam Select message | Basic |
| 47 | AAS_BEAM_REQ | AAS Beam Request message | Basic |
| 48 | AAS_BEAM_RSP | AAS Beam Response message | Basic |
| 49 | DREG-REQ | SS De-registration message | Basic |
| ~~50–255~~ | | ~~*Reserved*~~ | — |
| 50 | MOB_SLP-REQ | sleep request message | basic |
| 51 | MOB_SLP-RSP | sleep response message | basic |
| 52 | MOB_TRF-IND | traffic indication message | broadcast |
| 53 | MOB_NBR-ADV | neighbor advertisement message | broadcast,<br>primary management |
| 54 | MOB_SCN-REQ | scanning interval allocation request | basic |
| 55 | MOB_SCN-RSP | scanning interval allocation response | basic |
| 56 | MOB_BSHO-REQ | BS HO request message | basic |
| 57 | MOB_MSHO-REQ | MS HO request message | basic |
| 58 | MOB_BSHO-RSP | BS HO response message | basic |
| 59 | MOB_HO-IND | HO indication message | basic |
| 60 | MOB_SCN-REP | Scanning result report message | primary management |
| 61 | MOB_PAG-ADV | BS broadcast paging message | broadcast |
| 62 | MBS_MAP | MBS MAP message | — |
| 63 | PMC_REQ | Power control mode change request message | Basic |
| 64 | PMC_RSP | Power control mode change response message | Basic |
| 65 | PRC-LT-CTRL | Setup/Tear-down of long-term MIMO precoding | Basic |
| 66 | MOB_ASC-REP | Association result report message | primary management |
| 67–255 | | *Reserved* | — |

[a] For subscribers and base stations that support PKMv2, PKM-RSP is sometimes transmitted on the broadcast connection.

***Change the text below Table 14 as indicated:***

In general, the PKM-RSP message is carried on the Primary Management connection. However, in order to send the PKM-RSP message in key push mode to MS for multicast service or broadcast service, it may be carried on the Broadcast connection.

During the adaptive antenna system (AAS) portion of the frame the DL-MAP, UL-MAP, DCD, UCD, MOB_NBR-ADV, MOB_TRF-IND, MOB_PAG-ADV, and CLK-MAP messages may be sent using the basic CID.

### 6.3.2.3.1 Downlink Channel Descriptor (DCD) message

***Change the text as indicated:***

A DCD shall be transmitted by the BS at a periodic interval (Table 342) to define the characteristics of a downlink physical channel.

**Table 15—DCD message format**

| Syntax | Size | Notes |
|---|---|---|
| DCD_Message_Format() { | | |
| **Management Message Type = 1** | 8 bits | |
| ~~**Downlink channel ID**~~ *Reserved* | 8 bits | Shall be set to zero |
| **Configuration Change Count** | 8 bits | |
| **TLV Encoded information for the overall channel** | *variable* | TLV specific |
| Begin PHY Specific Section { | | See applicable PHY subclause |
| for (i = 1; i <= *n*; i++) { | | For each downlink burst profile 1 to *n* |
| **Downlink_Burst_Profile** | | PHY specific |
| } | | |
| } | | |
| } | | |

A BS shall generate DCDs in the format shown in Table 15, including all of the following parameters:

**Configuration Change Count**
Incremented by one (modulo 256) by the BS whenever any of the values of this channel descriptor change, except for the Frame Number for the OFDM PHY. If the value of this count in a subsequent DCD remains the same, the SS can quickly decide that the remaining fields have not changed and may be able to disregard the remainder of the message.

~~**Downlink Channel ID**~~
~~The identifier of the downlink channel to which this message refers. This identifier is arbitrarily chosen by the BS and is unique only within the MAC domain. This acts as a local identifier for transactions such as ranging.~~

### 6.3.2.3.2 Downlink map (DL-MAP) message

***Change the second paragraph as indicated:***

A BS shall generate DL-MAP messages in the format shown in Table 16, including all of the following parameters:

**PHY Synchronization**
The PHY synchronization field is dependent on the PHY specification used. The encoding of this field is given in each PHY specification separately.

**DCD Count**
Matches the value of the configuration change count of the DCD, which describes the downlink burst profiles that apply to this map.

**Base Station ID**
The Base Station ID is a 48-bit long field identifying the BS. The Base Station ID shall be programmable. The most significant 24 bits shall be used as the operator ID. This is a network management hook that can be ~~combined with the Downlink Channel ID of the~~ sent with the DCD message for handling edge-of-sector and edge-of-cell situations.

***Change Table 16 as indicated:***

**Table 16—DL-MAP message format**

| Syntax | Size | Notes |
|---|---|---|
| DL-MAP_Message_Format() { | | |
| **Management Message Type = 2** | 8 bits | |
| **PHY Synchronization Field** | *variable* | See appropriate PHY specification. |
| **DCD Count** | 8 bits | |
| **Base Station ID** | 48 bits | |
| Begin PHY Specific Section { | | See applicable PHY subclause. |
| if (WirelessMAN-OFDMA) { | | |
| **No. OFDMA symbols** | 8 bits | Number of OFDMA symbols in the DL subframe including all AAS/ permutation zone. |
| } | | |
| for (i = 1; i <= *n*; i++) { | | For each DL-MAP element 1 to *n*. |
| DL-MAP_IE() | *variable* | See corresponding PHY specification. |
| } | | |
| } | | |
| if !(byte boundary) { | | |
| **Padding Nibble** | 4 bits | Padding to reach byte boundary. |
| } | | |
| } | | |

***Insert the following text at the end of the 6.3.2.3.2:***

The UL-MAP message (when present) shall be always transmitted in the first PDU on the burst described by the first DL-MAP_IE of the DL-MAP (or, in the case of the OFDM PHY mode, of the DLFP).

The DL-MAP_IEs in the DL-MAP shall be ordered in the increasing order of the transmission start time of the relevant PHY burst. The transmission start time is conveyed by the contents of the DL_MAP_IE in a manner that is PHY dependant.

The logical order in which MAC PDUs are mapped to the PHY layer bursts in the downlink is defined as the order of DL-MAP_IEs in the DL-MAP message.

### 6.3.2.3.4 Uplink map (UL-MAP) message

***Change Table 18 as indicated:***

**Table 18—UL-MAP message format**

| Syntax | Size | Notes |
|---|---|---|
| UL-MAP_Message_Format() { | | |
| **Management Message Type = 3** | 8 bits | |
| ~~**Uplink Channel ID**~~*Reserved* | 8 bits | Shall be set to zero. |
| **UCD Count** | 8 bits | |
| **Allocation Start Time** | 32 bits | |
| Begin PHY Specific Section { | | See applicable PHY subclause. |
| if (WirelessMAN-OFDMA) { | | |
| **No. OFDMA symbols** | 8 bits | Number of OFDMA symbols in the UL subframe |
| } | | |
| for (i = 1; i <= *n*; i++) { | | For each UL-MAP element 1 to *n*. |
| UL-MAP_IE() | *variable* | See corresponding PHY specification. |
| } | | |
| } | | |
| if !(byte boundary) { | | |
| **Padding Nibble** | 4 bits | Padding to reach byte boundary. |
| } | | |
| } | | |

***Delete the 'Uplink Channel ID' description below Table 18:***

~~**Uplink Channel ID**~~
~~The identifier of the uplink channel to which this message refers.~~

***Change the third paragraph as indicated:***

IEs define uplink bandwidth allocations. Each UL-MAP message (except when the PHY layer is OFDMA PHY) shall contain at least one IE that marks the end of the last allocated burst. Ordering of IEs carried by the UL-MAP is PHY-specific.

***Insert the following text at the end of the subclause:***

For SC, SCa, and OFDMA PHYs, the UL-MAP message (if such exists) shall always be transmitted on the burst decribed by the first DL_MAP_IE (and following the H-ARQ_MAP_Pointer_IE, if such exists in the

OFDMA PHY) of the DL-MAP message. If there are multiple PDUs in the burst described by the first DL_MAP_IE, the UL-MAP message shall be the first one.

The logical order in which MAC PDUs are mapped to the PHY layer bursts in the uplink is defined as the order of UL-MAP_IEs in the UL-MAP message.

#### 6.3.2.3.5 Ranging request (RNG-REQ) message

***Change 6.3.2.3.5 as indicated:***

An RNG-REQ shall be transmitted by the SS at initialization and periodically to determine network delay and to request power and/or downlink burst profile change. The format of the RNG-REQ message is shown in Table 19. The RNG-REQ message may be sent in Initial Ranging and data grant intervals.

**Table 19—RNG-REQ message format**

| Syntax | Size | Notes |
|---|---|---|
| RNG-REQ_Message_Format() { | | |
| **Management Message Type = 4** | 8 bits | |
| ~~**Downlink Channel ID**~~ *Reserved* | 8 bits | Shall be set to zero |
| **TLV Encoded Information** | *variable* | TLV specific |
| } | | |

The CID field in the MAC header shall assume the following values when sent in an Initial Ranging interval:

a) Initial ranging CID if the SS is attempting to join the network.
b) Initial ranging CID if the SS has not yet registered and is changing downlink (or both downlink and uplink) channels.
c) In all other cases, the Basic CID is used as soon as one is assigned in the RNG-RSP message.

If sent in a data grant interval, the CID is always equal to the Basic CID.

An SS shall generate RNG-REQ messages in the format shown in Table 19.~~, including the following parameter:~~

> ~~**Downlink Channel ID**~~
> ~~The identifier of the downlink channel on which the SS received the UCD describing the uplink on which this ranging request message is to be transmitted. This is an 8-bit field~~.

All ~~other~~ parameters are coded as TLV tuples as defined in 11.5.

TLV message elements shall only be included in RNG-REQ messages of adequate UL bandwidth. In OFDMA, when the MS transmits the handover CDMA ranging code, the BS shall provide for initial UL bandwidth allocation of size at least sufficient for transmission of RNG-REQ message with MS MAC address TLV and Grant Management subheader. If required TLV message elements cannot be accommodated in the UL bandwidth of a current RNG-REQ message, after the MS obtains a Basic CID from the BS, the MS shall make UL BW request of sufficient size to conduct additional RNG-REQ including all required message elements, at the first available opportunity.

The following parameters shall be included in the RNG-REQ message when the SS is attempting ~~to join the network~~initial entry to the network:

**Requested Downlink Burst Profile**

**SS MAC Address**

The following parameter shall be included in the RNG-REQ message when transmitted during SS initial entry to the network. The parameter shall be sent on the SS's Basic connection or for OFDMA on the initial ranging connection:

**MAC Version (11.1.3)**

The following parameters may be included in the RNG-REQ message after the SS has received an RNG-RSP addressed to the SS:

**Requested Downlink Burst Profile**

**Ranging Anomalies**

The following parameter may be included in the RNG-REQ message:

**AAS broadcast capability**

The following parameter may be included in the RNG-REQ message when the MS is attempting to perform re-entry, association or handover:

**Requested Downlink Burst Profile**

The following parameter shall be included in the RNG-REQ message when the MS is attempting to perform re-entry, association or handover:

**Serving BSID**

The BSID of the BS to which the MS is currently connected (has completed the registration cycle and is in Normal Operation). The serving BSID shall not be included if the aging timer is timed-out (serving BSID AGINGTIMER, see Table 342). Inclusion of serving BSID in the RNG-REQ message signals to the target BS that the MS is currently connected to the network through the serving BS and is performing association or is in the process of handover network re-entry.

The following TLV parameter shall be included in the RNG-REQ message when the MS is attempting to perform re-entry, handover, or Location Update:

**Ranging Purpose Indication**

Presence of item in message indicates MS action as follows:

If Bit #0 is set to 1, in combination with serving BS ID BSID indicates the MS is currently attempting to HO; or in combination with Paging Controller ID the MS is attempting Network Re-entry from Idle Mode to the BS.

If Bit #1 is set to 1, indicates MS action of Idle Mode Location Update Process.

The following TLV parameter shall be included in the RNG-REQ message when the MS is attempting to perform re-entry:

**Paging Controller ID**

The Paging Controller ID is a logical network identifier for the serving BS or other network entity retaining MS service and operational information and/or administering paging activity for the MS while in Idle Mode.

The following TLV parameter may be included in RNG-REQ message when an MS is performing initial ranging to the selected target BS:

**HO_ID**

Optional ID assigned for use in initial ranging to the target BS during HO once the BS is selected as the target BS (see 6.3.22.2.7).

The following parameter may be included in the RNG-REQ message when the MS is attempting to perform re-entry, association, or handover:

**MS MAC Address**

MS MAC Address shall be included if HO_ID is omitted.

The following TLV parameter may be included in the RNG-REQ message when MS is attempting to perform Location Update:

**MAC Hash Skip Threshold**

Maximum number of successive MOB_PAG-ADV messages that may be sent from a BS without individual notification for an MS, including MAC address hash of an MS for which Action Code is 00, ‘No Action Required’.

The following TLV parameter shall be included in the RNG-REQ message when the MS is attempting to perform Location Update due to power down:

**Power Down Indicator**

Indicates the MS is currently attempting to perform Location Update due to power down.

The following parameter may be included in RNG-REQ message when the MS is attempting to perform handover and needs to inform target BS of its preference to continue in sleep mode after handover to target BS.

**Power_Saving_Class_Parameters**

Compound TLV to specify Power Saving Class operation.

The following parameter may be included in the RNG-REQ message when the MS is attempting to perform network re-entry or handover and the MS has a valid HMAC/CMAC Tuple necessary to expedite security authentication.

**HMAC/CMAC Tuple (see 11.1.2)**

The HMAC/CMAC Tuple shall be the last attribute in the message.

### 6.3.2.3.6 Ranging Response (RNG-RSP) message

***Delete the third paragraph:***

~~A BS shall generate RNG-RSPs in the form shown in Table 20, including all of the following parameters:~~

> ~~**Uplink Channel ID**~~
> ~~The identifier of the uplink channel on which the BS received the RNG-REQ to which this response refers. This is an 8-bit quantity.~~

***Change the 'Uplink Channel ID' field in Table 20 as indicated:***

| | | |
|---|---|---|
| ~~**Uplink Channel ID**~~*Reserved* | 8 bits | Shall be set to zero. |

***Change the last paragraph as indicated:***

The following WirelessMAN-OFDMA PHY specific parameters shall be included in the RNG-RSP message when an initial or periodic ranging message based on code division multiple access (CDMA) is received, in which case the RNG-RSP shall use the initial ranging CID.

***Insert the following at the end of 6.3.2.3.6:***

The RNG-RSP is directed to the SS if it is sent on the Basic CID of the SS or if the RNG-RSP contains the MAC address of the SS, or, in the case of OFDMA, if the RNG-RSP contains CDMA-code parameters specifying the code sent by the SS.

When a BS sends a RNG-RSP message in response to a RNG-REQ message containing serving BSID, the BS may include the following TLV parameter in the RNG-RSP message:

**Service Level Prediction**—This value indicates the level of service the MS can expect from this BS. The following encodings apply:

0 = No service possible for this MS.
1 = Some service is available for one or several service flows authorized for the MS.
2 = For each authorized service flow, a MAC connection can be established with QoS specified by the AuthorizedQoSParamSet.
3 = No service level prediction available.

A Service Level Prediction may be accompanied by a number of service flow Encodings as specified in 11.13 sufficient to uniquely identify the AuthorizedQoSParamSet associated with the Service Level Prediction (SLP). If service flow encodings are included, then the SLP response is specific to the presented AuthorizedQoSParamSet defined by the associated encodings. Included service flow encodings are restricted to the following parameters only:

- Global Service Class Name.
- Service flow QoS parameter set encodings as defined in 11.13 such that the combination of Global Service Class Name and any service flow modifying parameters fully defines an AuthorizedQoSParamSet profile being assessed.
- Service flow Identifier.

If individual AuthorizedQoSParamSet profiles are provided for multiple Service Level Predictions, then each Service Level Prediction is specific to its associated AuthorizedQoSParamSet profile and shall include only response options 0 or 2.

When a BS sends a RNG-RSP message in response to a RNG-REQ message containing Paging Controller ID, the BS shall include the following TLV parameter in the RNG-RSP message:

**Location Update Response**
Response to Idle Mode LocationUpdate Request:
0b00=Failure of Idle Mode Location Update. The MS shall perform Network Re-entry from Idle Mode
0b01=Success of Idle Mode Location Update
0b10, 0b11: Reserved

**Paging Information**
New Paging Information assigned to MS. Paging Information shall only be included if Location Update Response = 0b01 and if Paging Information has changed.

**Paging Controller ID**
Paging Controller ID is a logical network identifier for the serving BS or other network entity retaining MS service and operational information and/or administering paging activity for the MS while in Idle Mode. Paging Controller ID shall only be included if Location Update Response = 0b01 and if Paging Controller ID has changed.

The following TLV parameter shall be included in the RNG-RSP message when the MS is attempting to perform network re-entry or handover and the target BS wishes to identify re-entry process management messages that may be omitted during the current HO attempt:

**HO Process Optimization**
Identifies re-entry process management messages that may be omitted during the current HO attempt due to the availability of MS service and operational context information obtained by means that are beyond the scope of this standard, and the MS service and operational status post-HO completion. The target BS may elect to use MS service and operational information obtained over the backbone network to build and send unsolicited SBC-RSP and/or REG-RSP management messages to update MS operational information. The MS shall not enter Normal Operation with Target BS until completing receiving all network re-entry, MAC management message responses as indicated in HO Process Optimization.

The following parameter may be included in RNG-RSP message transmitted in response to RNG-REQ message containing MAC Hash Skip Threshold:

**MAC Hash Skip Threshold**
Maximum number of successive MOB_PAG-ADV messages that may be sent from a BS without individual notification for an MS, including MAC address hash of an MS for which Action Code for the MS is 00, 'No Action Required'.

The following TLV parameter shall be included in the RNG-RSP message when the periodic ranging in sleep operation completes and the serving BS decides to assign a new SLPID for the MS:

**SLPID_Update (11.16.1)**
The SLPID_Update is a compound TLV value that provides a shorthand method for changing the SLPID used by the MS during sleep mode operation. The SLPID_Update TLV specifies new SLPID replacing old SLPID.

The following parameter may be included in RNG-RSP message by the BS to activate or deactivate Power Saving Class of type II and type III.

**Power_Saving_Class_Parameters**
Compound TLV to specify Power Saving Class operation.

The following TLV parameter may be included in RNG-RSP message transmitted the BS permits an activation of Power Saving Class. This TLV indicates the enabled action that MS performs upon reaching trigger condition in sleep mode.

**Enabled-Action-Triggered**
Indicates possible action upon reaching trigger condition

The following TLV parameter shall be included in the RNG-RSP message when a BS sends RNG-RSP message as a reply to the RNG-REQ message from ~~a~~ an MS which is performing initial ranging during HO and for which the BS has a current HO ID value:

**HO_ID**
Optional ID assigned for use in initial ranging to the target BS once this BS is selected as the target BS (see 6.3.20.5).

The following TLV parameter shall be included for the BS to notify the MS of known future Next Periodic Ranging for the MS with its serving BS:

**Next Periodic Ranging**
Indicates the Frame Offset for the next periodic ranging opportunity. This value shall be set to zero to indicate that there has been DL traffic addressed to the MS.

The following parameter, necessary to expedite security authentication, shall be included in the RNG-RSP message when the BS notifies the MS through the HO Process Optimization TLV that the PKM-REQ/RSP sequence may be omitted for the current HO re-entry attempt, or when the BS wishes to acknowledge a valid HMAC/CMAC Tuple in the acknowledged RNG-REQ management message:

**HMAC/CMAC Tuple (see 11.1.2)**

The HMAC/CMAC Tuple shall be the last attribute in the message.

The following TLV parameter shall be included in the RNG-REQ message when a BS sends RNG-RSP message as a reply to the RNG-REQ message from an MS that is performing Location Update due to power down and:

**Power Down Response**
Indicates the MS's Power Down Location Update result.
0x00= Failure of Power Down Information Update.
0x01= Success of Power Down Information Update.

The following TLV may be present in RNG-RSP (see 7.8.1)

**PKMv2 SA-TEK-Challenge Tuple**

This carries the initial challenge of the 3-way handshake.

### 6.3.2.3.7 Registration request (REG-REQ) message

***Change the second paragraph below Table 21 as follows:***

The REG-REQ shall contain the following TLVs:

**Hashed Message Authentication Code (HMAC)/CMAC Tuple**
Shall be final attribute in the message's TLV attribute list (11.1.2).

In Mesh Mode, message digest is calculated using HMAC_KEY_U.

***Change the third paragraph below Table 21 as indicated:***

For PMP operation, the REG-REQ shall contain the following TLVs:

**~~Uplink~~ CID Support (11.7.6)**
**SS management support (11.7.2)**
**IP management mode (11.7.3)**

***Change the fourth paragraph below Table 21 as indicated:***

In Mesh Mode, the REG-REQ shall contain the following TLVs:

**SS MAC Address (11.7.9)**
**MAC Version (11.1.3)**

***Insert the following text at the end of 6.3.2.3.7***

For an MS, the REG-REQ (on initial network entry) shall contain the following TLVs:

**Handover supported (11.7.12)**
**Mobility parameters support (11.7.14)**

The REG-REQ may contain the following TLV:

**MAC header and extended subheader support (11.7.25).**

### 6.3.2.3.8 Registration Response (REG-RSP) message

***Change the first paragraph below Table 22 as follows:***

The REG-RSP shall contain the following TLVs:

**SS management support (11.7.2)**
Response to REG-REQ indicating the mode of SS management operation.
**Secondary Management CID (11.7.5)**
Present only if the SS has indicated in the REG-REQ that it is a managed SS.
When the Secondary Management CID is present, the following uplink QoS parameters may be also included in the message:
Traffic priority (11.13.5)
Maximum sustained traffic rate (11.13.6)
Minimum reserved traffic rate (11.13.8)
Maximum latency (11.13.14)
**IP management mode (11.7.3)**
Response to REG-REQ indication of whether or not the requester wishes to accept IP-based traffic on the Secondary Management Connection, once the initialization process has completed.
**HMAC/CMAC Tuple (11.1.2)**
The HMAC/CMAC Tuple attribute shall be the final attribute in the message's TLV attribute list.
In Mesh Mode, message digest is calculated using HMAC_KEY_D.

***Change the end of the subclause as indicated:***

The REG-RSP may contain the following TLVs:

**SS Capabilities Encodings (11.7.8)**
Response to the capabilities of the requester provided in the REG-REQ. Included in the response if the request included capabilities information. The response indicates whether or not the capabilities may be used. If a capability is not recognized, the response indicates that this capability shall not be used by the requester. Capabilities returned in the REG-RSP shall not be set to require greater capability of the requester than is indicated in the REG-REQ.

**IP Version (11.7.4)**

**Vendor ID Encoding (of the responder; 11.1.5)**

**Vendor-specific information (11.1.6)**
Included if the RNG-REQ contained the Vendor ID Encoding of the requestor.

**Convergence sublayer capabilities (11.7.7)**
Response to the capabilities of the requester provided in the REG-REQ. Included in the response if the request included Convergence Sublayer Capabilities information. The response indicates whether or not the capabilities may be used. If a capability is not recognized, the response indicates that this capability shall not be used by the requester. Capabilities returned in the REG-RSP shall not be set to require greater capability of the requester than is indicated in the REG-REQ.

**ARQ Parameters (11.7.1)**
ARQ and fragmentation parameters specified by the BS to complete ARQ parameter negotiation for the secondary management connection. This information is only included in the message if ARQ Parameters where supplied by the SS in the original REG-REQ message. For purposes of the parameter negotiation dialog, the parameters supplied in this message are equivalent to those supplied in the DSA-RSP message.

~~**IP management mode (11.7.3)**~~
~~Response to REG-REQ indication of whether or not the requester wishes to accept IP-based traffic on the Secondary Management Connection, once the initialization process has completed.~~

***Insert the following text at the end 6.3.2.3.8:***

For mobile stations, when the information is available to create CID update TLV, the target BS shall include the CID_update and SAID_update TLVs in the REG-RSP for an MS recognized by the target BS as performing HO or Network Re-entry from Idle Mode. BS may include the Compressed CID Update TLV instead of the CID_update TLV in REG-RSP message if CID update procedure is required. The target BS recognizes an MS performing Network Re-entry from Idle Mode by the presence of a serving BSID or Paging Controller ID and Ranging Purpose Indication with Bit #0 set to 1 in the RNG-REQ message.

**CID_update**
The CID_update is a compound TLV value that provides a shorthand method for replacing the active connections used by the MS in its previous serving BS. Each CID_update TLV specifies a CID in the target BS that shall replace a CID used in the previous serving BS. Multiple instances of CID_update may occur in the REG-RSP to facilitate re-creating and re-assigning admitted or active service flows for the MS from its previous serving BS. If any of the service flow parameters change (including Target SAID, see 11.3.18), then those service flow parameter encoding TLVs that have changed will be added. If the BS cannot re-establish a particular service flow, it shall not include an instance of CID_update for that service flow.
These TLVs enable the target BS to renew connections used in the previous serving BS, but with different QoS settings.

**Compressed CID_update**
The Compressed CID_update TLV also provides a method for replacing the active connections used by the MS in its previous serving BS as CID update TLV. It can diminish the length of

REG-RSP message. CID update and Compressed CID update TLVs shall be exclusively included in REG-RSP message. (See 11.7.10.1.)

**SAID_update**

The SAID_update is a compound TLV value that provides a shorthand method for renewing active SAs used by the MS in its previous serving BS. The TLVs specify SAID in the target BS that shall replace active SAID used in the previous serving BS. Multiple iterations of these TLVs may occur in the REG-RSP suitable to re-creating and re-assigning all active Security Associations for the MS from its previous serving BS including Primary, Dynamic and Static SAIDs. If any of the Security Associations parameters change, then those Security Associations parameters encoding TLVs that have changed will be added.

When a BS has multiple number Provisioned service flows to transmit to an MS, the BS may include:

**Total number of provisioned service flow TLV (11.7.19).**

The REG-RSP may contain the following TLV:

**MAC header and extended subheader support (11.7.25).**

For an MS, the REG-RSP (on initial network entry) shall contain the following TLVs:

**Handover supported (11.7.12).**
**Mobility parameters support (11.7.14).**

### 6.3.2.3.9 Privacy key management (PKM) messages (PKM-REQ/PKM-RSP)

***Change the text directly below Table 24 as indicated:***

PKM protocol messages transmitted from the BS to the SS shall use the form shown in Table 25. They are transmitted on the SSs Primary Management Connection. When the BS sends PKM-RSP message in key push mode to MS for multicast service or broadcast service, it may be carried on the Broadcast connection.

***Change the text between Table 25 and Table 26 as indicated:***

The parameters shall be as follows:

**Code**

The Code is one byte and identifies the type of PKM packet. When a packet is received with an invalid Code, it shall be silently discarded. The code values are defined in Table 26.

**PKM Identifier**

The Identifier field is one byte. An SS uses the identifier to match a BS response to the SS requests. In the case of 3-way SA-TEK procedure, however, a BS uses it to match an SS response to the BS's challenges.

The SS shall increment (modulo 256) the Identifier field whenever it issues a new PKM message. In PKMv1, a ~~A~~ "new" message is an Authorization Request or Key Request that is not a retransmission being sent in response to a Timeout event. In PKMv2, a PKMv2 RSA-Request, PKMv2 SA-TEK-Challenge, or PKMv2 Key-Request message is a "new" message. For retransmissions, the Identifier field shall remain unchanged.

The Identifier field in PKMv2 EAP-Transfer messages, PKMv2 Authenticated EAP messages, and ~~in~~ Authentication Information messages, which are informative and do not effect any response messaging, shall be set to zero. The Identifier field in a BS's PKM-RSP message shall match the Identifier field of the PKM-REQ message the BS is responding to. The Identifier field in TEK Invalid messages and PKMv2 TEK Invalid messages, which are not sent in response to PKM-REQs, shall be set to zero. The Identifier field in ~~PKMv2 Group~~ unsolicited Authorization Invalid messages shall be set to zero. The Identifier field in

PKMv2 Group-Key-Update-Command messages, which are used to distribute the updated GTEK and traffic keying material, shall be set to zero.

On reception of a PKM-RSP message, the SS associates the message with a particular state machine (the Authorization state machine in the case of Authorization Replies, Authorization Rejects, and Authorization Invalids for the PKMv1, PKMv2 RSA Reply, PKMv2 RSA Reject, PKMv2 EAP Transfer, PKMv2 SA-TEK-Challenge, ~~SA-TEK-Request~~, PKMv2 SA-TEK-Response for the PKMv2; a particular TEK state machine in the case of Key Replies, Key Rejects, and TEK Invalids for the PKMv1, PKMv2-Key-Reply, PKMv2-Key-Reject, PKMv2 TEK-Invalids, and PKMv2 Group-Key-Update-Commands for the PKMv2).

In PKMv1, only SS shall keep track of the identifier of its latest.

An SS shall keep track of the identifier of its latest, pending Authorization Request. The SS shall discard Authorization Reply and Authorization Reject messages with Identifier fields not matching that of the pending Authorization Request.

An SS shall keep track of the identifiers of its latest, pending Key Request for each SA. The SS shall discard Key Reply and Key Reject messages with Identifier fields not matching those of the pending Key Request messages.

In PKMv2, both an SS and a BS shall keep track of the identifier of its latest.

An SS shall keep track of the identifier of its latest, pending PKMv2 RSA-Request. The SS shall discard PKMv2 RSA-Reply and PKMv2 RSA-Reject messages with Identifier fields not matching that of the pending PKMv2 RSA-Request. Moreover, a BS shall keep it, pending PKMv2 RSA-Reply. The BS shall discard PKMv2 RSA-Acknowledgement messages with identifier fields not matching that of the pending PKMv2 RSA-Reply.

A BS shall keep track of the identifier of its latest, pending PKMv2 SA-TEK-Challenge. The BS shall discard PKMv2 SA-TEK-Request messages with Identifier fields not matching that of the pending PKMv2 SA-TEK-Challenge. In addition, an SS shall keep it, pending PKMv2 SA-TEK-Request. The SS shall discard PKMv2 SA-TEK-Reply messages with identifier fields not matching that of the pending PKMv2 SA-TEK-Request.

An SS shall keep track of the identifier of its latest, pending PKMv2 Key-Request. The SS shall discard PKMv2 Key-Reply and PKMv2 Key-Reject messages with Identifier fields not matching that of the pending PKMv2 Key-Request.

**Attributes**

PKM attributes carry the specific authentication, authorization, and key management data exchanged between client and server. Each PKM packet type has its own set of required and optional attributes. Unless explicitly stated, there are no requirements on the ordering of attributes within a PKM message. The end of the list of attributes is indicated by the LEN field of the MAC PDU header.

***Change Table 26 as indicated:***

### Table 26—PKM message codes

| Code | PKM message type | MAC Management message name |
|---|---|---|
| 0-2 | *Reserved* | — |
| 3 | SA Add | PKM-RSP |
| 4 | Auth Request | PKM-REQ |
| 5 | Auth Reply | PKM-RSP |
| 6 | Auth Reject | PKM-RSP |
| 7 | Key Request | PKM-REQ |
| 8 | Key Reply | PKM-RSP |
| 9 | Key Reject | PKM-RSP |
| 10 | Auth Invalid | PKM-RSP |
| 11 | TEK Invalid | PKM-RSP |
| 12 | Auth Info | PKM-REQ |
| 13 | PKMv2 RSA-Request | PKM-REQ |
| 14 | PKMv2 RSA-Reply | PKM-RSP |
| 15 | PKMv2 RSA-Reject | PKM-RSP |
| 16 | PKMv2 RSA-Acknowledgement | PKM-REQ |
| 17 | PKMv2 EAP Start | PKM-REQ |
| 18 | PKMv2 EAP-Transfer | PKM-REQ/PKM-RSP |
| 19 | PKMv2 Authenticated EAP-Transfer | PKM-REQ/PKM-RSP |
| 20 | PKMv2 SA TEK Challenge | PKM-RSP |
| 21 | PKMv2 SA TEK Request | PKM-REQ |
| 22 | PKMv2 SA TEK Response | PKM-RSP |
| 23 | PKMv2 Key-Request | PKM-REQ |
| 24 | PKMv2 Key-Reply | PKM-RSP |
| 25 | PKMv2 Key-Reject | PKM-RSP |
| 26 | PKMv2 SA-Addition | PKM-RSP |
| 27 | PKMv2 TEK-Invalid | PKM-RSP |
| 28 | PKMv2 Group-Key-Update-Command | PKM-RSP |
| 29 | PKMv2 EAP Complete | PKM-RSP |
| 30 | PKMv2 Authenticate EAP Start | PKM-REQ |
| 29~~13~~–255 | *Reserved* | — |

Auth Invalid and Auth Info messages may be used in PKMv1 and PKMv2.

### 6.3.2.3.9.2 Authorization Request (Auth Request) message

***Change the last paragraph as indicated:***

An SAID attribute contains a ~~Privacy~~ Primary SAID. In this case, the provided SAID is the SS's Basic CID, which is equal to the Basic CID assigned to the SS during initial ranging.

***Insert new subclause 6.3.2.3.9.11 at the end of 6.3.2.3.9:***

### 6.3.2.3.9.11 PKMv2 RSA-Request message

A client MS sends a PKMv2 RSA-Request message to the BS in order to request mutual authentication in the RSA-based authorization.

Code: 13

Attributes are shown in Table 37a.

**Table 37a— PKMv2 RSA-Request attributes**

| Attribute | Contents |
|---|---|
| MS_Random | A 64-bit random number generated in the MS |
| MS_Certificate | Contains the MS's X.509 user certificate |
| SAID | MS's primary SAID equal to the Basic CID |
| SigSS | An RSA signature over all the other attributes in the message |

The MS-certificate attribute contains an X.509 MS certificate (see 7.6) issued by the MS's manufacturer. The MS's X.509 certificate is as defined in 6.3.2.3.9.2.

The SigSS indicates an RSA signature over all the other attributes in this message, and the MS's private key is used to make an RSA signature.

***Insert new subclause 6.3.2.3.9.12:***

### 6.3.2.3.9.12 PKMv2 RSA-Reply message

Sent by the BS to a client MS in response to a PKMv2 RSA-Request message, the PKMv2 RSA-Reply message contains an encrypted pre-PAK, the key's lifetime, and the key's sequence number. The pre-PAK shall be encrypted with the MS's public key. The MS_Random number is returned from the PKMv2 RSA-Request message, along with a random number supplied by the BS, thus enabling assurance of key liveness.

Code: 14

Attributes are shown in Table 37b.

**Table 37b— PKMv2 RSA-Reply attributes**

| Attribute | Contents |
|---|---|
| MS_Random | A 64-bit random number generated in the MS |
| BS_Random | A 64-bit random number generated in the BS |
| Encrypted pre-PAK | RSA-OAEP-Encrypt(PubKey(MS), pre-PAK \| MS MAC Address) |
| Key Lifetime | PAK Aging timer |
| Key Sequence Number | PAK sequence number |
| BS_Certificate | Contains the BS's X.509 certificate |
| SigBS | An RSA signature over all the other attributes in the message |

The SigBS indicates an RSA signature over all the other attributes in this message, and the BS's private key is used to make an RSA signature.

***Insert new subclause 6.3.2.3.9.13:***

### 6.3.2.3.9.13 PKMv2 RSA-Reject message

The BS responds to an SS's authorization request with an PKMv2 RSA-Reject message if the BS rejects the SS's authorization request.

Code: 15

Attributes are shown in Table 37c.

**Table 37c—PKMv2 RSA-Reject attributes**

| Attribute | Contents |
|---|---|
| MS_Random | A 64 bit random number generated in the MS |
| BS_Random | A 64 bit random number generated in the BS |
| Error-Code | Error code identifying reason for rejection of authorization request |
| BS_Certificate | Contains the BS's X.509 certificate |
| Display-String (optional) | Display string providing reason for rejection of authorization request |
| SigBS | An RSA signature over all the other attributes in the message |

The Error-Code and Display-String attributes describe to the requesting MS the reason for the RSA-based authorization failure.

The SigBS indicates an RSA signature over all the other attributes in this message, and the BS's private key is used to make an RSA signature.

***Insert new subclause 6.3.2.3.9.14:***

#### 6.3.2.3.9.14 PKMv2 RSA-Acknowledgement message

The MS sends the PKMv2 RSA-Acknowledgement message to BS in response to a PKMv2 RSA-Reply message or a PKMv2 RSA-Reject message. Only if the value of Auth Result Code is failure, then the Error-Code and Display-String can be included in this message.

Code: 16

Attributes are shown in Table 37d.

**Table 37d—PKMv2 RSA-Acknowledgement attributes**

| Attribute | Contents |
|---|---|
| BS_Random | A 64-bit random number generated in the BS |
| Auth Result Code | Indicates result (Success or Failure) of authorization procedure |
| Error-Code | Error code identifying reason for rejection of authorization request |
| Display-String (optional) | Display string providing reason for rejection of authorization request |
| SigSS | An RSA signature over all the other attributes in the message |

The SigSS indicates an RSA signature over all the other attributes in this message, and the SS’s private key is used to make an RSA signature.

***Insert new subclause 6.3.2.3.9.15:***

#### 6.3.2.3.9.15 PKMv2 EAP Start message

In the case of EAP re-authentication, “HMAC Digest/CMAC Digest” and “Key Sequence Number” attributes shall be included. At initial EAP authentication, these attributes are omitted.

Code: 17

Attributes are shown in Table 37e.

**Table 37e—EAP-Start attributes**

| Attribute | Contents |
|---|---|
| Key Sequence Number | AK sequence number |
| HMAC Digest/CMAC Digest | Message digest calculated using AK |

***Insert new subclause 6.3.2.3.9.16:***

### 6.3.2.3.9.16 PKMv2 EAP Transfer message

When an MS has an EAP payload received from an EAP method for transmission to the BS or when a BS has an EAP payload received from an EAP method for transmission to the MS, it encapsulates it in a PKMv2 EAP Transfer message. In the case of re-authentication, "HMAC Digest/CMAC Digest" and "Key Sequence Number" attributes shall be included.

Code: 18

Attributes are shown in Table 37f.

**Table 37f—PKMv2 EAP Transfer attributes**

| Attribute | Contents |
|---|---|
| EAP Payload | Contains the EAP authentication data, not interpreted in the MAC |
| Key Sequence Number | AK sequence number |
| HMAC Digest/ CMAC Digest | Message Digest calculated using AK |

The EAP Payload field carries data in the format described in section 4 of RFC 3748.

***Insert new subclause 6.3.2.3.9.17:***

### 6.3.2.3.9.17 PKMv2 Authenticated EAP Transfer messages

This message is used for Authenticated EAP-based authorization (if this was specified by Authorization Policy Support negotiated in the SBC-REQ/RSP exchange). Specifically, when an MS or BS has an EAP payload received from an EAP method for transmission after an authentication established EIK, it encapsulates the EAP payload in a PKMv2 Authenticated EAP Transfer message.

Code: 19

Attributes are shown in Table 37g.

**Table 37g—PKMv2 Authenticated EAP message attributes**

| Attribute | Contents |
|---|---|
| Key Sequence Number | PAK Sequence Number (optional) |
| EAP Payload | Contains the EAP authentication data, not interpreted in the MAC |
| HMAC/CMAC Digest | Message Digest calculated using EIK |

The EAP Payload field carries EAP data in the format described in RFC 3748.

The CMAC-Digest's or HMAC Digest's attribute shall be the final attribute in the message's attribute list.

Inclusion of the CMAC or HMAC Digest allows the MS and BS to cryptographically bind previous authorization and following EAP authentication by authenticating the EAP payload. The key for the CMAC Value or HMAC Digest is derived from the EIK.

PAK Sequence Number attribute carries PAK sequence number only if MS and BS negotiate "Authenticated EAP after RSA" mode.

***Insert new subclause 6.3.2.3.9.18:***

### 6.3.2.3.9.18 PKMv2 SA-TEK-Challenge message

The BS transmits the PKMv2 SA-TEK-Challenge message as a first step in the 3-way SA-TEK handshake at initial network entry and at reauthorization. The BS shall send this message to the MS after finishing authorization procedure(s) selected by the negotiated Authorization Policy Support included in the SBC-REQ/RSP messages. It identifies an AK to be used, and includes a random number challenge to be returned by the MS in the PKMv2 SA-TEK-Request message.

Code: 20

Attributes are shown in Table 37h.

**Table 37h—PKMv2 SA-TEK-Challenge message attributes**

| Attribute | Contents |
|---|---|
| BS_Random | A freshly generated random number of 64 bits. |
| Key Sequence Number | AK sequence number. |
| AKID | AKID of the AK (this is the AKID of the *new* AK in the case of re-authentication). |
| Key lifetime | PMK lifetime, this attribute shall include only follows EAP-based authorization or EAP-based reauthorization procedures. |
| HMAC/CMAC Digest | Message authentication digest for this message. |

The generation of the AK sequence number and the AKID is defined in 7.2.2.4.1.

The HMAC Digest attribute or the CMAC-Digest attribute shall be the final attribute in the message's attribute list.

Inclusion of the HMAC Digest or the CMAC-Digest allows the MS and BS to authenticate a PKMv2 SA-TEK-Challenge message. The HMAC or the CMAC authentication keys are derived from the AK.

***Insert new subclause 6.3.2.3.9.19:***

### 6.3.2.3.9.19 PKMv2 SA-TEK-Request message

The MS transmits the PKMv2 SA-TEK-Request message after receipt and successful HMAC Digest or CMAC value verification of an SA-Challenge tuple or PKMv2 SA-TEK-Challenge message from the BS. The PKMv2 SA-TEK-Request proves liveliness of the MS and its possession of the AK to the BS. If this message is being generated during initial network entry, then it constitutes a request for SA-Descriptors identifying the primary and static SAs and GSAs the requesting MS is authorized to access and their particular properties (e.g., type, cryptographic suite).

If this message is being generated following HO, then it constitutes a request for establishment (in the target BS) of TEKs, GTEKs and GKEKs for the MS and renewal of active primary, static and dynamic SAs and associated SAIDs used by the MS in its previous serving BS.

Code: 21

Attributes are shown in Table 37i.

**Table 37i—PKMv2 SA-TEK-Request message attributes**

| Attribute | Contents |
|---|---|
| MS_Random | A 64-bit number chosen by the MS freshly for every new handshake[a] |
| BS_Random | The 64-bit random number used in the PKMv2 SA-TEK-Challenge message or SA-Challenge Tuple |
| Key Sequence Number | AK sequence number |
| AKID | Identifies the AK that was used for protecting this message |
| Security-Capabilities | Describes requesting MS’s security capabilities |
| Security Negotiation Parameters | Confirms requesting MS’s security capabilities (see 11.8.4) |
| PKMv2 configuration settings | PKMv2 configuration defined in 11.9.36 |
| HMAC/CMAC Digest | Message authentication digest for this message |

[a] Receipt of a new BS Random value in SA-TEK-Challenge or SA-Challenge tuple indicates the beginning of a new handshake.

***Insert new subclause 6.3.2.3.9.20:***

### 6.3.2.3.9.20 PKMv2 SA-TEK-Response message

The BS transmits the PKMv2 SA-TEK-Response message as a final step in the 3-way SA-TEK handshake.

Code: 22

Attributes are shown in Table 37j.

**Table 37j—PKMv2 SA-TEK-Response message attributes**

| Attribute | Contents |
|---|---|
| MS_Random | The number received from the MS. |
| BS_Random | The random number included in the PKMv2 SA-TEK-Challenge message or SA-Challenge TLV. |
| Key Sequence Number | AK sequence number. |
| AKID | This identifies the AK to the MS that was used for protecting this message. |

**Table 37j—PKMv2 SA-TEK-Response message attributes *(continued)***

| Attribute | Contents |
|---|---|
| SA_TEK_Update | A compound TLV list each of which specifies an SA identifier (SAID) and additional properties of the SA that the MS is authorized to access. This compound field may be present at the reentry only. For each active SA in previous serving BS, corresponding TEK, GTEK and GKEK parameters are included. |
| Frame Number | An absolute frame number in which the old PMK and all its associate AKs should be discarded. |
| (one or more) SA-Descriptor(s) | Each compound SA-Descriptor attribute specifies an SA identifier (SAID) and additional properties of the SA. This attribute is present at the initial network entry only. |
| Security Negotiation Parameters | Confirms the authentication and message integrity parameters to be used (see 11.8.4). |
| HMAC Digest/CMAC Digest | Message authentication digest for this message. |

***Insert new subclause 6.3.2.3.9.21:***

### 6.3.2.3.9.21 PKMv2 Key-Request message

An MS sends a PKMv2 Key-Request message to the BS to request new TEK and TEK-related parameters (GTEK and GTEK-related parameters for the multicast or broadcast service) or GKEK and GKEK-related parameters for the multicast or broadcast service.

Code: 23

Attributes are shown in Table 37k.

**Table 37k—PKMv2 Key Request attributes**

| Attribute | Contents |
|---|---|
| Key Sequence Number | AK sequence number |
| SAID | Security association identifier<br>—GSAID for multicast or broadcast service |
| Nonce | A random number generated in an MS |
| HMAC Digest/CMAC Digest | Message Digest calculated using AK |

The HMAC Digest attribute or the CMAC-Digest attribute shall be the final attribute in the message's attribute list.

Inclusion of the HMAC Digest or the CMAC digest allows the MS and BS to authenticate the PKMv2 Key-Request message. The HMAC Digest or the CMAC-Digest's authentication key is derived from the AK.

***Insert new subclause 6.3.2.3.9.22:***

### 6.3.2.3.9.22 PKMv2 Key-Reply message

The BS responds to an MS's PKMv2 Key-Request message with a PKMv2 Key-Reply message.

Code: 24

Attributes are shown in Table 37l.

**Table 37l—PKMv2 Key-Reply attributes**

| Attribute | Contents |
|---|---|
| Key Sequence Number | AK sequence number. |
| SAID | Security association identifier<br>— GSAID for multicast or broadcast service. |
| TEK-Parameters | "Older" generation of key parameters relevant to SAID<br>— GTEK-Parameters for the multicast or broadcast service. |
| TEK-Parameters | "Newer" generation of key parameters relevant to SAID. |
| GKEK-Parameters | "Older" generation of GKEK-related parameters for multicast or broadcast service. |
| GKEK-Parameters | "Newer" generation of GKEK-related parameters for multicast or broadcast service. |
| Nonce | A same random number included in the PKMv2 Key Request message. |
| HMAC/CMAC Digest | Message Digest calculated using AK. |

The TEK-Parameters and the SAID attributes are as defined in 6.3.2.3.9.5.

The GKEK-Parameters attribute is a compound attribute containing all of the GKEK-related parameters corresponding to a GSAID. This would include the GKEK, the GKEK's remaining key lifetime, and the GKEK's key sequence number. The older generation of GKEK-Parameters is valid within the current lifetime and the newer generation of GKEK-Parameters is valid within the next lifetime.

The HMAC Digest or the CMAC-Digest attribute shall be the final attribute in the message's attribute list.

Inclusion of the HMAC Digest or the CMAC digest allows the MS and BS to authenticate the PKMv2 Key-Reply message. The HMAC Digest or the CMAC-Digest's authentication key is derived from the AK.

***Insert new subclause 6.3.2.3.9.23:***

### 6.3.2.3.9.23 PKMv2 Key-Reject message

The BS responds to an MS's PKMv2 Key-Request message with a PKMv2 Authorization-Reject message if the BS rejects the MS's traffic keying material request.

Code: 25

Attributes are shown in Table 37m.

**Table 37m—PKMv2 Key-Reject attributes**

| Attribute | Contents |
|---|---|
| Key Sequence Number | AK sequence number. |
| SAID | Security association identifier. |
| Error-Code | Error code identifying reason for rejection of the PKMv2 Key-Request message. |
| Display-String (optional) | Display string containing reason for the PKMv2 Key-Request message. |
| Nonce | A same random number included in the PKMv2 Key Request message. |
| HMAC/CMAC Digest | Message Digest calculated using AK. |

The HMAC Digest or the CMAC-Digest attribute shall be the final attribute in the message's attribute list.

Inclusion of the HMAC Digest or the CMAC digest allows the MS and BS to authenticate the PKMv2 Key-Reject message. The HMAC Digest or the CMAC-Digest's authentication key is derived from the AK.

***Insert new subclause 6.3.2.3.9.24:***

### 6.3.2.3.9.24 PKMv2 SA-Addition message

This message is sent by the BS to the SS to establish one or more additional SAs.

Code: 26

Attributes are shown in Table 37n.

**Table 37n—PKMv2 SA-Addition attributes**

| Attribute | Contents |
|---|---|
| Key Sequence Number | AK sequence number. |
| (one or more) SA-Descriptor(s) | Each compound SA-Descriptor attribute specifies an SA identifier (SAID) and additional properties of the SA. |
| HMAC/CMAC Digest | Message Digest calculated using AK. |

The HMAC Digest or the CMAC-Digest attribute shall be the final attribute in the message's attribute list.

Inclusion of the HMAC Digest or the CMAC digest allows the MS and BS to authenticate the PKMv2 SA-Add message. The HMAC Digest or the CMAC-Digest's authentication key is derived from the AK.

***Insert new subclause 6.3.2.3.9.25:***

### 6.3.2.3.9.25 PKMv2 TEK-Invalid message

The BS sends a PKMv2 TEK-Invalid message to a client MS if the BS determines that the MS encrypted an uplink PDU with an invalid TEK (i.e., an SAID's TEK key sequence number), contained within the received packet's MAC header, is out of the BS's range of known, valid sequence numbers for that SAID.

Code: 27

Attributes are shown in Table 37o.

**Table 37o—PKMv2 TEK-Invalid attributes**

| Attribute | Contents |
|---|---|
| Key Sequence Number | AK sequence number |
| SAID | Security Association Identifier |
| Error-Code | Error code identifying reason for PKMv2 TEK-Invalid message |
| Display-String (optional) | Display string containing reason for the PKMv2 TEK-Invalid message |
| HMAC/CMAC Digest | Message Digest calculated using AK |

The HMAC Digest or the CMAC-Digest attribute shall be the final attribute in the message's attribute list.

Inclusion of the HMAC Digest or the CMAC digest allows the MS and BS to authenticate the PKMv2 SA-Add message. The HMAC Digest or the CMAC-Digest's authentication key is derived from the AK.

***Insert new subclause 6.3.2.3.9.26:***

### 6.3.2.3.9.26 PKMv2 Group-Key-Update-Command message

This message is sent by BS to push the GTEK and/or GKEK parameters to MSs served with the specific multicast service or broadcast service.

Code: 28

Attributes are shown in Table 37p.

**Table 37p—PKMv2 Group Key update command attributes**

| Attribute | Contents |
|---|---|
| Key-Sequence-Number | AK sequence number |
| GSAID | Security Association ID |
| Key Push Modes | Usage code of Key Update Command message. |
| Key Push Counter | Counter one greater than that of older generation. |
| GTEK-Parameters | "Newer" generation of GTEK-related parameters relevant to GSAID. The GTEK-Parameters is the TEK-Parameters for multicast or broadcast service. |

**Table 37p—PKMv2 Group Key update command attributes *(continued)***

| Attribute | Contents |
|---|---|
| GKEK-Parameters | "Newer" generation of GKEK-related parameters for multicast or broadcast service. |
| HMAC/CMAC Digest | Message integrity code of this message. |

Key Sequence Number is the sequence number of the synchronized AK (Authorization Key) between an MS and a BS.

GSAID is SAID for the multicast group or the broadcast group. The type and length of the GSAID is equal to ones of the SAID.

There are two types in a PKMv2 Group Key Update Command message, GKEK update mode and GTEK update mode. The former is used to update GKEK and the latter is used to update GTEK for the multicast service or the broadcast service. Key Push Modes indicates the usage code of a PKMv2 Group Key Update Command message. The PKMv2 Group Key Update Command message for the GKEK update mode is carried on the Primary Management connection, but one for the GTEK update mode is carried on the Broadcast connection. A few attributes in a PKMv2 Group Key Update Command message shall not be used according this Key Push Modes attribute's value. See 11.9.33 for details.

Key Push Counter is used to protect for replay attack. This value is one greater than that of older generation.

A PKMv2 Group Key Update Command message contains only newer generation of key parameters, because this message inform an MS next traffic key material. The GTEK-Parameters attribute is a compound attribute containing all of the keying material corresponding to a newer generation of a GSAID's GTEK. This would include the GTEK, the GTEK's remaining key lifetime, the GTEK's key sequence number, the associated GKEK sequence number, and the cipher block chaining (CBC) initialization vector. The GTEK is TEK for the multicast group or the broadcast group. The type and length of the GTEK is equal to ones of the TEK. The GKEK (Group Key Encryption Key) can be randomly generated from a BS or a certain network node (i.e., an ASA server). The GKEK should be identically shared within the same multicast group or the broadcast group. The GTEK is encrypted with GKEK for the multicast service or the broadcast service. GKEK parameters contain the GKEK encrypted by the KEK, GKEK sequence number, and GKEK lifetime. See 7.5.4.4 for details.

The HMAC/CMAC Digest attribute shall be the final attribute in the message's attribute list. Inclusion of the keyed digest allows the receiving client to authenticate the Group Key Update Command message. The HMAC/CMAC Digest's authentication key is derived from the AK for the GKEK update mode and GKEK for the GTEK update mode. See 7.5.4.3 for details.

***Insert new subclause 6.3.2.3.9.27:***

### 6.3.2.3.9.27 PKMv2 EAP Complete

In double EAP mode (EAP after EAP), BS sends the PKMv2 EAP Complete message to MS with EAP-Success to inform MS of completing the first EAP conversation.

This message is used only if MS and BS negotiate EAP in EAP mode.

The Key Sequence Number and HMAC/CMAC Digest attributes of this message appear only in re-authentication.

Code: 29

Attributes are shown in Table 37q.

Table 37q—PKMv2 EAP Complete attributes

| Attribute | Contents |
|---|---|
| EAP Payload | Contains the EAP authentication data, not interpreted in the MAC layer |
| Key Sequence Number | AK sequence number appear only if AK is available from previous double EAP |
| HMAC Digest/CMAC Digest | Message Digest calculated using AK only if AK is available from previous double EAP Message Digest calculated using EIK when initial authentication |

***Insert new subclause 6.3.2.3.9.28:***

#### 6.3.2.3.9.28 PKMv2 Authenticated EAP Start

In double EAP mode (EAP after EAP), MS sends the PKMv2 EAP Authenticated EAP Start message to BS in order to initiate second round EAP. This message is signed by EIK, which is generated by 1st EAP.

This message is used only for initial authentication of double EAP.

Attributes are shown in Table 37r.

Table 37r—PKMv2 Authenticated EAP Start attribute

| Attribute | Contents |
|---|---|
| MS_Random | Random number generated by MS |
| HMAC Digest/CMAC Digest | Message Digest calculated using EIK |

#### 6.3.2.3.10 DSA-REQ message

***Change the explanation text of the "HMAC" field as indicated:***

**HMAC/CMAC Tuple (see 11.1.2)**

The HMAC/CMAC Tuple attribute contains a keyed message digest (to authenticate the sender). The HMAC Tuple attribute shall be the final attribute in the DSx message's attribute list.

#### 6.3.2.3.11 DSA-RSP message

***Change the explanation text of the "Service Flow Parameters" field as indicated:***

**Service Flow Parameters** (see 11.13)
The complete specification of the service flow shall be included in the DSA-RSP if it includes a newly assigned CID or an expanded Service Class Name~~ or to point to specific parameter that caused rejection of connection creation (only in the case CC = "reject-not supported-parameter-value" or "reject-not-supported-parameter")~~.

***Delete the mandatory content of DSA-RSP in case of unsuccessful transaction and the explanation text of the "Service Flow Error Set" field:***

~~If the transaction is unsuccessful, the DSA-RSP shall include:~~

~~**Service Flow Error Set** (see 11.13)~~
~~A Service Flow Error Set and identifying service flow reference/SFID shall be included for every failed service flow in the corresponding DSA-REQ message. Every Service Flow Error Set shall include every specific failed QoS Parameter of the corresponding service flow (see 11.13). This parameter shall be omitted if the entire DSA-REQ is successful.~~

***Change the explanation text of the "HMAC" field as indicated:***

**HMAC/CMAC Tuple (see 11.1.2)**
The HMAC/CMAC Tuple attribute contains a keyed message digest (to authenticate the sender). The HMAC Tuple attribute shall be the final attribute in the DSx message's attribute list.

#### 6.3.2.3.11.1 SS-Initiated DSA

***Delete the last paragraph:***

~~If the transaction is unsuccessful, the BS shall use the original service flow reference to identify the failed parameters in the DSA-RSP.~~

***Delete subclause 6.3.2.3.11.2***

#### ~~6.3.2.3.11.2 BS-Initiated DSA~~

#### 6.3.2.3.12 DSA-ACK message

***Delete the explanation text of the "Service Flow Error Set" field:***

~~**Service Flow Error Set** (see 11.13)~~
~~The Service Flow Error Set of the DSA-ACK message encodes specifics of any failed service flows in the DSA-RSP message. A Service Flow Error Set and identifying service flow reference shall be included for every failed QoS Parameter of every failed service flow in the corresponding DSA-REQ message (see 11.13). This parameter shall be omitted if the entire DSA-REQ is successful.~~

***Change the explanation text of the "HMAC" field as indicated:***

**HMAC/CMAC Tuple (see 11.1.2)**
The HMAC/CMAC Tuple attribute contains a keyed message digest (to authenticate the sender). The HMAC Tuple attribute shall be the final attribute in the DSx message's attribute list.

### 6.3.2.3.13 DSC Request (DSC-REQ) message

*Change the explanation text of the "HMAC" field as indicated:*

**HMAC/CMAC Tuple (see 11.1.2)**
The HMAC/CMAC Tuple attribute contains a keyed message digest (to authenticate the sender). The HMAC Tuple attribute shall be the final attribute in the DSx message's attribute list.

### 6.3.2.3.14 DSC Response (DSC-RSP) message

*Delete the mandatory content of DSC-RSP in case of unsuccessful transaction and the explanation text of the "Service Flow Error Set" field:*

~~If the transaction is unsuccessful, the DSC-RSP shall contain the following:~~

~~**Service Flow Error Set** (see 11.13)~~
~~A Service Flow Error Set and identifying CID shall be included for every failed service flow in the corresponding DSC-REQ message. Every Service Flow Error Set shall include every specific failed QoS Parameter of the corresponding service flow (see 11.13). This parameter shall be omitted if the entire DSC-REQ is successful.~~

*Change the explanation text of the "HMAC" field as indicated:*

**HMAC/CMAC Tuple (see 11.1.2)**
The HMAC/CMAC Tuple attribute contains a keyed message digest (to authenticate the sender). The HMAC Tuple attribute shall be the final attribute in the DSx message's attribute list.

### 6.3.2.3.15 DSC Acknowledge (DSC-ACK) message

*Delete the explanation text of the 'Service Flow Error Set" field:*

~~**Service Flow Error Set** (see 11.13)~~
~~The Service Flow Error Set of the DSC-ACK message encodes specifics of any failed service flows in the DSC-RSP message. A Service Flow Error Set and identifying SFID shall be included for every failed QoS Parameter of each failed service flow in the corresponding DSC-RSP message (see 11.13). This parameter shall be omitted if the entire DSC-RSP is successful.~~

*Change the explanation text of the "HMAC" field as indicated:*

**HMAC/CMAC Tuple (see 11.1.2)**
The HMAC/CMAC Tuple attribute contains a keyed message digest (to authenticate the sender). The HMAC Tuple attribute shall be the final attribute in the DSx message's attribute list.

### 6.3.2.3.16 DSD-REQ message

*Change the explanation text of the "HMAC" field as indicated:*

**HMAC/CMAC Tuple (see 11.1.2)**
The HMAC/CMAC Tuple attribute contains a keyed message digest (to authenticate the sender). The HMAC Tuple attribute shall be the final attribute in the DSx message's attribute list.

### 6.3.2.3.17 DSD-RSP message

*Change the explanation text of the "HMAC" field as indicated:*

**HMAC/CMAC Tuple (see 11.1.2)**

The HMAC/CMAC Tuple attribute contains a keyed message digest (to authenticate the sender). The HMAC Tuple attribute shall be the final attribute in the DSx message's attribute list.

### 6.3.2.3.20 Downlink Burst Profile Change Request (DBPC-REQ) message

*Change the first paragraph as indicated:*

This message is not applicable to OFDMA PHY.

The DBPC-REQ message is sent by the SS to the BS on the SS's Basic CID to request a change of the least robust downlink burst profile used by the BS to transport data to the SS (i.e., the Downlink Operational Burst Profile). Note that a change of downlink burst profile may also be requested by means of a RNG-REQ message as defined in 6.3.2.3.5.

*Change the second paragraph as indicated:*

The DBPC-REQ message shall be sent at the current operational Data Grant Burst Type for the SS. If the SS detects ~~fading~~ changes in the channel conditions on the downlink, the SS uses this message to request transition to a more appropriate Data Grant Burst Type ~~robust Data Grant Burst Type~~. The message format shall be as shown in Table 48.

### 6.3.2.3.21 Downlink Burst Profile Change Response (DBPC-RSP) message

*Insert the following sentence before the first paragraph:*

This message is not applicable to OFDMA PHY.

### 6.3.2.3.22 Reset Command (RES-CMD) message

*Change the explanation text of the "HMAC" field as indicated:*

**HMAC/CMAC Tuple (see 11.1.2)**

The HMAC/CMAC Tuple shall be the last attribute in the message.

### 6.3.2.3.23 SS basic capability request (SBC-REQ) message

*Change the last paragraph as indicated:*

Basic Capability Requests contain those SS Capabilities Encodings (~~11.7.8~~11.8) that are necessary for effective communication with the SS during the remainder of the initialization protocols. Only the following parameters shall be included in the Basic Capabilities Request:

**Physical Parameters Supported** (see 11.8.3)
**Bandwidth Allocation Support** (see 11.8.1)

The following parameters may be included:

**Capabilities for construction and transmission of MAC PDUs** (see 11.8.2)

**PKM flow control** (see 11.7.8.6)
**Authorization policy support** (see 11.8.4.2)
**Maximum number of supported security association** (see 11.7.8.8)

*Insert at the end of 6.3.2.3.23:*

Security Negotiation Parameters (see 11.8.4)

**HMAC/CMAC Tuple**

Either HMAC Tuple or CMAC Tuple shall be the final attribute in the message’s TLV attribute list. This attribute should be included in the message during HO reentry (see 11.1.2).

### 6.3.2.3.24 SS basic capability response (SBC-RSP) message

*Insert at the end of 6.3.2.3.24:*

Security Negotiation Parameters (see 11.8.4)

**HMAC/CMAC Tuple**

Either HMAC Tuple or CMAC Tuple shall be the final attribute in the message’s TLV attribute list. This attribute should be included in the message during HO reentry (see 11.1.2).

Capabilities for Construction and Transmission of MAC PDUs (see 11.8.2):

**PKM flow control** (see 11.8.4)
**Authorization Policy Support** (see 11.8.5)
**Maximum number of supported security association** (see 11.8.6)

### 6.3.2.3.26 De/Re-register command (DREG-CMD) message

*Change Table 55 as indicated:*

**Table 55—Action codes and actions**

| Action code (hexadecimal) | Action |
|---|---|
| 00 | SS shall ~~leave the current channel and attempt to access another channel~~immediately terminate service with the BS and should attempt network entry at another BS. |
| 01 | SS shall listen to the current ~~channel~~BS but shall not transmit until an RES-CMD message or DREG-CMD with Action Code ~~that allows transmission~~02 or 03 is received. |
| 02 | SS shall listen to the current ~~channel~~BS but only transmit on the Basic~~,~~ and Primary Management~~, and Secondary Management~~ Connections. |
| 03 | SS shall return to normal operation and may transmit on any of its active connections. |
| 04 | SS shall terminate current Normal Operations with the BS; the BS shall transmit this action code only in response to any SS DREG-REQ message. |
| 05 | MS shall immediately begin de-registration from serving BS and request initiation of MS Idle Mode. |

**Table 55—Action codes and actions *(continued)***

| Action code (hexadecimal) | Action |
|---|---|
| 06 | The MS may retransmit the DREG-REQ message after the time duration (REQ-duration) provided in the message. |
| 07 | The MS shall not retransmit the DREG-REQ message and shall wait the DREG-CMD message. BS transmittal of a subsequent DREG-CMD with Action Code 03 shall cancel this restriction. |
| ~~05~~08–FF | *Reserved* |

***Change the first paragraph below Table 55 as follows:***

The DREG-CMD shall include the following parameters encoded as TLV tuples:

**HMAC/CMAC Tuple (see 11.1.2)**
The HMAC/CMAC Tuple shall be the last attribute in the message.

***Insert the following text after Table 55:***

When the DREG-CMD message is sent with Action Code = 0x05, the following TLVs shall be included:

**Paging Information (see 11.14)**
The Paging Information TLV defines the Paging Group ID and the PAGING_CYCLE and PAGING OFFSET parameters to be used by the MS in IDLE mode

**Paging Controller ID**
The Paging Controller ID is a logical network identifier for the serving BS or other network entity retaining MS service and operational information and/or administering paging activity for the MS while in IDLE Model. Paging Controller ID shall be set to BSID when a BS is acting as Paging Controller.

**Idle Mode Retain Information**
Idle Mode Retain Information provided as part of this message is indicative only. Network Reentry from Idle Mode process requirements may change at time of actual re-entry. For each bit location, a value of 0 indicates the information for the associated re-entry management messages shall not be retained and managed, a value of 1 indicates the information for the associated reentry management message shall be retained and managed.
Bit #0: Retain MS service and operational information associated with SBC-REQ/RSP messages.
Bit #1: Retain MS service and operational information associated with PKM-REQ/RSP messages.
Bit #2: Retain MS service and operational information associated with REG-REQ/RSP messages.
Bit #3: Retain MS service and operational information associated with Network Address.
Bit #4: Retain MS service and operational information associated with Time of Day.
Bit #5: Retain MS service and operational information associated with TFTP messages.
Bit #6: Retain MS service and operation information associated with Full service (MAC state machines, CS classifier information, etc.). The information retained by setting Bit #6 does not include those information associated with SBC-REQ/RSP messages, PKM-REQ/RSP messages, REG-REQ/RSP messages, Network Address, Time of Day, and TFTP messages unless otherwise specified by setting one or more Bits #0–#5.
Bit #7: Consider Paging Preference of each Service Flow in resource retention. Bit #7 is meaningful when Bit #2 and Bit #6 have a value of 1. If Bit #2, Bit #6 and Bit #7 is 1, MS

service and operational information associated with Full service (MAC state machines, CS classifier information, etc.) are retained for Service Flows with positive Paging Preference. If Bit #2 and Bit #6 are 1 and Bit #7 is 0, MS service and operational information associated with Full service (MAC state machines, CS classifier information, etc.) are retained for all Service Flows.

When the DREG-CMD is sent with Action Code = 0x05, the following TLVs may be included:

**MAC Hash Skip Threshold**
Maximum number of successive MOB_PAG-ADV messages that may be sent from a BS without individual notification for an MS, including MAC Address hash of an MS for which Action Code is 00, 'No Action Required'. If a BS receives the DREG-REQ message containing MAC Hash Skip Threshold TLV, the BS may include MAC Hash Skip Threshold TLV in the DREG-CMD message. If the value is set to 0xFF, a BS shall omit MAC Address hash of the MS with ‘No Action Required’ for every MOB_PAG-ADV message. If the value is set to zero, BS shall include the MS MAC Address hash in every MOB_PAG-ADV message.

The DREG-CMD message may include the following parameters encoded as TLV tuples:

**REQ-duration**
Waiting value for the DREG-REQ message re-transmission (measured in frames) If serving BS includes REQ-duration in a message including an Action Code = 0x05, the MS may initiate an Idle Mode request through a DREG-REQ with Action Code = 0x01, request for MS De-Registration from serving BS and initiation of MS Idle Mode, at REQ-duration expiration.

### 6.3.2.3.28 Config File TFTP Complete (TFTP-CPLT) message

***Change first paragraph as indicated:***

The Config File TFTP-CPLT message shall be generated by ~~the~~a managed SS when it has successfully retrieved its configuration file from the provisioning server (see 6.3.9.12). If the SS does not need a config file it shall send the TFTP-CPLT message to the BS anyway, to indicate that it has completed ~~secondary management connection~~ initialization and is ready to accept services. The format of the TFTP-CPLT shall be as shown in Table 57.

***Change the explanation text of the “HMAC” field as indicated:***

**HMAC/CMAC Tuple (see 11.1.2)**
The HMAC/CMAC Tuple shall be the last attribute in the message.

### 6.3.2.3.32 ARQ Reset message

***Change Table 61 as indicated:***

**Table 61—ARQ Reset message format**

| Syntax | Size | Notes |
|---|---|---|
| ARQ_Reset_Message_Format() { | | |
| **Management Message Type = 35** | 8 bits | |
| **Connection ID** | 16 bits | CID to which this message refers. |

### Table 61—ARQ Reset message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Type** | 2 bits | 0b00 = Original message from Initiator<br>0b01 = Acknowledgment from Responder<br>0b10 = Confirmation from Initiator<br>0b11 = *Reserved* |
| **Direction** | 2 bits | 0b00 = Uplink or downlink<br>0b01 = Uplink<br>0b10 = Downlink<br>0b11 = *Reserved* |
| *Reserved* | ~~6~~4 bits | Shall be set to zero. |
| } | | |

***Insert the following sentence below Table 61:***

For transport CIDs, the Direction bits shall be set to 0b00 on transmission, and ignored on reception. For secondary management CIDs, the Direction bits shall be set to 0b01 or 0b10 as appropriate and other values shall cause the message to be treated as invalid and discarded on reception.

### 6.3.2.3.33 Channel measurement Report Request/Response (REP-REQ/RSP)

***Change the first paragraph as indicated:***

If the BS, operating in bands below 11 GHz ~~or a DM-configured BS operating at any frequency~~, requires RSSI and CINR channel measurement reports, it shall send the channel measurements Report Request message. ~~In license-exempt bands, it~~ The Report Request message shall additionally be used to request the results of the ~~DFS~~ measurements the BS has previously scheduled. Table 62 shows the REP-REQ ~~meassage~~ message.

***Change the second paragraph as indicated:***

The REP-REQ message shall contain the following TLV encoded parameters:

**Report Request**

The channel measurement Report Response message shall be used by the SS to respond to the channel measurements listed in the received Report Requests. ~~In license-exempt bands~~ Where regulation mandates detection of specific signals by the SS, the SS shall also send a REP-RSP in an unsolicited fashion upon detecting ~~a Primary User~~ such signals on the channel it is operating in, if mandated by regulatory requirements. The SS may also send a REP-RSP containing channel measurement reports, in an unsolicited fashion, or when ~~non-primary user~~ other interference is detected above a threshold value. In cases where specific signal detection by an SS is not mandated by regulation, the SS may indicate ‘Unmeasured. Channel not measured” (see 11.12) in the REP-RSP message when responding to the REP-REQ message from the BS. Table 63 shows the REP-RSP message.

***Insert the following sentence at the end of the subclause:***

Upon sending a REP-RSP message, an SS shall reset all its measurement counters for each channel on which it reported.

### 6.3.2.3.34 Fast Power Control (FPC) message

***Change first paragraph as indicated:***

Power control shall be effected by the use of periodic ranging. In addition, the BS may adjust the power levels of multiple subscribers simultaneously with the Fast Power Control (FPC) message. SSs shall apply the indicated change within the “~~SS downlink management message~~ FPC processing time”. If the SS cannot apply the commanded power correction (SS is already at maximum or minimum power) the SS shall send a RNG-REQ message with “Ranging Anomalies” parameter. FPC shall be sent on the broadcast CID. This message shall only apply to SCa, OFDM, and OFDMA PHY specifications. See Table 64. Implementation of FPC message at BS is optional.

***Insert the following record into Table 64, after the ‘Number of Stations’ field:***

| | | |
|---|---|---|
| **Power measurement frame** | 8 bits | |

***Insert the following text below Table 64:***

**Power measurement frame**
The 8 LSB of the frame number in which the BS measured the power corrections referred to in the message.

### 6.3.2.3.41 AAS Beam Select message

***Change the description of* “AAS beam index” *field below Table 86 as indicated:***

**AAS beam index**
This index shall correspond to the direction the AAS beam is pointing at during the ~~AAS_DL_Scan_IE()~~ AAS_DLFP() preferred by the SS (see 8.4.4.6).

***Insert the following text at the end of 6.3.2.3.41:***

For systems supporting mobility, the parameter “Allow AAS Beam Select Messages” in the UCD channel encoding TLV messages can be configured to indicate that these messages should not be sent by any MS, and the default value of “Allow AAS Beam Select Messages” is 1.

### 6.3.2.3.42 SS De-registration Request (DREG-REQ) message

***Change 6.3.2.3.42 as indicated:***

**Table 87—DREG-REQ message format**

| Syntax | Size | Notes |
|---|---|---|
| DREG-REQ message format() { | — | — |
| **Management message type = 49** | 8 bits | — |
| **De-Registration_Request_Code** | 8 bits | 0x00 = SS De-Registration request from BS<br>0x01=request for MS De-Registration from serving BS and initiation of MS Idle Mode<br>0x02 = Response for the Unsolicited MS De-Registration initiated by the BS.<br>0x0~~1~~3-0xFF = *Reserved* |

**Table 87—DREG-REQ message format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| TLV encoded parameters | *variable* | — |
| } | — | — |

An SS shall generate SS DREG-REQs including the following parameters:

**De-Registration_Request_Code**
Request code identifying the type of ~~d~~De-~~r~~Registration request:
0x00 = SS ~~d~~De-~~r~~Registration request ~~for de-registration~~ from BS and network
0x01 = MS request for ~~d~~De-~~r~~Registration from serving BS and initiation of Idle Mode
0x02 = MS response for the Unsolicited De-Registration initiated by BS
0x0~~1~~3-0xFF = Reserved

The DREG-REQ shall include the following parameters encoded as TLV tuples:

**HMAC/CMAC Tuple (see 11.1.2)**
The HMAC/CMAC Tuple shall be the last attribute in the message.

The MS shall include the following parameters in the DREG-REQ only if De-Registration_Request_Code = 0x01:

**Paging Cycle Request**
PAGING_CYCLE requested by the MS

**Idle Mode Retain Information**
MS request for Paging Controller retention of network re-entry related MAC management message MS service and operational information to expedite future Network Re-entry from Idle Mode. For each Bit location, a value of 0 indicates the information associated with the specified MAC management message is not requested to be retained and managed, a value of 1 indicates the information is requested to be retained and managed.
Bit #0: Retain MS service and operational information associated with SBC-REQ/RSP messages.
Bit #1: Retain MS service and operational information associated with PKM-REQ/RSP messages.
Bit #2: Retain MS service and operational information associated with REG-REQ/RSP messages.
Bit #3: Retain MS service and operational information associated with Network Address.
Bit #4: Retain MS service and operational information associated with Time of Day.
Bit #5: Retain MS service and operational information associated with TFTP messages.
Bit #6: Retain MS service and operation information associated with Full service (MAC state machines, CS classifier information, etc.). The information retained by setting Bit #6 does not include those information associated with SBC-REQ/RSP messages, PKM-REQ/RSP messages, REG-REQ/RSP messages, Network Address, Time of Day, and TFTP messages unless otherwise specified by setting one or more Bits #0–#5.
Bit #7: Consider Paging Preference of each Service Flow in resource retention. Bit #7 is meaningful when Bit #2 and Bit #6 have a value of 1. If Bit #2, Bit #6 and Bit #7 is 1, MS service and operational information associated with Full service (MAC state machines, CS classifier information, etc.) are retained for Service Flows with positive Paging Preference. If Bit #2 and Bit #6 are 1 and Bit #7 is 0, MS service and operational information associated with Full service (MAC state machines, CS classifier information, etc.) are retained for all Service Flows.

The MS may include the following parameters in the DREG-REQ message only if DeRegistration_Request_Code = 0x01:

**MAC Hash Skip Threshold**
Maximum number of successive MOB_PAG-ADV messages that may be sent from a BS individual notification for an MS, including MS MAC address hash of an MS for which Action Code is 0b00, 'No Action Required'.

***Change the title of 6.3.2.3.43 as indicated (note removal of hyphen in 'H-ARQ' throughout):***

### 6.3.2.3.43 ~~H-ARQ~~ HARQ MAP message

#### 6.3.2.3.43.1 ~~H-ARQ~~ HARQ message format

***Change text in the second paragraph as indicated:***

BS may broadcast multiple ~~H-ARQ~~ HARQ MAP messages using multiple bursts after the MAP message. Each ~~H-ARQ~~ HARQ MAP message ~~should~~shall have a different modulation and coding rate. ~~If the frame contains DCD or UCD message following the MAP message, the H-ARQ MAP should follow DCD or UCD message.~~

***Change the second instance of 'Compact DL-MAP IE()' field in Table 88 to 'Compact UL-MAP IE()'***

***Change the text under the 'Syntax' column of the 'CRC appended' field in Table 88 from "CRC appended" to "Reserved" insert under the 'Notes' column of the same field the following sentence:***

Shall be set to zero

***Change the description of 'CRC appended' field below Table 88 as indicated:***

**CRC ~~appended~~**
~~A value of one indicates a~~ CRC-32 value is appended to the end of the compressed map(s) data. The CRC is computed across all bytes of the compressed map(s) starting with the byte containing the Compressed map indicator through the last byte of the map(s) as specified by the Map message length field. The CRC calculation is the same as that used for standard MAC messages. ~~A value of zero indicates that no CRC is appended.~~

#### 6.3.2.3.43.2 Format configuration

***Change Table 91 as indicated:***

**Table 91—Format configuration IE**

| Syntax | Size | Notes |
|---|---|---|
| Compact_DL-MAP_IE( ) { | | |
| **DL-MAP IE Type = 4** | 3 bits | Format_Configuration_IE |
| **New Format Indication** | 1 bit | 0 = Use the format configured by the latest Format_Configuration_IE<br>1 = New format |
| if (New Format Indication == 1) { | | |

### Table 91—Format configuration IE *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **CID Type** | 2 bits | 0b00 = Normal CID<br>0b01 = RCID11 (default)<br>0b10 = RCID7<br>0b11 = RCID3 |
| **Safety Pattern** | ~~10~~5 bits | |
| **Subchannel type for Band AMC** | 2 bits | See Band AMC specification (8.4.6.3).<br>0b00 = Default type (default)<br>0b01 = 1 bin x6 symbols type<br>0b10 = 2 bin x3 symbols type<br>0b11 = 3 bin x2 symbols type |
| **Max Logical Bands** | 2 bits | 0 = 3 bands,<br>1 = 6 bands,<br>2 = 12 bands (default)<br>3 = 24 bands |
| **No. Symbols for Broadcast** | ~~4~~5 bits | No. Symbol, (default = 0) |
| **No. Symbols for DL Band AMC** | ~~4~~6 bits | No. Symbol, (default = 0) |
| **No. Symbols for UL Band AMC** | ~~4~~6 bits | No. Symbol, (default = 0) |
| } | | |
| } | | |

***Change the description of the 'New Format Indication', 'Safety Pattern', 'No. Symbols for Broadcast', 'No. Symbols for DL Band AMC' and 'No. Symbols for UL Band AMC' fields below Table 91 as indicated:***

**New Format Indication**

If this value set to 0, the format should be configured by the latest Format Configuration_IE in the previous frames. Otherwise, all parameters in Format Configuration IE ~~should~~shall be configured. The configured parameters are valid for the following Compact_DL/UL_MAP_IE. At the start of each frame all parameters are set to default values.

**Safety Pattern**

If this value is less than 16, the number of safety bins is 12 and the indices of allocated bins for safety are $16m+x$, where $x$ is the value of Safety Pattern and $m$ = 0 ... 11. If this value is ~~not less than~~from 16 to 31, the number of safety bins is 24 and the indices of allocated bins for safety are $16m+x'$ and $16m+(x'+8)$, where $x' = x - 16$ and $m$ = 0...11. If the safety pattern exists, it should be always allocated first. The safety pattern is valid in the region of AMC zone only. If safety pattern is set to all ones, safety channel is disabled.

**No. Symbols for Broadcast**

~~This specifies the number of symbols allocated for Broadcast subchannel.~~This field specifies the number of symbols allocated for Broadcast symbol region. The Broadcast symbols shall be allocated at the end of the DL sub-frame. The number of symbols is counted from the last symbol of the DL sub-frame. The PermBase for this broadcast symbol region shall be set to 0.

**No. Symbols for DL Band AMC**

This specifies the number of symbols allocated for DL Band AMC ~~subchannel~~ symbol region. The symbols for Band AMC shall be allocated before the broadcast symbol region. The other DL symbols excluding the symbols for Broadcast and DL Band are allocated for the DL Normal subchannel. PermBase for DL Band AMC is the same as one for normal subchannels region.

**No. Symbols for UL Band AMC**
This specifies the number of symbols allocated for UL Band AMC ~~subchannel~~ symbol region. The symbols for UL Band AMC shall be allocated at the end of the UL sub-frame and the number of symbols are counted from the last symbol of the UL sub-frame. The other UL symbols excluding the symbols for UL Band are allocated for the UL Normal subchannel. PermBase for UL Band AMC is the same as one for normal subchannels region.

***Insert the following text before Table 92:***

A logical band is a grouping of the AMC bands defined in 8.4.6.3. For example, three logical bands imply that logical band 0 is composed of AMC bands 0..15, logical band 1 is composed of AMC bands 16..31, and logical band 2 is composed of AMC bands 32...47. In general, if $K$ = Max Logical Bands, then logical band $J$ = 0...($K$–1)] contains physical bands $48/K \times J$, $48/K \times J + 1$, …, $48/K \times (J + 1) - 1$ .

### 6.3.2.3.43.3 Reduced CID

***Change the first paragraph as indicated:***

~~Figure 93~~ Table 93 presents the format of reduced CID. BS may use reduced CID instead of basic CID or multicast CID to reduce the size of HARQ MAP message. The type of reduced CID is determined by BS considering the range of basic CIDs of SS connected with the BS and specified by the RCID_Type field of the Format Configuration IE.

***Change the second paragraph as indicated:***

The reduced CID is composed of 1 bit of prefix and n-bits of LSB of CID of SS. The prefix is set to 1 for the broadcast CID or multicast polling CID and set to 0 for basic CID. The reduced CID cannot be used instead of transport CID, primary management CID, or secondary management CID. An exception to the above is when the multicast polling RCID is used in DL. If a downlink CID decoded from a prefix 1 and RCID-11 is in the range of the Multicast polling CID (0xFF00–0xFFFD) then the DL CID should be interpreted as a DL transport CID by subtracting 0xFF (0xFFFD–0xFEFE).

***Change the third paragraph as indicated:***

Figure 22 shows the decoding of reduced CID when ~~the RCID_Type is set to 3~~RCID 11 is used.

***In Figure 22, replace all instances of "RDC11" with "RCID 11".***

***Change the description of the 'RCID n' field below Table 93 as indicated:***

**RCID n**
n-bits LSB of CID. If the DL CID decoded from a prefix 1 and RCID-11 is in the range of the Multicast polling CID (0xFF00–0xFFFD) then the DL CID should be interpreted as a DL transport CID by subtracting 0xFF (0xFFFD–0xFEFE).

### 6.3.2.3.43.4 ~~H-ARQ~~ HARQ control IE

***Change 6.3.2.3.43.4 as indicated (note removal of hyphen in 'H-ARQ' throughout):***

The format of ~~H-ARQ~~HARQ_Control_IE, which includes encoding/decoding information for ~~H-ARQ~~HARQ enabled DL/UL bursts, is presented in the MAC frame. This IE shall be located in the compact DL/UL MAP_IE.

**Table 94—~~H-ARQ~~HARQ_Control_IE format**

| Syntax | Size | Notes |
|---|---|---|
| ~~H-ARQ~~HARQ_Control_IE () | — | — |
| **Prefix** | 1 bit | 0 = Temporary disable ~~H-ARQ~~HARQ<br>1 = enable ~~H-ARQ~~HARQ |
| if (Prefix == 1) { | — | — |
| **AI_SN** | 1 bit | ~~H-ARQ~~HARQ ID Seq. No |
| **SPID/*Reserved*** | 2 bits | Subpacket ID when IR is defined by the FEC mode, otherwise reserved (encoded 0b00) |
| **ACID** | 4 bits | ~~H-ARQ~~HARQ CH ID |
| } else { | — | — |
| *Reserved* | 3 bits | Shall be set to zero |
| } | — | — |
| } | — | — |

**Prefix**
Indicates whether ~~H-ARQ~~HARQ is enabled or not.

**AI_SN**
Defines ARQ Identifier Sequence Number. This is toggled between 0 and 1 on successfully transmitting each encoder packet with the same ARQ channel.

**SPID**
Defines SubPacket ID, which is used to identify the four subpackets generated from an encoder packet. The SPID field only applies to FEC modes supporting incremental redundancy.

**ACID**
Defines ~~H-ARQ~~HARQ Channel ID, which is used to identify ~~H-ARQ~~HARQ channels. Each connection can have multiple HARQ channels, each of which may have an encoder packet transaction pending.

### 6.3.2.3.43.5 CQICH Control IE

***Change the first paragraph as indicated:***

The format of CQICH Control IE is presented in Table 95. The specific reporting value shall follow the directions indicated in the latest CQICH allocation IE (8.4.5.4.12).

***Change Table 95 as indicated:***

### Table 95—~~H-ARQ~~CQICH Control IE ~~format~~

| Syntax | Size | Notes |
|---|---|---|
| CQICH_Control_IE() { | — | — |
| **CQICH Indicator** | 1 bit | If the indicator is set to 1, the CQICH_Control IE follows. |
| if (CQICH indicator == 1) { | — | — |
| **Allocation Index** | 6 bits | Index to the channel in a frame the CQI report should be transmitted by the MS. |
| **Period (p)** | 2 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the MS in every $2^p$ frames. |
| **Frame offset** | 3 bits | The MS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the MS should start reporting in eight frames. |
| **Duration (d)** | 4 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the MS for $2^{(d-I)}$ frames. If d is 0b1111, the MS should report until the BS commands the MS to stop. |
| } else { | — | — |
| ~~*Reserved*~~ **CQI reporting threshold** | 3 bits | ~~Shall be set to zero.~~ A threshold used by an MS to report its CINR using CQI channel; If 0b000, this threshold is neglected. SS shall treat these bits as *reserved* and shall be set to zero. |
| } | — | — |
| } | — | — |

***Insert the following definition to the end of the subclause (following "Duration" definition):***

**CQI reporting threshold**

Used by the MS to determine whether it reports current channel measurement through CQI channel if allocated in the future. If the value is set to 0b000, this threshold is inactive afterwards; otherwise it is activated. SS shall treat these bits as reserved and shall be set to zero.

***Insert the following new table:***

### Table 95a—Threshold Values

| Value (binary) | CINR (dB) |
|---|---|
| 000 | CQT inactivated |
| 001 | –6.0 |
| 010 | –4.0 |
| 011 | –2.0 |
| 100 | –0.0 |
| 101 | 2.0 |
| 110 | 4.0 |
| 111 | 6.0 |

### 6.3.2.3.43.6 Compact_DL-MAP IE

### 6.3.2.3.43.6.1 Compact_DL-MAP IE for normal subchannel

***Change the first paragraph as indicated:***

The format of Compact DL-MAP IE for normal subchannel is presented in Table 96. The direction of slot allocation for downlink is along with the subchannel index first and then the symbol index. The direction of data mapping shall be according to 8.4.3.4.

### Table 96—~~H-ARQ~~HARQ Compact_DL-MAP IE format for normal subchannel

| Syntax | Size | Notes |
|---|---|---|
| Compact_DL-MAP_IE () { | — | — |
| **DL-MAP Type =0** | 3 bits | — |
| **UL-MAP append** | 1 bit | — |
| **RCID_IE** | *variable* | — |
| if (HARQ mode = 0) { | — | — |
| **$N_{EP}$ code** | 4 bits | Code of encoder packet bits (see 8.4.9.2.3.5) |
| **$N_{SCH}$ code** | 4 bits | Code of allocated subchannels (see 8.4.9.2.3.5) |
| } else if (HARQ mode = 1) { | — | — |
| **Shortened DIUC** | 3 bits | Shortened DIUC |
| **Companded SC** | 5 bits | Code of allocated subchannels (see 8.4.9.5) |
| } | — | — |
| **~~H-ARQ~~HARQ_Control_IE** | *variable* | — |

**Table 96—~~H-ARQ~~HARQ Compact_DL-MAP IE format for normal subchannel *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **CQICH_Control_IE** | *variable* | — |
| if (UL-MAP append) { | — | — |
| if (HARQ mode = 0) { | — | CTC IR |
| $N_{EP}$ **code for UL** | 4 bits | Code of encoder packet bits (see 8.4.9.2.3.5) |
| $N_{SCH}$ **code for UL** | 4 bits | Code of allocated subchannels (see 8.4.9.2.3.5) |
| }else if (HARQ mode = 1) { | — | Generic Chase |
| **Shortened UIUC** | 3 bits | Shortened UIUC |
| **Companded SC** | 5 bits | Code of allocated subchannels (see 8.4.9.5) |
| } | — | — |
| **~~H-ARQ~~HARQ_Control_IE for UL** | *variable* | — |
| } | — | — |
| } | — | — |

**DL-MAP Type**

~~This~~ The DL-MAP Type value specifies the type of the ~~C~~compact_DL-MAP IE. A value of 0 indicates the Normal Subchannel.

**UL-MAP append**

A value of 1 indicates the uplink access information is appended to the end of the DL-MAP IE.

**RCID_IE**

Represent the assignment of the IE.

**$N_{EP}$ code, $N_{SCH}$ code**

The combination of $N_{EP}$ code and $N_{SCH}$ code indicates the number of allocated subchannels and scheme of coding and modulation for the DL burst.

**Shortened DIUC**

A shortened version of the DIUC. The shortened DIUC takes on values 0..7 of the DIUC as defined in the DCD. See 8.4.5.3.1.

**Companded SC**

The Companded SC indicates the number of allocated subchannels.

**$N_{EP}$ code for UL, $N_{SCH}$ code for UL**

The combination of $N_{EP}$ code and $N_{SCH}$ code indicates the number of allocated subchannels and scheme of coding and modulation for the UL burst.

**Shortened UIUC**

A shortened version of the UIUC. The shortened UIUC takes on values 1..8 of the UIUC as defined in the UCD. See 8.4.5.4.1.

**Companded SC**

The Companded SC indicates the number of allocated subchannels.

### 6.3.2.3.43.6.2 Compact_DL-MAP IE for Band AMC Subchannel

***Change the first paragraph as indicated:***

Slots for downlink AMC zone are allocated along the subchannel index first within a band. The direction of data mapping for downlink AMC zone slots shall be frequency first (across bands when multiple bands are allocated). The format of Compact DL-MAP IE for Band AMC Subchannel is presented in Table 97.

**Table 97—~~H-ARQ~~ HARQ Compact_DL-MAP IE format for band AMC**

| Syntax | Size | Notes |
|---|---|---|
| Compact_DL-MAP_IE () { | — | — |
| **DL-MAP Type =1** | 3 bits | — |
| *Reserved* | 1 bit | Shall be set to zero |
| **RCID_IE** | *variable* | — |
| if (HARQ mode = 0) { | — | CTC IR |
| **$N_{EP}$ code** | 4 bits | Code of encoder packet bits (see 8.4.9.2.3.5) |
| **$N_{SCH}$ code** | 4 bits | Code of allocated subchannels (see 8.4.9.2.3.5) |
| } else if (HARQ mode = 1) { | — | Generic Chase |
| **Shortened DIUC** | 3 bits | Shortened DIUC |
| **Companded SC** | 5 bits | Code of allocated subchannels (see 8.4.9.5) |
| } | — | — |
| **Nband** | Nb-Band | Number of bands, 0 = use BITMAP instead |
| if (Nband == 0) { | — | — |
| **Band BITMAP** | Nb-BITMAP | *n*-th LSB is 1 if *n*-th band is selected |
| } else { | — | — |
| for (i=0;i< Nband ; i++) | — | — |
| **Band Index** | Nb-Index | Band selection. |
| } | — | — |
| **Allocation Mode** | 2 bits | Indicates the subchannel allocation mode.<br>0b00 = same number of subchannels for the selected bands<br>0b01 = different number of subchannels for the selected bands<br>0b10 = total number of subchannels for the selected bands determined by $N_{SCH}$ code and $N_{EP}$ code<br>0b11 = *Reserved* |
| *Reserved* | 2 bits | Shall be set to zero |
| if (Allocation Mode == 0b00){ | — | — |
| **No. Subchannels** | 8 bits | — |
| } else if (Allocation Mode == 0b01){ | — | — |
| for (i=0;i< band count; i++) | — | If Nband is 0, band count is the number of 1 in Band BITMAP. Otherwise band count is Nband. |

**Table 97—~~H-ARQ~~ HARQ Compact_DL-MAP IE format for band AMC *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **No. Subchannels** | 8 bits | — |
| } | — | — |
| **HARQ_Control_IE** | *variable* | — |
| **CQICH_Control_IE** | *variable* | — |
| } | — | — |

**DL-MAP Type**

~~This~~ The DL-MAP Type value specifies the type of the Compact DL-MAP IE. A value of 1 indicates the Band AMC Subchannel.

**RCID_IE**

Represent the assignment of the IE.

**$N_{EP}$ code, $N_{SCH}$ code**

The combination of $N_{EP}$ code and $N_{SCH}$ code indicates the number of allocated subchannels and scheme of coding and modulation for the DL burst.

**Shortened DIUC**

A shortened version of the DIUC. The shortened DIUC takes on values 0..7 of the DIUC as defined in the DCD. See 8.4.5.3.1.

**Companded SC**

The Companded SC indicates the number of allocated subchannels.

**Nband**

Indicates the number of bands selected for the burst. If this value is set to 0, the Band BITMAP is used to indicate the number and the position of selected bands instead. The number of the maximum logical bands determines the length of this field.

**Band BITMAP**

~~This~~ The Band BITMAP is valid when Nband is 0. The *n*-th LSB of the Band BITMAP is set to 1 when the *n*-th logical band is selected for the burst. If the number of the maximum logical bands is 12 then the length of the Band BITMAP is 12 bits. The band count is set to the number of 1s in the Band BITMAP. The number of the maximum logical bands determines the length of this field.

**Band Index**

~~This~~ The Band Index value indexes the selected band offset and is valid when Nband is larger than 0. The number of the maximum logical bands determines the length of this field.

**Allocation Mode**

~~This~~ The Allocation Mode value indicates the subchannel allocation mode in the selected bands. The value is set to ~~binary 00~~ 0 when the same numbers of subchannels are allocated in the selected bands by the ~~following~~ field 'No. Subchannels'. The value is set to 0b01 when different numbers of subchannels are allocated in each of the selected bands by the following fields 'No. Subchannels'. The value is set to 0b10 when the total number of subchannels allocated in the selected bands is defined by $N_{SCH}$ code and $N_{EP}$ code. The subchannels fill from the bands with lowest index.

**No. Subchannels**

~~This~~ The No. Subchannels value indicates the number of subchannels allocated for this burst.

***Delete Figure 23—Subchannel allocation modes of Compact DL-MAP_IE for Band AMC.***

### 6.3.2.3.43.6.3 Compact_DL-MAP IE for safety subchannel

***Change Table 98 as indicated:***

**Table 98—HARQ Compact_DL-MAP IE format for safety**

| Syntax | Size | Notes |
|---|---|---|
| Compact_DL-MAP_IE () { | — | — |
| **DL-MAP Type =2** | 3 bits | — |
| **UL-MAP append** | 1 bit | — |
| **RCID_IE** | *variable* | — |
| if (HARQ mode = 0) { | — | CTC IR |
| **$N_{EP}$ code** | 4 bits | Code of encoder packet bits (see 8.4.9.2.3.5) |
| **$N_{SCH}$ code** | 4 bits | Code of allocated subchannels (see 8.4.9.2.3.5) |
| } else if (HARQ mode = 1) { | — | Generic Chase |
| **Shortened DIUC** | 3 bits | Shortened DIUC |
| **Companded SC** | 5 bits | Code of allocated subchannels (see 8.4.9.5) |
| } | — | — |
| **BIN offset** | 8 bits | — |
| **~~H-ARQ~~HARQ_Control_IE** | *variable* | — |
| **CQICH_Control_IE** | *variable* | — |
| if (UL-MAP append) { | — | — |
| if (HARQ mode = “CTC IR”) { | — | — |
| **$N_{EP}$ code for UL** | 4 bits | Code of encoder packet bits (see 8.4.9.2.3.5) |
| **$N_{SCH}$ code for UL** | 4 bits | Code of allocated subchannels (see 8.4.9.2.3.5) |
| }else if (HARQ mode = “Generic”) { | — | — |
| **ShortenedUIUC** | 3 bits | Shortened UIUC |
| **Companded SC** | 5 bits | Code of allocated subchannels (see 8.4.9.5) |
| } | — | — |
| **BIN offset for UL** | 8 bits | — |
| **~~H-ARQ~~HARQ_Control_IE for UL** | *variable* | — |
| } | — | — |
| } | — | — |

**DL-MAP Type**

~~This~~ The DL-MAP Type value specifies the type of the ~~C~~compact_DL-MAP IE. A value of 2 indicates the Safety Subchannel.

**RCID_IE**
Represent the assignment of the IE.

**$N_{EP}$ code, $N_{SCH}$ code**
The combination of $N_{EP}$ code and $N_{SCH}$ code indicates the number of allocated subchannels and scheme of coding and modulation for the DL burst.

**Shortened DIUC**
A shortened version of the DIUC. The shortened DIUC takes on values 0..7 of the DIUC as defined in the DCD. See 8.4.5.3.1.

**Companded SC**
The Companded SC indicates the number of allocated subchannels.

**BIN Offset**
The offset of the BIN allocated for this DL burst. See appropriate specification.

**$N_{EP}$ code for UL, $N_{SCH}$ code for UL**
The combination of $N_{EP}$ code and $N_{SCH}$ code indicates the number of allocated subchannels and scheme of coding and modulation for the UL burst.

**Shortened UIUC**
A shortened version of the UIUC. The shortened UIUC takes on values 1..8 of the UIUC as defined in the UCD. See 8.4.5.4.1.

**Companded SC**
The Companded SC indicates the number of allocated subchannels.

**BIN Offset for UL**
The offset of the BIN allocated for this UL burst. See appropriate specification.

#### 6.3.2.3.43.6.4Compact DL-MAP IE for DIUC subchannel

*Change Table 99 as indicated:*

**Table 99—~~H-ARQ~~ HARQ Compact_DL-MAP IE format for DIUC subchannel**

| Syntax | Size | Notes |
|---|---|---|
| Compact_DL-MAP_IE () { | | |
| **DL-MAP IE Type = 3** | 3 bits | |
| *Reserved* | 1 bit | Shall be set to zero |
| **DIUC** | 4 bits | |
| if (DIUC == 15) { | | |
| **Extended DIUC dependent IE()** | variable | |
| } else { | | |
| **RCID_IE** | *variable* | |
| **No. Subchannels** | 8 bits | The number of subchannels allocated by the IE |
| **Repetition coding indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| *Reserved* | 2 bits | Shall be set to zero |
| } | | |

**Table 99—~~H-ARQ~~ HARQ Compact_DL-MAP IE format for DIUC subchannel *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **H-ARQ_Control_IE** | *variable* | |
| **CQICH_Control_IE** | *variable* | |
| } | | |

***Insert the following text below Table 99:***

**Repetition coding indication**
Indicates the repetition code used inside the allocated burst.

### 6.3.2.3.43.6.5 Compact DL-MAP IE for HARQ ACK BITMAP

***Change the second paragraph as indicated:***

For example, when an SS transmits a ~~H-ARQ~~ HARQ enabled burst at *i*-th frame and the burst is *j*-th ~~H-ARQ~~ HARQ enabled burst in the MAP, the SS should receive ~~H-ARQ~~ HARQ ACK at *j*-th LSB bit of the BITMAP, which is sent by the BS at *i*+(frame offset)-th frame. If the HARQ ACK BITMAP is omitted, the HARQ enabled SS shall retain the transmitted HARQ burst and retransmit it when the BS requests retransmission with HARQ Control IE.

***Change the description of the "BITMAP" field below Table 100 as indicated:***

**BITMAP**
Includes ~~H-ARQ~~ HARQ ACK information for ~~H-ARQ~~ HARQ enabled UL bursts. The size of BITMAP should be equal or larger than the number of ~~H-ARQ~~ HARQ enabled UL-bursts. The *j*-th HARQ enabled burst in the UL-MAP is corresponding to the *j*-th LSB in the BITMAP.

***Insert the following text at the end of 6.3.2.3.43.6.5:***

Whenever HARQ enabled UL-SDMA allocations are made within a frame, the ACK BITMAP Length shall be large enough to carry the ACKs for the both the SDMA and non-SDMA allocations. Also, the ACKs for the SDMA users allocated on the second layer shall be appended to the ACKs for the non-SDMA and first-layer SDMA users.

### 6.3.2.3.43.6.6 Compact DL-MAP IE for extension

*Insert the following table at the end of 6.3.2.3.43.6.6:*

**Table 101a—DL-MAP Subtypes**

| DL-MAP subtype | Description |
|---|---|
| 0 | TimeDiversity_MBS |
| 1 | HARQ mode switch |
| 2–31 | Reserved |

*Insert new subclause 6.3.2.3.43.6.7:*

### 6.3.2.3.43.6.7 MIMO Compact_DL-MAP IE format

When MIMO enabled DL burst are present within a frame, they shall be allocated before non-MIMO DL burst in both diversity and AMC zones. Figure 23a exemplifies the DL HARQ subframe structure, where the optional MIMO midamble is shown and 2x3 AMC type is depicted. Both MIMO diversity and MIMO AMC zones shall contain even number of symbols. For any remaining physical resources for each zone, padding subchannels shall be allocated to the region.

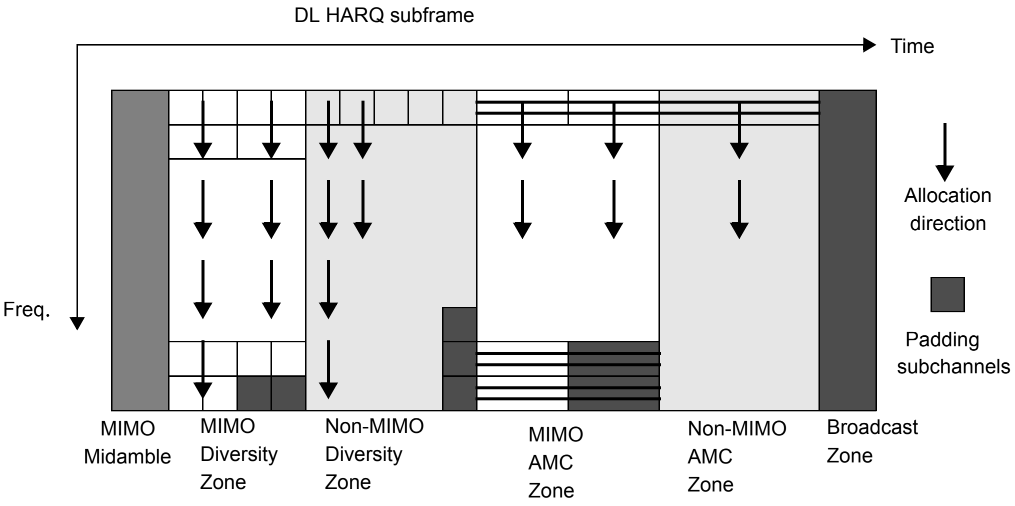

DL HARQ subframe
Time
Freq.
Allocation direction
Padding subchannels
MIMO Midamble
MIMO Diversity Zone
Non-MIMO Diversity Zone
MIMO AMC Zone
Non-MIMO AMC Zone
Broadcast Zone

Figure 23a—Downlink HARQ subframe structure

Each MIMO enabled DL burst shall be first allocated by the regular Compact_DL-MAP IE for diversity subchannels (see Table 94) and AMC subchannels (see Table 95), followed by the extended MIMO Compact_DL-MAP IE. The format of MIMO Compact_DL-MAP IE is presented in Table 101b. This extended IE shall follow right after the basic allocation IE for each MIMO enabled DL burst.

### Table 101b—MIMO Compact_DL-MAP IE

| Syntax | Size | Notes |
|---|---|---|
| MIMO_Compact_DL-MAP_IE() { | — | — |
| **Compact DL-MAP Type** | 3 bits | Type = 7 |
| **DL-MAP Sub-type** | 5 bits | MIMO = 0x01 |
| **Length** | 4 bits | Length of the IE in Bytes |
| **Mode Change** | 1 bit | Indicates change of MIMO mode<br>0b0 = No change from previous allocation<br>0b1 = Change of MIMO mode |
| **Antenna Grouping/Selection** | 1 bit | Application of antenna grouping/selection to the burst<br>0b0 = Not applied<br>0b1 = AG/AS applied |
| **Codebook based Precoding** | 1 bit | Application of codebook based precoding to the burst<br>0b0 = Not applied<br>0b1 = Codebook based precoding applied |
| **N_layer** | 2 bits | Number of multiple coding/modulation layers<br>0b00 – 1 layer<br>0b01 – 2 layers<br>0b10 – 3 layers<br>0b11 – 4 layers |
| if( Mode Change == 1){ | — | — |
| **Mt** | 2 bits | Indicates number of STC output streams<br>0b00 = 1 stream<br>0b01 = 2 streams<br>0b10 = 3 streams<br>0b11 = 4 streams |
| If (N_Layer == 0b00) { | — | — |
| If (Mt==0b01){ | — | — |
| **Matrix** | 2 bits | Indicates transmission matrix (See 8.4.8)<br>0b00 = Matrix A (Transmit Diversity)<br>0b01 = Matrix C (Vertical Encoding)<br>0b10–11 = *Reserved* |
| } elseif (Mt==0b10 \|\| Mt==10b1){ | — | — |
| **Matrix** | 2 bits | Indicates transmission matrix (See 8.4.8)<br>0b00 = Matrix A (Transmit Diversity)<br>0b01 = Matrix B (Vertical Encoding)<br>0b10 = Matrix C (Vertical Encoding)<br>0b11 = *Reserved* |
| } | — | — |
| } elseif (N_Layer == 0b01) { | — | — |
| If (Mt==01){ | — | — |
| **Matrix** | 2 bits | — |
| } elseif (Mt==10 \|\| Mt==11){ | — | — |

### Table 101b—MIMO Compact_DL-MAP IE *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Matrix** | 2 bits | Indicates transmission matrix (See 8.4.8)<br>0b00 = Matrix B (Horizontal Encoding)<br>0b01–11 = *Reserved* |
| } | — | — |
| } elseif (N_Layer == 0b10) { | — | — |
| if (Mt==10\|\| Mt==0b11){ | — | — |
| **Matrix** | 2 bits | Indicates transmission matrix (See 8.4.8)<br>0b00 = Matrix C (Horizontal Encoding)<br>0b01–11 = *Reserved* |
| } | — | — |
| } elseif (N_Layer == 0b11) { | — | — |
| if (Mt==0b11){ | — | — |
| **Matrix** | 2 bits | Indicates transmission matrix (See 8.4.8)<br>0b00 = Matrix C (Horizontal Encoding)<br>0b01–11 = *Reserved* |
| } | — | — |
| } | — | — |
| if (Antenna Grouping/Selection == 1) { | — | — |
| If (N_Layer == 0b00) { | — | — |
| If (Mt==0b10){ | — | — |
| **Antenna Grouping/Selection Index** | 4 bits | Indicates the index of antenna grouping/ selection. See 8.4.8.3.4 and 8.4.8.3.5<br>0b0000 = A1<br>0b0001 = A2 (Vertical Encoding)<br>0b0010 = A3 (Vertical Encoding)<br>0b0011 = B1 (Vertical Encoding)<br>0b0100 = B2 (Vertical Encoding)<br>0b0101 = B3 (Vertical Encoding)<br>0b0110–111 = *Reserved* |
| } elseif (Mt==11){ | — | — |
| **Antenna Grouping/Selection Index** | 4 bits | Indicates the index of antenna grouping/ selection. See 8.4.8.3.4 and 8.4.8.3.5<br>0b0000 = A1<br>0b0001 = A2<br>0b0010 = A3<br>0b0011 = B1 (Vertical Encoding)<br>0b0100 = B2 (Vertical Encoding)<br>0b0101 = B3 (Vertical Encoding)<br>0b0110 = B4 (Vertical Encoding)<br>0b0111 = B5 (Vertical Encoding)<br>0b1000 = B6 (Vertical Encoding)<br>0b1001–111 = *Reserved* |
| } | — | — |
| } elseif (N_Layer == 0b01) { | — | — |
| If (Mt==0b10){ | — | — |

### Table 101b—MIMO Compact_DL-MAP IE *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Antenna Grouping/Selection Index** | 4 bits | Indicates the index of antenna grouping/ selection. See 8.4.8.3.4 and 8.4.8.3.5<br>0b0000 = B1 (Horizontal Encoding)<br>0b0001 = B2 (Horizontal Encoding)<br>0b0010 = B3 (Horizontal Encoding)<br>0b0011–111 = *Reserved* |
| } elseif (Mt==0b11){ | — | — |
| **Antenna Grouping/Selection Index** | 4 bits | Indicates the index of antenna grouping/ selection. See 8.4.8.3.4 and 8.4.8.3.5<br>0b0000 = B1 (Horizontal Encoding)<br>0b0001 = B2 (Horizontal Encoding)<br>0b0010 = B3 (Horizontal Encoding)<br>0b0011 = B4 (Horizontal Encoding)<br>0b0100 = B5 (Horizontal Encoding)<br>0b0101 = B6 (Horizontal Encoding)<br>0b0110–111 = *Reserved* |
| } | — | — |
| } | — | — |
| } | — | — |
| if (Codebook based precoding == 1) { | — | — |
| **Codebook based precoding Index** | 6 bits | Indicates the index of precoding matrix W in the codebook. See 8.4.8.3.6 |
| } | — | — |
| } | — | — |
| for (j=1;j<N_layer+1; j++) { | — | This loop specifies the $N_{EP}$/DIUC for layers 2 and above when required for STC. The same $N_{SCH}$ and RCID applied for each layer |
| if (HARQ Mode =CTC Incremental Redundancy) { | 4 bits | HARQ Mode is specified in the HARQ Compact_DL-MAP IE format for Switch HARQ Mode.\ |
| $\mathbf{N_{EP}}$ | 4 bits | — |
| } Else if (HARQ Mode = Generic Chase) { | — | — |
| **DIUC** | 4 bits | — |
| } | — | — |
| if (CQICH indicator == 1) { | — | CQICH indicator comes from the preceding Compact DL-MAP IE |
| **Allocation Index**[1] | 6 bits | Index to CQICH assigned to this layer |
| } | — | — |
| } | — | — |
| if (CQICH indicator == 1) { | 2 bits | The number of additional CQICHs allocated to this MS. (0 – 3) |
| **CQICH_Num** | 2 bits | The number of additional CQICHs allocated to this MS. (0 – 3) |

**Table 101b—MIMO Compact_DL-MAP IE *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| for (i=0; i<CQICH_Num; i++) { | — | — |
| **Feedback_type** | 3 bits | Type of contents on the additional CQICH from MS<br>0b000 = Fast DL measurement/Default Feedback with antenna grouping<br>0b001 = Fast DL measurement/Default Feedback with antenna selection<br>0b010 = Fast DL measurement/Default Feedback with reduced codebook<br>0b011 = Quantized precoding weight feedback<br>0b100 = Index to precoding matrix in codebook<br>0b101 = Channel Matrix Information<br>0b101 = Per stream power control<br>0b110–0b111 = *Reserved* |
| **Allocation index** | 6 bits | — |
| **CQICH Usage** | 3 bits | Indicates the usage of this CQICH<br>0b000 = 6-bit CQI (default)<br>0b001 = *Reserved*<br>0b010 = 3-bit CQI (even)<br>0b011 = 3-bit CQI(odd)<br>0b100 = 6-bit CQI (primary)<br>0b101 = 6-bit CQI (secondary)<br>0b110–0b111 = *Reserved.* |
| } | — | — |
| } | — | — |
| **Padding** | *variable* | Padding to byte; shall be set to 0 |
| } | — | — |

**Matrix Indicator**

This field indicates MIMO matrix for the burst.

**Antenna Grouping/Selection Index**

The ‘Antenna Grouping/Selection Index’ field indicates antenna grouping/selection index for the current burst. For the actual description of the following matrices, see 8.4.8.3.4 and 8.4.8.3.5.

**Allocation Index**[1]

Indicates position from the start of the CQICH region.
The Feedback type of this CQICH shall be one of the three default types (type 0b000, 0b001, 0b010) according to the following rule:
Feedback type = 0b000 if ((Antenna Grouping/Selection == 1) and (matrix == A or B))
Feedback type = 0b001 if ((Antenna Grouping/Selection == 1) and (matrix == C))
Feedback type = 0b010 if ((Codebook based precoding == 1))

**Feedback Type**

Indicates the type of feedback content on the allocated CQICH from MS. Its mapping shall be

0b000 = Fast DL measurement/Default Feedback with antenna grouping
0b001 = Fast DL measurement/Default Feedback with antenna selection
0b010 = Fast DL measurement/Default Feedback with reduced codebook
0b011 = Quantized precoding weight feedback
0b100 = Index to precoding matrix in codebook
0b101 = Channel Matrix Information
0b110 ~ 0b111 = Reserved

When the feedback type is either 0b000, 0b001, or 0b010, the MS shall transmit either the regular S/N measurement using the formula in 8.4.5.4.10.5 in its lower 32 codewords in 8.4.5.4.10.4, or the MIMO mode feedback of the specified type in its upper 32 codewords according to Table 296d in 8.4.5.4.10.7.

For each layer, a codeword shall be constructed according to 8.4.9.2.3.5 with the $N_{EP}$ and $N_{SCH}$ combination and mapped onto the corresponding layer. Multiple codewords from multiple layers shall be interpreted as one HARQ channel whose parameters are given in the preceding Compact DL-MAP IE.

At the receiver, an ACK shall be transmitted only when there is no CRC error detected on every layer. Otherwise, a NACK shall be transmitted.

SDMA transmissions may be allocated on the downlink with the SDMA Compact DL-MAP IE (Table 101c). Num_layer means the number of SDMA layers (2, 3, or 4) being allocated. For each SDMA layer, if the dedicated pilot bit is set to 1 in the STC_ZONE IE (8.4.5.3.4) for the zone in which the SDMA allocations are being made, Num_layer selects the pilot format for the burst by interpreting Num_layer as the number of transmit antennas (as defined in 8.4.8), and the MS with the first RCID shall be assigned the pilot pattern corresponding to antenna 1, of 8.4.8, the second to the pilot pattern corresponding to antenna 2, and so on.

**Table 101c—SDMA Compact_DL-MAP IE format**

| Syntax | Size | Notes |
|---|---|---|
| SDMA_Compact_DL-MAP_IE() { | — | — |
| **Compact DL-MAP Type** | 3 bits | Type = 7 |
| **DL-MAP sub-type** | 5 bits | SDMA = 0x03 |
| **Length** | 4 bits | Length of the IE in bytes |
| **Num_layers** | 2 bits | Number of multiple coding/modulation layers:<br>0b00 = 1 layer<br>0b01 = 2 layers<br>0b10 = 3 layers<br>0b11 = 4 layers |
| **Padding** | 2 bits | Shall be set to zero. |
| for (j=1; j<Num_layer; j++) { | — | This loop specifies the $N_{EP}$ for layers 2 and above when required for STC. The same $N_{SCH}$ and RCID applied for each layer |
| **RCID** | *variable* | MS identifier for the current layer of the SDMA allocation |
| **if (HARQ Mode =CTC Incremental Redundancy) { $N_{EP}$ } elseif (HARQ Mode = Generic Chase) { DIUC }** | 4 bits | HARQ Mode is specified in the HARQ Compact_DL-MAP IE format for Switch HARQ Mode |

**Table 101c—SDMA Compact_DL-MAP IE format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **CQI Feedback_type** | 3 bits | Type of contents on CQICH for this MS<br>0b000 = Default feedback<br>0b001 = Precoding weight matrix W<br>0b010 = Channel matrix H<br>0b011 = MIMO mode and permutation zone<br>0b100–0b111 = Reserved |
| **CQICH_Num** | 2 bits | Total number of CQICHs assigned to this MS is (CQICH_Num +1) |
| **for (i=1;i<CQICH_Num;i++) {** | — | — |
| **Allocation index** | 6 bits | Index to uniquely identify the additional CQICH resources assigned to the MS |
| } | | |
| **Padding** | *variable* | The padding bits are used to ensure the contents within each layer loop are an integer number of bytes. Shall be set to zero |
| } | — | — |
| } | — | — |

***Insert new subclause 6.3.2.3.43.6.8:***

### 6.3.2.3.43.6.8 HARQ Compact_DL-MAP IE format for Switch HARQ Mode

In the HARQ-MAP, a BS may transmit DL-MAP Type = 7 with the Switch HARQ mode IE. Allocations subsequent to this IE shall be for the HARQ mode identified.

**Table 101d—HARQ Compact_DL-MAP IE format for switch HARQ mode**

| Syntax | Size | Notes |
|---|---|---|
| Compact_DL-MAP_IE () { | — | — |
| **DL-MAP Type = 7** | 3 bits | — |
| **DL-MAP subtype** | 5 bits | Extension subtype Value = 1 |
| **Length** | 4 bits | Length of the IE in Bytes |
| **HARQ mode** | 4 bits | Subtype dependent payload |
| } | — | — |

**DL-MAP Type**
The DL-MAP Type value specifies the type of the C~~c~~ompact_DL-MAP IE. A value of 7 indicates the extension type.

**DL-MAP Subtype**
The DL-MAP Subtype value specifies the extended map type defined in Table 101a as HARQ mode switch.

**Length**

This indicates the length of this IE in Bytes. This is encoded as 2.

**HARQ mode**

The HARQ mode is a 4-bit value that specifies the HARQ mode for all subsequent Compact_DL-MAP IEs to the end of the current HARQ map. See 8.4.9.5 for encoding of this value.

***Insert new subclause 6.3.2.3.43.6.9:***

### 6.3.2.3.43.6.9 HARQ Compact MBS MAP IE

Table 101e—HARQ Compact MBS_MAP_IE format for extension

| Syntax | Size | Notes |
|---|---|---|
| Compact MBS_MAP_IE{ | — | — |
| **DL_MAP Type = 3** | 3 bits | — |
| **Multicast CID** | 12 bits | 12 LSBs of CID for multicast |
| **MBS Zone Identifier** | 7 bits | — |
| **Macro diversity enhanced** | 1 bit | — |
| If (macro diversity enhanced = 1){ | — | — |
| **Permutation** | 2 bits | — |
| **Idcell** | 6 bits | — |
| **OFDMA Symbol Offset** | 8 bits | OFDMA symbol offset with respect to start of the MBS portion |
| **N_EP code** | 4 bits | The combination of $N_{EP}$ code and $N_{SCH}$ code indicates the number of allocated subchannels and scheme of coding and modulation for the MBS_MAP message in MBS portion |
| **N_SCH code** | 4 bits | — |
| } else { | — | — |
| **N_EP** | 4 bits | The combination of $N_{EP}$ code and $N_{SCH}$ code indicates the number of allocated subchannels and scheme of coding and modulation for the DL burst |
| **N_SCH code** | 4 bits | — |
| **AI_SN** | 1 bits | — |
| **SPID** | 2 bits | — |
| **ACID** | 4 bits | — |
| **Next MBS frame offset** | 8 bits | The Next MBS frame offset value is lower 8 bits of the frame number in which the BS shall transmit the next MBS frame |
| **Next MBS OFDMA Symbol offset** | 8 bits | The offset of the OFDMA symbol in which the next MBS portion starts, measured in OFDMA symbols from the beginning of the downlink frame in which the MBS_MAP is transmitted |
| } | — | — |
| if !(byte boundary) { | — | — |

**Table 101e—HARQ Compact MBS_MAP_IE format for extension *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **Padding Nibble** | *variable* | Padding to reach byte boundary |
| } | — | — |
| } | — | — |

**AI SN**

Defines ARQ Identifier Sequence Number. This is toggled between 0 and 1 on successfully transmitting each encoder packet with the same ARQ channel.

**SPID**

Defines SubPacket ID, which is used to identify the four subpackets generated from an encoder packet.

**ACID**

Defines ARQ Channel ID for TimeDiversity MBS packet. Each TimeDiversity MBS connection can have multiple ARQ channels, each of which may have an encoder packet transaction pending.

The MBS burst indicated by the HARQ Compact MBS_MAP_IE is encoded at the same way of HARQ. But it does not need the acknowledgement from MS.

### 6.3.2.3.43.7 UL-MAP_IE

### 6.3.2.3.43.7.1 Compact UL-MAP IE for normal subchannel

***Change the first paragraph as indicated:***

The format of Compact UL-MAP IE for normal subchannel is presented in Table 102. The direction of slot allocation and the direction of data mapping for uplink shall be according to 8.4.3.4.

***Change Table 102 and the text that follows as indicated:***

**Table 102—~~H-ARQ~~ HARQ Compact_UL-MAP IE format for normal subchannel**

| Syntax | Size | Notes |
|---|---|---|
| Compact_UL-MAP_IE () { | — | — |
| **UL-MAP Type =0** | 3 bits | — |
| *Reserved* | 1 bit | Shall be set to zero |
| **RCID_IE** | *variable* | — |
| if (HARQ mode = 0) { | — | CTC IR |
| **$N_{EP}$ code** | 4 bits | Code of encoder packet bits (see 8.4.9.2.3.5) |
| **$N_{SCH}$ code** | 4 bits | Code of allocated subchannels (see 8.4.9.2.3.5) |
| } else if (HARQ mode = 1) { | — | Generic Chase |
| **Shortened UIUC** | 4 bits | Shortened UIUC |
| **Companded SC** | 4 bits | Code of allocated subchannels (see 8.4.9.5) |

**Table 102—~~H-ARQ~~ HARQ Compact_UL-MAP IE format for normal subchannel *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| } | — | — |
| ~~H-ARQ~~HARQ_Control_IE | *variable* | — |
| } | — | — |

**UL-MAP Type**

~~This~~ The UL-MAP Type value specifies the type of the compact UL-MAP IE. A value of 0 indicates the Normal Subchannel.

**RCID_IE**

Represent the assignment of the IE.

**$N_{EP}$ code, $N_{SCH}$ code**

The combination of $N_{EP}$ code and $N_{SCH}$ code indicates the number of allocated subchannels and scheme of coding and modulation for the UL burst.

**Shortened UIUC**

A shortened version of the UIUC. The shortened UIUC takes on values 1..8 of the UIUC as defined in the UCD. See 8.4.5.4.1.

**Companded SC**

The Companded SC indicates the number of allocated subchannels.

### 6.3.2.3.43.7.2 Compact UL-MAP IE for Band AMC Subchannel

***Change the first paragraph as indicated:***

The format of Compact UL-MAP IE for Band AMC Subchannel is presented in Table 103. Slots for uplink AMC zone are allocated along the symbol index first within a band. The direction of data mapping for uplink AMC zone slots shall be frequency first (across bands when multiple bands are allocated).

***Change Table 103 and the text that follows as indicated:***

**Table 103—~~H-ARQ~~ HARQ Compact_UL-MAP IE format for band AMC**

| Syntax | Size | Notes |
|---|---|---|
| Compact_UL-MAP_IE () { | — | — |
| **UL-MAP Type =band** | 3 bits | — |
| *Reserved* | 1 bit | Shall be set to zero |
| **RCID_IE** | *variable* | — |
| if (HARQ mode = 0) { | — | CTC IR |
| **$N_{EP}$ code** | 4 bits | Code of encoder packet bits (see 8.4.9.2.3.5) |
| **$N_{SCH}$ code** | 4 bits | Code of allocated subchannels (see 8.4.9.2.3.5) |
| } else if (HARQ mode = 1) { | — | Generic Chase |
| **Shortened UIUC** | 3 bits | Shortened UIUC |
| **Companded SC** | 5 bits | Code of allocated subchannels (see 8.4.9.5) |

**Table 103—~~H-ARQ~~ HARQ Compact_UL-MAP IE format for band AMC *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| } | — | — |
| **Nband** | Nb-Band | Indicates the number of selected bands.<br>0 = BITMAP indicates the number and offset of selected bands |
| if (Nband == 0) { | — | — |
| **Band BITMAP** | Nb-BITMAP | *n*-th LSB is 1 if *n*-th band is selected |
| } else { | — | — |
| for (i=0;i< Nband ; i++) | — | — |
| **Band Index** | Nb-Index | Band selection. |
| } | — | — |
| **Allocation Mode** | 2 bits | Indicates the subchannel allocation mode.<br>0b00 = same number of subchannels for the selected bands<br>0b01 = different number of subchannels for the selected bands<br>0b10 = total number of subchannels for the selected bands determined by $N_{SCH}$ code<br>0b11 = *Reserved* |
| *Reserved* | 2 bits | Shall be set to zero |
| if (Allocation Mode == 0b00){ | — | — |
| **No. Subchannels** | 8 bits | — |
| } else if (Allocation Mode == 1){ | — | — |
| for (i=0;i< band count; i++) | — | If Nband is 0, band count is the number of 1 in Band BITMAP. Otherwise band count is Nband. |
| **No. Subchannels** | 8 bits | — |
| } | — | — |
| **~~H-ARQ~~HARQ_Control_IE** | *variable* | — |
| } | — | — |

**UL-MAP Type**

~~This~~ The UL-MAP Type value specifies the type of the compact UL-MAP IE. A value of 1 indicates the Band AMC Subchannel.

**RCID_IE**

Represent the assignment of the IE.

**$N_{EP}$ code, $N_{SCH}$ code**

The combination of $N_{EP}$ code and $N_{SCH}$ code indicates the number of allocated subchannels and scheme of coding and modulation for the UL burst.

**Shortened UIUC**
A shortened version of the UIUC. The shortened UIUC takes on values 1..8 of the UIUC as defined in the UCD. See 8.4.5.4.1.

**Companded SC**
The Companded SC indicates the number of allocated subchannels.

**Nband**
Indicates the number of bands selected for the burst. If this value is set to 0, the Band BITMAP is used to indicate the number and the position of selected bands instead. The number of the maximum logical bands determines the length of this field.

**Band BITMAP**
~~This~~ The Band BITMAP is valid when Nband is 0. The *n*-th LSB of the Band BITMAP is set to 1 when the *n*-th logical band is selected for the burst. If the number of the maximum logical bands is 12 then the length of the Band BITMAP is 12 bits. The band count is set to the number of 1s in the Band BITMAP. The number of the maximum logical bands determines the length of this field.

**Band Index**
~~This~~ The Band Index value indexes the selected band offset and is valid when Nband is larger than 0. The number of the maximum logical bands determines the length of this field.

**Allocation Mode**
~~This~~ The Allocation Mode value indicates the subchannel allocation mode in the selected bands. The value is set to 0b00 when the same numbers of subchannels are allocated in the selected bands by the ~~following~~ field ‘No. Subchannels’. The value is set to 0b01 when different numbers of subchannels are allocated in each selected bands by the following fields “No. Subchannels”. The value is set to 0b10 when the total number of subchannels allocated in the selected bands is defined by $N_{SCH}$ code and $N_{EP}$ code. The subchannels fill from the bands with lowest index. The allocation mode variant is shown in Figure 23.

**No. Subchannels**
~~This~~ The No. Subchannels value indicates the number of subchannels allocated for this burst.

### 6.3.2.3.43.7.3 Compact UL-MAP IE for safety subchannel

***Change the first paragraph as indicated:***

The format of Compact UL-MAP IE for safety subchannel is presented in ~~Table 98~~Table 104.

***Change Table 104 and the text that follows as indicated:.***

**Table 104—~~H-ARQ~~ HARQ Compact_UL-MAP IE format for safety**

| Syntax | Size | Notes |
|---|---|---|
| Compact_UL-MAP_IE () { | — | — |
| **UL-MAP Type =2** | 3 bits | — |
| *Reserved* | 1 bit | Shall be set to zero |
| **RCID_IE** | *variable* | — |
| if (HARQ mode = 0) { | — | CTC IR |
| **$N_{EP}$ code** | 4 bits | Code of encoder packet bits (see 8.4.9.2.3.5) |
| **$N_{SCH}$ code** | 4 bits | Code of allocated subchannels (see 8.4.9.2.3.5) |
| } else if (HARQ mode = 1) { | — | Generic Chase |
| **Shortened UIUC** | 3 bits | Shortened UIUC |

**Table 104—~~H-ARQ~~ HARQ Compact_UL-MAP IE format for safety *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **Companded SC** | 5 bits | Code of allocated subchannels (see 8.4.9.5) |
| } | — | — |
| **BIN offset** | 8 bits | — |
| **~~H-ARQ~~HARQ_Control_IE** | *variable* | — |
| } | — | — |

**UL-MAP Type**
~~This~~ The UL-MAP Type value specifies the type of the compact UL-MAP IE. A value of 2 indicates the Safety Subchannel.

**RCID_IE**
Represent the assignment of the IE.

**$N_{EP}$ code, $N_{SCH}$ code**
The combination of $N_{EP}$ code and $N_{SCH}$ code indicates the number of allocated subchannels and scheme of coding and modulation for the UL burst.

**Shortened UIUC**
A shortened version of the UIUC. The shortened UIUC takes on values 1..8 of the UIUC as defined in the UCD. See 8.4.5.4.1.

**Companded SC**
The Companded SC indicates the number of allocated subchannels.

**BIN Offset**
The offset of the BIN allocated for this UL burst.

#### 6.3.2.3.43.7.4 Compact UL-MAP IE for UIUC subchannel

*Change Table 105 as indicated:*

**Table 105—H-ARQ Compact_UL-MAP IE format for UIUC subchannel**

| Syntax | Size | Notes |
|---|---|---|
| Compact_UL-MAP_IE () { | | |
| **UL-MAP Type =4** | 3 bits | |
| *Reserved* | 1 bit | Shall be set to zero |
| **UIUC** | 4 bits | |
| **RCID_IE** | *variable* | |
| if (UIUC == 12) { | | |
| **OFDMA symbol offset** | 8 bits | |
| **Subchannel offset** | 7 bits | |
| **No. OFDMA symbols** | 7 bits | |
| **No. Subchannels** | 7 bits | |

Table 105—H-ARQ Compact_UL-MAP IE format for UIUC subchannel *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Ranging method** | 2 bits | 0b00 - Initial Ranging over two symbols<br>0b01 - Initial Ranging over four symbols<br>0b10 - BW Request/Periodic Ranging over one symbol<br>0b11 - BW Request/Periodic Ranging over three symbols |
| *Reserved* | 1 bit | Shall be set to zero |
| } else if (UIUC == 14) { | | |
| **CDMA_Allocation_IE()** | 32 bits | |
| } | | |
| } else if (UIUC == 15) { | | |
| **Extended UIUC dependent IE()** | *variable* | |
| } else { | | |
| **No. Subchannels** | 8 bits | The number of subchannels allocated by the IE |
| **Repetition coding indication** | 2 bits | 0b00 - No repetition coding<br>0b01 - Repetition coding of 2 used<br>0b10 - Repetition coding of 4 used<br>0b11 - Repetition coding of 6 used |
| *Reserved* | 2 bits | Shall be set to zero |
| } | | |
| **H-ARQ_Control_IE** | *variable* | |
| } | | |

***Insert the following text below Table 105:***

**Repetition coding indication**
Indicates the repetition code used inside the allocated burst.

### 6.3.2.3.43.7.5 Compact UL-MAP IE for ~~H-ARQ~~ HARQ Region allocation

***Insert the following paragraph at the beginning of the subclause:***

HARQ ACK Region shall reside in fast-feedback region. This means that when the Compact UL-MAP IE for HARQ ACK Region indicates a region within the region that is allocated for FAST FEEDBACK, then the region shall be used for HARQ ACK region.

***Change the third paragraph as indicated:***

The ~~H-ARQ~~ HARQ enabled SS that receives ~~H-ARQ~~ HARQ DL burst at *i*-th frame should transmit ACK signal through the half-subchannel in the ~~H-ARQ~~ HARQ region at (*i*+*j*)-th frame. The frame offset "*j*" is defined by the "~~H-ARQ~~ HARQ ACK Delay for DL Burst" field in the UCD message. The half-subchannel offset in the~~H-ARQ~~ HARQ Region is determined by the order of ~~H-ARQ~~ HARQ enabled DL burst in the ~~H-ARQ~~ HARQ MAP. For example, when an SS receives a ~~H-ARQ~~ HARQ enabled burst at *i*-th frame and the burst is *n*-th ~~H-ARQ~~ HARQ enabled burst in the ~~H-ARQ~~ HARQQ MAP, the SS should transmit ~~H-ARQ~~ HARQ ACK at *n*-th half-subchannel in ~~H-ARQ~~ HARQ Region that is allocated by the BS at the (*i*+*j*)-th frame. The Compact MAP IE indexing HARQ burst should set the RCID field to basic CID of an SS, and the prefix field in the HARQ Control IE to 1. Otherwise, the MAP IE shall not be considered as HARQ enabled burst.

***Insert the following text at the end of 6.3.2.3.43.7.5:***

Whenever HARQ enabled DL-SDMA allocations are made within a frame, the ACKs for the SDMA users allocated on the second layer shall be appended to the ACKs for the non-SDMA and first-layer SDMA users.

### 6.3.2.3.43.7.6 Compact UL-MAP IE for CQICH Region Allocation

***Insert the following two paragraphs as the first paragraphs of the subclause:***

When there exist a need to allocate multiple CQICHs to an MS, the number of used subchannels for CQICH region shall be increased by the total number of additional CQICHs for all MS within the frame, and their positions shall be specified by Allocation Indices of their respective MIMO_Compact_DL-MAP IE.

HARQ CQICH region shall reside in fast-feedback region. This means that when the Compact UL-MAP IE for CQICH Region indicates a region within the region that is allocated for fast-feedback channel, then the region shall be used for HARQ CQICH region.

***Change the first paragraph as indicated:***

The CQI region information is delivered through the Compact_UL-MAP_IE as shown in Table 107. SS sends CQI report in CQI region. The CQICH control IE allocates a CQI channel in a CQICH region. When no CQICH Region allocation IE exists in HARQ MAP then fast-feedback region shall be used instead for CQICH region.

### 6.3.2.3.43.7.7 Compact UL-MAP IE for extension

***Insert the following at the end of 6.3.2.3.43.7.7:***

Table 108a represents the extended types of compact DL MAP.

**Table 108a—UL-MAP subtypes**

| **extended compact UL-MAP Type** | **Description** |
|---|---|
| 0 | Switch HARQ Mode |
| 1..7 | *Reserved* |

*Insert new subclause 6.3.2.3.43.7.8:*

#### 6.3.2.3.43.7.8 Compact UL-MAP IE for Allocation start offset

The format of Compact UL-MAP IE for allocation start offset is presented in Table 109.

**Table 109—~~H-ARQ~~ HARQ Compact_UL-MAP IE format for allocation start offset**

| Syntax | Size | Notes |
|---|---|---|
| Compact_UL-MAP_IE () { | | |
| **UL-MAP Type =7** | 3 bits | |
| **UL-MAP subtype** | 5 bits | Extension subtype |
| **Length = 2** | 4 bits | Length of the IE in bytes |
| **Start symbol offset** | 5 bits | Offset from the start of UL sub-frame |
| **Start subchannel offset** | 8 bits | |
| } | | |

**UL-MAP Type**
Specifies the type of the compact UL-MAP IE. A value of 7 indicates the extension type.
**UL-MAP Subtype**
Specifies the subtype of the compact UL-MAP IE.
**Length**
Indicates the length of this IE in bytes. If an SS cannot recognize the UL-MAP Subtype, it skips the IE.
**Start symbol offset**
A subsequent HARQ UL data burst allocation shall start from the symbol specified in the value. However, this value does not affect to the ranging region, CQICH region, and HARQ ACK region.
**Start subchannel offset**
A subsequent HARQ UL data burst allocation shall start from the subchannel specified in the value. However, this value does not affect to the ranging region, CQICH region, and HARQ ACK region.

*Insert new subclause 6.3.2.3.43.7.9:*

#### 6.3.2.3.43.7.9 MIMO Compact UL MAP IE format

When MIMO enabled UL burst are present within a frame, they shall be allocated before non-MIMO DL burst in both diversity and AMC zones. Figure 23a exemplifies the UL HARQ subframe structure, where the 1-by-6 AMC type is depicted.

Within the MIMO diversity zone, subchannels shall take the form of Mini-subchannel Type 0b01 in Table 312, which spans over six symbols. Within the MIMO AMC zone, subchannels shall take 1-by-6 AMC type. Both MIMO diversity and MIMO AMC zones shall contain multiples of six symbols.

Each MIMO enabled UL burst shall be first allocated by the regular Compact UL-MAP IE for diversity subchannels (see Table 100) and AMC subchannels (see Table 101), followed by the extended MIMO Compact UL-MAP IE. The indication of zone boundary shall be made by the presence of UL Zone IE in Table 292.

The format of MIMO Compact UL-MAP IE is presented in Table 109a. This extended IE shall follow right after the basic allocation IE for each MIMO enabled UL burst.

### Table 109a—MIMO Compact UL-MAP IE format

| Syntax | Size | Notes |
|---|---|---|
| MIMO Compact UL-MAP IE() | — | — |
| **Compact UL-MAP Type** | 3 bits | Type = 7 |
| **UL-MAP Subtype** | 5 bits | MIMO = 0x01 |
| **Length** | 4 bits | Length of the IE in Bytes |
| **Matrix indicator** | 1 bit | UL STC matrices (see 8.4.8.4)<br>For 2-antenna MS,<br>0 = Matrix A<br>1 = Matrix B<br>For Collaborative SM capable MS<br>0 = Pilot pattern A<br>1 = Pilot pattern B |
| **Num_layer** | 1 bit | Number of multiple coding/modulation layers<br>0–1 layer<br>1–2 layers |
| for (j=1;j<Num_layer; j++) { | — | This loop specifies the $N_{EP}$ for layers 2 and above when required for STC.<br>The same $N_{SCH}$ and RCID applied for each layer |
| if (HARQ Mode =CTC Incremental Redundancy) { | — | HARQ Mode is specified in the HARQ Compact_UL-MAP IE format for Switch HARQ Mode. |
| **$N_{EP}$** | 4 bits | — |
| } elseif (HARQ Mode = Generic Chase) { | — | — |
| **UIUC** | 4 bits | — |
| } | — | — |
| } | — | — |
| **Padding** | *variable* | The padding bits are used to ensure the IE size is integer number of bytes |
| } | — | — |

For each layer, a codeword shall be constructed according to 8.4.9.2.3.5 with the $N_{EP}$ and $N_{SCH}$ combination and mapped onto the corresponding layer. Multiple codewords from multiple layers shall be interpreted as one HARQ channel whose parameters are given in the preceding Compact UL-MAP IE.

At the receiver, an ACK shall be transmitted only when there is no CRC error detected on every layer. Otherwise, a NACK shall be transmitted.

***Insert new subclause 6.3.2.3.43.7.10:***

### 6.3.2.3.43.7.10 SDMA Compact UL-MAP IE format

SDMA transmissions may be allocated in the uplink with the SDMA Compact UL-MAP IE (Table 109b).

**Num_layer**

The Num_layer specifies the number of SDMA layers. It is interpreted as the number of transmit antennas (as defined in 8.4.8). The first layer/user shall use pilot pattern A and the second layer/user shall use pilot pattern B. The third layer/user shall use pilot pattern C and the fourth layer/user shall use pilot pattern D.

Table 109b—SDMA Compact UL-MAP IE format

| Syntax | Size | Notes |
|---|---|---|
| SDMA_Compact_UL-MAP_IE() { | — | — |
| **Compact UL-MAP Type** | 3 bits | Type = 7 |
| **UL-MAP Sub-type** | 5 bits | SDMA = 0x03 |
| **Length** | 4 bits | Length of the IE in Bytes |
| **Matrix indicator** | 1 bit | UL STC matrices (see 8.4.8.4) For 2-antenna MS, 0 = Matrix A 1 = Matrix B |
| **Num layer** | 1 bit | Number of multiple coding/modulation layers:<br>0– 1 layer<br>1– 2 layers |
| **Padding** | 2 bits | For byte alignment. Shall be set to zero. |
| For (j=1;j<Num_layer; j++) { | | This loop specifies the $N_{EP}$ for layer 2 when required for STC. |
| **RCID** | *variable* | MS identifier for the current layer of the SDMA allocation |
| if (HARQ Mode =CTC Incremental Redundancy) { | — | HARQ Mode is specified in the HARQ Compact_UL-MAP IE format for Switch HARQ Mode. |
| **$N_{EP}$** | 4 bits | — |
| } elseif (HARQ Mode = Generic Chase) { | — | — |
| **UIUC** | 4 bits | — |
| } | — | — |
| **Padding** | *variable* | The padding bits are used to ensure the contents within the layer loop are an integer number of bytes. Shall be set to zero. |
| } | — | — |
| } | — | — |

***Insert new subclause 6.3.2.3.44:***

### 6.3.2.3.44 Sleep Request message (MOB_SLP-REQ)

An MS supporting sleep mode uses the MOB_SLP-REQ message to request definition and/or activation of certain Power Save Classes of types 1, 2, and 3. The MOB_SLP-REQ message is sent from the MS to the BS on the MS's basic CID. If Definition bit is set, the message contains suggested by the MS definition of new Power Saving Class.

Table 109c—Sleep-Request (MOB_SLP-REQ) message format

| Syntax | Size | Notes |
|---|---|---|
| MOB_SLP-REQ_Message_format() { | — | — |
| **Management message type = 50** | 8 bits | — |
| **Number of Classes** | 8 bits | Number of power saving classes. |
| for (i=0; i< Number of Classes; i++) { | — | — |
| **Definition** | 1 bit | — |
| **Operation** | 1 bit | — |
| **Power_Saving_Class_ID** | 6 bits | — |
| if (Operation = 1) { | — | — |
| **Start_frame_number** | 6 bits | — |
| **Reserved** | 2 bits | — |
| } | — | — |
| if (Definition = 1) { | — | — |
| **Power_Saving_Class_Type** | 2 bits | — |
| **Direction** | 2 bits | — |
| **Traffic_triggered_wakening_flag** | 1 bit | — |
| **Reserved** | 3 bits | — |
| **initial-sleep window** | ~~6~~ 8 bits | — |
| **listening-window** | 8 bits | — |
| **final-sleep window base** | 10 bits | — |
| **final-sleep window exponent** | 3 bits | — |
| **Number_of_Sleep_CIDs** | 3 bits | — |
| for (i=0; i<Number_of_Sleep_CIDs; i++ { | — | — |
| **CID** | 16 bits | — |
| } | — | — |
| } | — | — |
| **TLV encoded information** | *variable* | — |
| } | — | — |

Parameters shall be as follows:

**Definition**

0 = Definition of Power Saving Class absent; in this case the message shall request activation or deactivation of Power Saving Class identified by Power_Saving_Class_ID.

1 = Definition of Power Saving Class present.

**Operation**

0 = Deactivation of Power Saving Class (for types 1 and 2 only).

1 = Activation of Power Saving Class.

**Power_Saving_Class_ID**

Assigned Power Saving Class identifier. The ID shall be unique within the group of Power Saving Classes associated with the MS. This ID may be used in further MOB_SLP-REQ/RSP messages for activation / deactivation of Power Saving Class.

**Start_frame_number**

Start frame number for first sleep window.

**Direction**

Defined the directions of the class's CIDs.

0b00 = Unspecified. Each CID has its own direction assign in its connection creation. Can be DL, UL, or both (in the case of management connections).

0b01 = Downlink direction only.

0b10 = Uplink direction only.

0b11 = *Reserved*.

**Traffic_triggered_wakening_flag (for Type I only)**

0 = Power Saving Class shall not be deactivated if traffic appears at the connection as described in 6.3.19.2.

1 = Power Saving Class shall be deactivated if traffic appears at the connection as described in 6.3.19.2.

**Listening window**

Assigned Duration of MS listening window (measured in frames). For Power Saving Class type III, it is not relevant and shall be encoded as 0.

**Initial-sleep window**

Assigned initial duration for the sleep window (measured in frames). For Power Saving Class type III, it is not relevant and shall be encoded as 0.

**Final-sleep window base**

Assigned final value for the sleep interval (measured in frames). For Power Saving Class type II, it is not relevant and must be encoded as 0. For Power Saving Class type III, it is the base for duration of single sleep window requested by the message.

**Final-sleep window exponent**

Assigned factor by which the final-sleep window base is multiplied in order to calculate the final-sleep window. The following formula is used:

$$\text{final-sleep window} = \text{final-sleep window base} \times 2^{(\text{final-sleep window exponent})}$$

For Power Saving Class type III, it is the exponent for the duration of single sleep window requested by the message.

**Number_of_CIDs**

If Number_of_CIDs = 0, it means that all unicast CIDs associated with the MS are requested for addition to the class.

**CID**

CIDs of unicast connections comprising the Power Saving Class. CID = 0 denotes set of all management connections associated with the MS.

The following TLV parameter may be included in MOB_SLP-REQ message transmitted when requesting an activation of Power Saving Class. This TLV indicates the enabled action that MS performs upon reaching trigger condition in sleep mode.

**Enabled-Action-Triggered**
Indicates possible action upon reaching trigger condition.

The MOB_SLP-REQ shall include the following parameters encoded as TLV tuples:

**HMAC/CMAC Tuple (see 11.1.2)**

The HMAC/CMAC Tuple shall be the last attribute in the message.

***Insert new subclause 6.3.2.3.45:***

### 6.3.2.3.45 Sleep Response message (MOB_SLP-RSP)

The MOB_SLP-RSP message shall be sent from BS to an MS on Broadcast CID or on the MS's basic CID in response to an MOB_SLP-REQ message, or may be sent unsolicited. If Definition bit is set, the message contains the definition of a new Power Saving Class together with an assigned Power_Saving_Class_ID that shall be unique per MS if only unicast traffic connections are included and unique per cell if only multicast connections are included. Mixture of multicast and unicast connections in a single class is not allowed.

After reception of the message, the MS shall assemble connections in Power Saving Classes and optionally activate them as requested in the message. If for certain class activation is deferred (Activation = 0), the BS may signal activation at later time in another unsolicited MOB_SLP-RSP message (Table 109d).

Table 109d—Sleep-Response (MOB_SLP-RSP) message format

| Syntax | Size | Notes |
|---|---|---|
| MOB_SLP-RSP_Message_format() { | — | — |
| **Management message type = 51** | 8 bits | — |
| **Number of Classes** | 8 bits | Number of power saving classes. |
| for (i = 0; i < Number_of_Classes; i++) { | — | — |
| **Length of Data** | 7 bits | — |
| **Sleep Approved** | 1 bit | |
| **Definition** | 1 bit | — |
| **Operation** | 1 bit | — |
| **Power_Saving_Class_ID** | 6 bits | — |
| if (Sleep Approved == 1) { | — | — |
| if (Operation = 1) { | — | — |
| **Start_frame_number** | 6 bits | — |
| *Reserved* | 2 bits | — |
| } | — | — |
| if (Definition = 1) { | — | — |
| **Power_Saving_Class_Type** | 2 bits | — |

### Table 109d—Sleep-Response (MOB_SLP-RSP) message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Direction** | 2 bits | — |
| **initial-sleep window** | 8 bits | — |
| **listening window** | 8 bits | — |
| **final-sleep window base** | 10 bits | — |
| **final-sleep window exponent** | 3 bits | — |
| **TRF-IND required** | 1 bit | — |
| **Traffic_triggered_wakening_flag** | 1 bit | — |
| *Reserved* | 1 bit | — |
| if (TRF-IND required) { | — | — |
| **SLPID** | 10 bits | — |
| ***Reserved*** | 2 bits | — |
| } | — | — |
| **Number_of_CIDs** | 4 bits | — |
| for (i = 0; i < Number_of_CIDs; i++) { | — | — |
| **CID** | 16 bits | — |
| } | — | — |
| if (MDHO or FBSS capability enabled) { | — | If MDHO or FBSS capability is enabled in the REG-REQ/RSP message exchange. |
| **Maintain Diversity Set and Anchor BS** | 1 bit | — |
| if (Maintain Diversity Set and Anchor BS) { | — | — |
| **MDHO/FBSS duration (s)** | 3 bits | — |
| } | — | — |
| } | — | — |
| } | — | — |
| *Padding* | *variable* | If needed for alignment to byte boundary |
| if (Operation = 1) { | — | — |
| **Power Saving Class TLV encoded information** | *variable* | — |
| } | — | — |
| } else { | — | In case Sleep Approved == 0 |
| **REQ-duration** | 8 bits | |
| } | | |
| **TLV encoded information** | *variable* | — |
| } | — | — |

Parameters shall be as follows:

**Length_of_Data**

Number of bytes in following specification of Power Saving Class.

**Sleep_Approved**

1 = Indicates that BS approves the MS's Activation/Deactivation Request of the Power Saving Class.

0 = Indicates that BS disapproves the MS's Activation/Deactivation Request of the Power Saving Class.

For a MOB_SLP-RSP transmitted in an unsolicited manner including Definition of one or more Power Saving Class IDs, the BS shall set Sleep Approved = 0 for each Power Saving Class ID defined in the message.

In case of the MOB_SLP-RSP transmitted from the BS in an unsolicited manner, the BS shall set "Sleep approved" = 1 for each Power Saving Class ID that is not defined in the message.

**Definition**

1 = Definition of Power Saving Class present.

**Operation**

0 = Deactivation of Power Saving Class (for types 1 and 2 only; used only with Definition = 0).

1 = Activation of Power Saving Class.

**Power_Saving_Class_ID**

Assigned Power Saving Class identifier. The ID shall be unique within the group of Power Saving Classes associated with the MS. This ID may be used in further MOB_SLP-REQ/RSP messages for activation/deactivation of Power Saving Class.

**Start_frame_number**

Start frame number for first sleep window.

**REQ-duration**

Waiting value for the MOB_SLP-REQ message re-transmission (measured in MAC frames): the MS may retransmit the MOB_SLP-REQ message after the time duration (REQ-duration) provided in the message.

**Power_Saving_Class_Type**

Requested Power Saving Class type

**Direction**

Defined the directions of the class's connections:

0b00 = Unspecified. Each connection has its own direction assigned during connection creation. Can be DL or UL.

0b10 = Uplink direction (for management connections only).

0b01 = Downlink direction (for management connections only).

0b11 = *Reserved.*

**Listening interval**

Assigned Duration of MS listening interval (measured in frames). For Power Saving Class type III, it is not relevant and must be encoded as 0.

**Initial-sleep window**

Assigned initial duration for the sleep window (measured in frames). For Power Saving Class type III, it is not relevant and must be encoded as 0.

**Final-sleep window base**

Assigned final value for the sleep interval (measured in frames). For Power Saving Class type II, it is not relevant and must be encoded as 0. For Power Saving Class type III, it is the base for duration of single sleep window requested by the message.

**Final-sleep window exponent**

Assigned factor by which the final-sleep window base is multiplied in order to calculate the final-sleep window. The following formula is used:

$$\text{final-sleep window} = \text{final-sleep window base} \times 2^{(\text{final-sleep window exponent})}$$

For Power Saving Class type II it is the exponent for the duration of single sleep window requested by the message.

**TRF-IND_Required**

For Power Saving Class Type I only.

1 = BS shall transmit at least one TRF-IND message during each listening window of the Power Saving Class.

This bit shall be set to 0 for another types.

**Traffic_triggered_wakening_flag** (for Type I only)

1 = Power Saving Class shall be deactivated if traffic appears at the connection as described in 6.3.19.2.

0 = Power Saving Class shall not be deactivated if traffic appears at the connection as described in 6.3.19.2.

**SLPID**

This is a number assigned by the BS whenever an MS is instructed to enter sleep mode. This number shall be unique in the sense that it is assigned to a single MS that is instructed to enter sleep mode. No other MS shall be assigned the same number while the first MS is still in sleep mode.

**Number_of_CIDs**

In case the message is sent on Basic connection of certain MS, Number_of_CIDs = 0 means that all CIDs associated with the MS are included into the class.

**CID**

CIDs of all connections comprising the Power Saving Class. This list shall contain either unicast connections or multicast connections or management connections, but not combination of connections of different types. If Basic CID is encoded, it means that all MS connections are included in a single class. CID = 0 is reserved for management operations. In case the message is sent on Basic connection of certain MS, CID = 0 denotes set of all management connections associated with the MS.

**Maintain Diversity Set and Anchor BS**

1: Diversity set and Anchor BS shall be maintained while in sleep mode for MDHO/FBSS duration.

0: Diversity set and Anchor BS shall not be maintained while in sleep mode.

**MDHO/FBSS duration (s)**

Diversity set and Anchor BS shall be maintained for 10x2exp(s) frames after the Power Saving Class is activated.

**Power Saving Class TLV encoded information**

May contain the following TLVs:

**Next Periodic Ranging**

This value indicates the offset of frame in which MS shall be ready to perform a periodic ranging with respect to the frame where MOB_SLP-RSP is transmitted.

The following TLV parameter may be included in MOB_SLP-RSP message transmitted the BS permits an activation of Power Saving Class. This TLV indicates the enabled action that MS performs upon reaching trigger condition in sleep mode.

**Enabled-Action-Triggered**

Indicates possible action upon reaching trigger condition.

The MOB_SLP-RSP shall include the following parameter encoded as TLV tuples:

**HMAC/CMAC Tuple (see 11.1.2)**

The HMAC/CMAC Tuple shall be the last attribute in the message.

***Insert new subclause 6.3.2.3.46:***

### 6.3.2.3.46 Traffic Indication message (MOB_TRF-IND)

This message is sent from BS to MS on the broadcast CID or sleep mode multicast CID. The message is intended for MSs that are in sleep mode that have one or more Power Saving Class IDs defined of Power Saving Class type I, and is sent during those MS's listening-intervals. All MS with no Power Saving Class IDs defined of Power Saving Class type I shall ignore this message. The message indicates whether there has been traffic addressed to each MS that is in sleep mode. For an MS that is in sleep mode, during its listening-window the MS shall decode this message to seek an indication addressed to itself.

When an MS awakens, it will check the frame number to ensure that it did not lose frame synchronization with the BS and read the SLPID-Group Indication bit-map or Traffic Indication bit-map assigned to it and decide whether to continue in sleep mode or return to Normal Operation.

There are two formats for the MOB_TRF-IND message, indicated by the FMT field. When FMT = 0, if the MS does not find its own SLPID-Group Indication bit-map or Traffic Indication bit-map to its SLPID in the MOB_TRF-IND message, it will consider this as a negative indication and may continue its sleep mode. The MS shall update its SLPID if it finds its own Old_New_SLPID in SLPID_Update TLV. When FMT = 1, if the MS does not find its own SLPID in the MOB_TRF-IND message, it will consider this as a negative indication and may continue its sleep mode.

BS may arbitrarily include a positive indication for an MS in MOB_TRF-IND message during listening-window if the MS's periodic ranging operation is scheduled to start sooner or later within next sleep-window, even if there is no DL Traffic to be sent to the MS.

**Table 109e—Traffic-Indication (MOB_TRF-IND) message format**

| Syntax | Size | Notes |
|---|---|---|
| MOB_TRF-IND_Message_format() { | — | — |
| **Management message type = 52** | 8 bits | — |
| **FMT** | 1 bit | — |
| if (FMT == 0) { | — | — |
| **SLPID Group Indication bit-map** | 32 bits | *N*-th bit of SLPID-Group indication bit-map MSB corresponds to N = 0] is allocated to SLPID Group that includes MS with SLPID values from N*32 to N*32+31<br>Meaning of this bit<br>0: There is no traffic for all the 32 MS that belong to the SLPID-Group<br>1: There is traffic for at least one MS in SLPID-Group. |

### Table 109e—Traffic-Indication (MOB_TRF-IND) message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Traffic Indication Bitmap** | *variable* | Traffic Indication bit map comprises the multiples of 32-bit long Traffic Indication unit.<br>A Traffic Indication unit for 32 SLPIDs is added to MOB_TRF-IND message whenever its SLPID Group is set to 1 32 bits of Traffic Indication Unit (starting from MSB) are allocated to MS in the ascending order of their SLPID values:<br>0: Negative indication<br>1: Positive indication |
| } else { | — | — |
| **Num_Pos** | 8 bits | Number of CIDs following |
| for (i=0; i<Num_Pos; i++) { | — | — |
| **SLPIDs** | 10 bits | — |
| } | — | — |
| } | — | — |
| Padding | *variable* | If needed, for alignment to byte boundary. |
| **TLV encoded items** | *variable* | — |
| } | — | — |

Parameters shall be as follows:

**FMT**

The FMT field indicates one of the SLPID bit-map based format and the Short Basic CID based format.

**SLPID-Group indication bit-map**

SLPIDs from 0 to 1023 are divided into 32 SLPID-Groups. Therefore, the respective SLPID-Group has the range as follows:

SLPID-Group#0 (MSB) corresponds to SLPID = 0…31.
SLPID-Group #1 corresponds to SLPID = 32…63.
…
SLPID-Group#31 corresponds to SLPID = 992…1023.

‘SLPID-Group Indication bit-map’ is a 32-bit-long field where each bit is assigned to the respective SLPID-Group. In other words, the most significant bit (MSB) in the field is assigned to SLPID-Group#0, and subsequent bit relates to SLPID-Group #1, etc.

The *n*-th bit ($b_n$), n=0~31, of SLPID-Group Indication bit-map shall be interpreted in the following manner:

$b_n$ = 0 means that there is no traffic for all the 32 MS belonging to SLPID-Group #*n*. In this case, the MS in sleep mode belonging to SLPID-Group #*n* may return to sleep mode.

$b_n$ = 1 means that there exists traffic for one or more MS belonging to SLPID-Group #*n*. In this case, the MS in sleep mode belonging to SLPID-Group #*n* shall read its own Traffic Indication bit-map in MOB_TRF-IND message.

**Traffic Indication bit-map**

Traffic Indication bit map comprises the multiples of 32-bit long Traffic Indication Unit for every SLPID-Group with SLPID-Group indication bit = 1. Bits in a 32-bit Traffic Indication unit (starting from MSB) are allocated to MS to in ascending order of SLPIDs. Each bit signals traffic information for the corresponding MS as follows:

0: Negative Indication
1: Positive Indication

**Num-pos**

The number of Positive indication.

**SLPID**

The SLPID for the Power_Saving_Class_ID deactivated by this message and for MS to be transited into an awake mode.

When MOB_TRF-IND message has FMT = 0, it may include the following TLV:

**SLPID_Update (11.17.1)**

The SLPID_Update is a compound TLV value that provides a shorthand method for changing the SLPID used by the MS in sleep mode operation. The SLPID_Update TLV specifies a new SLPID that replaces an old SLPID. The SLPID_Update TLV may contain multiple Old_New_SLPID values for the MS negatively indicated in MOB_TRF-IND message.

***Insert new subclause 6.3.2.3.47:***

### 6.3.2.3.47 Neighbor Advertisement (MOB_NBR-ADV) message

BSs supporting mobile functionality shall be capable of transmitting a MOB_NBR-ADV management message at a periodic interval (MOB_NBR-ADV interval, see Table 342a) to identify the network and define the characteristics of neighbor BS to potential MS seeking initial network entry or handover. For the compression of neighbor BSIDs using this message in MOB_SCN-REP and MOB_MSHO-REQ message, BSs shall keep mapping-tables of neighbor BS MAC addresses and neighbor BS indexes transmitted through MOB_NBR-ADV message, for each Configuration Change Count. Using these mapping-tables, BSs can derive 48-bit neighbor BSID from neighbor BS index included in MOB_SCN-REP or MOB_MSHO-REQ message.

If neighbor information is not available, this message need not be transmitted.

**Table 109f—MOB_NBR-ADV message format**

| Syntax | Size | Notes |
|---|---|---|
| MOB_NBR-ADV_Message_format() { | — | — |
| **Management Message Type = 53** | 8 bits | — |

### Table 109f—MOB_NBR-ADV message format *(continued)*

| | | |
|---|---|---|
| **Skip-optional-fields bitmap** | 8 bits | Bit [0]: if set to 1, omit Operator ID field.<br>Bit [1]: if set to 1, omit NBR BS ID field.<br>Bit [2]: if set to 1, omit HO process optimization field.<br>Bit [3]: if set to 1, omit QoS related fields.<br>Bit [4]–[7]: *Reserved.* |
| If (Skip-optional-fields-[0]=0) { | — | — |
| **Operator ID** | 24 bits | Unique ID assigned to the operator. |
| } | — | — |
| **Configuration Change Count** | 8 bits | Incremented each time the information for the associated neighbor BS has changed. |
| **Fragmentation Index** | 4 bits | Indicates the current fragmentation index. |
| **Total Fragmentation** | 4 bits | Indicates the total number of fragmentations. |
| **N_NEIGHBORS** | 8 bits | — |
| For (j=0 ; j<N_NEIGHBORS ; j++) { | — | — |
| **Length** | 8 bits | Length of message information within the iteration of N_NEIGHBOR in bytes. |
| **PHY Profile ID** | 8 bits | Aggregated IDs of Co-located FA Indicator, FA Configuration Indicator, FFT size, Bandwidth, Operation Mode of the starting subchannelization of a frame, and Channel Number. |
| if (FA Index Indicator == 1) { | — | — |
| **FA Index** | 8 bits | This field, Frequency Assignment Index, is present only the FA Index Indicator in PHY Profile ID is set. Otherwise, the neighbor BS has the same FA Index or the center frequency is indicated using the TLV encoded information. |
| } | — | — |
| if (BS EIRP Indicator == 1) { | — | — |
| **BS EIRP** | 8 bits | Signed Integer from –128 to 127 in unit of dBm This field is present only if the BS EIRP indicator is set in PHY Profile ID. Otherwise, the BS has the same EIRP as the serving BS. |
| } | — | — |
| if (Skip-optional-fields[1]=0) { | — | — |
| **Neighbor BSID** | 24 bits | This is an optional field for OFDMA PHY and it is omitted or skipped if Skip optional fields Flag = 1. |
| } | — | — |
| **Preamble Index/Subchannel Index** | 8 bits | For the SCa and OFDMA PHY this parameter defines the PHY specific preamble. For the OFDM PHY, the 5 LSB contain the active DL subchannel index. The 3 MSB shall be *Reserved* and set to ‘0b000’. |
| if (Skip-optional-fields[2]=0) { | — | — |

**Table 109f—MOB_NBR-ADV message format *(continued)***

| | | |
|---|---|---|
| **HO Process Optimization** | 8 bits | HO Process Optimization is provided as part of this message is indicative only. HO process requirements may change at time of actual HO. For each Bit location, a value of '0' indicates the associated reentry management messages shall be required, a value of '1' indicates the reentry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the target BS may send unsolicited SBC-RSP and/ or REG-RSP management messages<br>Bit #0: Omit SBC-REQ/RSP management messages during re-entry processing<br>Bit #1: Omit PKM Authentication phase except TEK phase during current re-entry processing<br>Bit #2: Omit PKM TEK creation phase during reentry processing<br>Bit #3: Omit REG-REQ/RSP management during current re-entry processing<br>Bit #4: Omit Network Address Acquisition management messages during current reentry processing<br>Bit #5: Omit Time of Day Acquisition management messages during current reentry processing<br>Bit #6: Omit TFTP management messages during current re-entry processing<br>Bit #7: Full service and operational state transfer or sharing between serving BS and target BS (ARQ, timers, counters, MAC state machines, etc…) |
| } | — | — |
| if (Skip-optional-fields-[3]=0) { | — | — |
| **Scheduling Service Supported** | 8 bits | Bitmap to indicate if BS supports a particular scheduling service. 1 indicates support, 0 indicates not support:<br>Bit #0: Unsolicited Grant Service (UGS)<br>Bit #1: Real-time Polling Service (rtPS)<br>Bit #2: Non-real-time Polling Service (nrtPS)<br>Bit #3: Best Effort<br>Bit #4: Extended real-time Polling Service (ertPS)<br>If the value of bit 0 through bit 4 is 0b00000, it indicates no information on service available.<br>Bits #5–7: *Reserved*; shall be set to zero. |
| } | — | — |
| **DCD Configuration Change Count** | 4 bits | This represents the 4 LSBs of the Neighbor BS current DCD configuration change count. |
| **UCD Configuration Change Count** | 4 bits | This represents the 4 LSBs of the Neighbor BS current UCD configuration change count. |
| **TLV Encoded Neighbor information** | *variable* | TLV specific. |
| } | — | — |
| } | — | — |

A BS shall generate MOB_NBR-ADV messages in the format shown in Table 109f. The following parameters shall be included in the MOB_NBR-ADV message unless otherwise noted as an optional item in which case they may be included:

**Operator ID**
The unique network ID shared by an association of BS. The 'Operator IE' field is present only if Bit #0 of Skip-optional-fields bitmap is 0.

**Configuration Change Count**
Incremented by one (modulo 256) whenever any of the values relating to any included data element changes, including DCD and UCD parameters. If the value of this count in a subsequent MOB_NBR-ADV message remains the same, the MS can quickly disregard the entire message.

**Fragmentation Index**
The Fragmentation Index field indicates the current fragmentation index. The index for the first fragmentation is 0.

**Total Fragmentation**
The Total Fragmentation field set to 1 when the neighbor list is not fragmented. Otherwise, this field indicates the total number of fragments. When the neighbor list is fragmented, the N_NEIGHBORS indicates the number of neighbor BSs in the current message.

**Skip-optional-fields Flag:**
The Skip-optional-fields Flag indicates whether some fields in MOB_NBR-ADV message may be omitted in the MOB_NBR-ADV message. The field is omitted if the bit is set to 1.
Bit #0: Omit Operator ID field
Bit #1: Omit NBR BS ID field
Bit #2: Omit HO process optimization field
Bit #3: Omit QoS related fields

**N_NEIGHBORS**
The count of the unique combination of Neighbor BSID, Preamble Index, and DCD.

For each advertised neighbor, the following parameters shall be included:

**Length**
Length of message information within the iteration of N_NEIGHBOR in bytes.

**Neighbor BSID**
The least significant 24 bits of the Base Station ID parameter in the DL-MAP message of the Neighbor BS. The 'Neighbor BSID' field is present only if Bit #1 of Skip-optional-fields bitmap is 0.

**Preamble Index/Subchannel Index**
For the SCa and OFDMA PHY this parameter defines the PHY specific preamble. For the OFDM PHY the 5 LSB contain the DL subchannel index (as defined in Table 211) used in the advertised BS sector. The 3 MSB shall be Reserved and set to 0b000.

**PHY Profile ID**
The PHY Profile ID is the aggregate ID's including the Co-located FA Indicator bit, the FA Configuration indicator bit, Time/Frequency Synchronization Indicator, BS EIRP Indicator, DCD/UCD Reference Indicator, FA Index Indicator, and the FA (Frequency Assignment) number. For systems using OFDM or OFDMA, the bit-by-bit definition of the PHY Profile ID is shown in Table 109g. If the Co-located FA Indicator bit is set, the following field of the NBR-ADV element including Preamble Index, HO Process Optimization, DCD/UCD Configuration Change Count, and TLV Encoded Neighbor Information may be omitted.

**FA Index**
Only if the FA Index Indicator bit in the PHY Profile ID is set to 1, the FA Index follows the PHY Profile ID. In addition, if the FA Indicator is followed, the DL center frequency shall be omitted in the DCD/UCD difference TLV information. The bit-by-bit definition shall be determined by a service provider or a governmental body like FCC.

**BS EIRP**
The neighbor BS EIRP is listed in a signed integer form from –128 to 127 in units of dBm. The 'BS EIRP' field shall be omitted if the BS EIRP Indicator bit in PHY Profile ID is set zero.

**HO Process Optimization**

HO Process Optimization is provided as part of this message is indicative only. HO process requirements may change at time of actual HO. For each Bit location, a value of '0' indicates the associated reentry management messages shall be required, a value of '1' indicates the reentry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the target BS may send unsolicited SBC-RSP and/ or REG-RSP management messages:

Bit #0: Omit SBC-REQ/RSP management messages during re-entry processing
Bit #1: Omit PKM Authentication phase except TEK phase during current re-entry processing
Bit #2: Omit PKM TEK creation phase during re-entry processing
Bit #3: Omit REG-REQ/RSP management during current re-entry processing
Bit #4: Omit Network Address Acquisition management messages during current reentry processing
Bit #5: Omit Time of Day Acquisition management messages during current reentry processing
Bit #6: Omit TFTP management messages during current re-entry processing
Bit #7: Full service and operational state transfer or sharing between serving BS and target BS (ARQ, timers, counters, MAC state machines, etc…)

**Scheduling Service Supported**

The Scheduling Service Supported field is present only if Bit #3 of Skip-optional-fields is 0. Bitmap to indicate if BS supports a particular scheduling service. 1 indicates support, 0 indicates not support:

Bit #0:Unsolicited Grant Service (UGS)
Bit #1:Real-time Polling Service (rtPS)
Bit #2:Non-real-time Polling service (nrtPS)
Bit #3:Best Effort
Bit #4:Extended real-time Polling Service (ertPS)
If the value of Bit #0 through #4 is 0b00000, it indicates no information on service available.

**DCD Configuration Change Count**

Represents the 4 LSBs of the Neighbor BS current DCD configuration change count.

**UCD Configuration Change Count**

Represents the 4 LSBs of the Neighbor BS current UCD configuration change count.

For each advertised Neighbor BS, the following TLV parameters may be included:

**Mobility Feature Supported**

Same as in 11.7.14.1.

When Mobility Feature Supported bit indicate support for idle mode, following TLV parameters may be included:

**Paging Group ID (16 bit)**

One or more logical affiliation groupings of BS

The following TLV parameters may be included.

**DCD_settings**

The DCD_settings is a TLV value that encapsulates a DCD message (excluding the generic MAC header and CRC) that may be transmitted in the advertised BS downlink channel. This information is intended to enable fast synchronization of the MS with the advertised BS downlink. The DCD settings fields shall contain only neighbor's DCD TLV values that are different from the serving BS corresponding values. For values that are not included, the MS shall assume they are identical to the corresponding values of the serving BS. The duplicate TLV encoding parameters within a Neighbor BS shall not be included in DCD setting.

**UCD_settings**

The UCD_settings is a TLV value that encapsulates a UCD message (excluding the generic MAC header and CRC) that may be transmitted in the advertised BS downlink channel. This information is intended to enable fast synchronization of the MS with the advertised BS uplink. The UCD settings fields shall contain only neighbor's UCD TLV values that are different from the serving BS's corresponding values. For values that are not included, the MS shall assume they are identical to the serving BS's corresponding values. The duplicate TLV encoding within a Neighbor BS shall not be included in UCD setting.

When the PHY parameters specified by the PHY Mode ID TLV are different than those of the serving BS, the following TLV shall be included:

**PHY Mode ID (see 11.19.1)**

a 16-bit value that specifies the PHY parameters, including channel bandwidth, FFT size, cyclic prefix, and frame duration.

**Table 109g—Bit-by-bit definition of PHY Profile ID of the BS**

| Item | Size | Notes |
|---|---|---|
| **Co-located FA Indicator** | 1 bit | If the BS (or FA) is co-located with the serving BS, this bit is set to 1. |
| **FA Configuration Indicator** | 1 bit | If this bit is set 1, the BS has the same FA configuration (the same number of FAs as well as their frequencies) as the BS broadcasting the NBR-ADV. |
| **Time/Frequency Synchronization Indicator** | 2 bits | 0b00 = Unsynchronized<br>0b01 = Time synchronization<br>0b10 = Time and Frequency synchronization<br>If time synchronization is indicated for the OFDMA PHY, then the downlink frames transmitted by the serving BS and the Neighbor BS shall be synchronized to a level of at least 1/8 cyclic prefix length. If frequency synchronization is indicated for the OFDMA PHY, then the BS reference clocks shall be synchronized to a level that yields RF center frequency offset of no more than 1% of the OFDMA carrier spacing of the Neighbor BS. |
| **BS EIRP Indicator** | 1 bit | If this bit is set, the BS EIRP follows the PHY Profile ID. |
| **DCD/UCD Reference Indicator** | 1 bit | 1: The DCD/UCD settings of this neighbor BS are the same as those of the preceding neighbor BS unless the TLV information specifies.<br>0: The DCD/UCD settings of this neighbor BS are the same as those of the serving BS unless the TLV information specifies. |
| **FA Index Indicator** | 1 bit | Only if this bit is set to 1, the FA Index follows the PHY Profile ID. In addition, if the FA Indicator is followed, the DL center frequency shall be omitted in the DCD/UCD difference TLV information. |
| **Trigger Reference Indicator** | 1 bit | The Trigger Reference Indicator is related to the Neighbor BS trigger metric TLV information of this neighbor BS.<br>1: The trigger settings of this neighbor BS are the same as those of the preceding neighbor BS.<br>0: The trigger settings of this neighbor BS are the same as those provided by the serving BS (via DCD).If the TLV information is present, it overrides values inherited from preceding neighbor BS. |

***Insert new subclause 6.3.2.3.48:***

### 6.3.2.3.48 Scanning Interval Allocation Request (MOB_SCN-REQ) message

A MOB_SCN-REQ message may be transmitted by an MS to request a scanning interval for the purpose of seeking available BSs and determining their suitability as targets for HO. An MS may request the scanning allocation to perform scanning or non-contention Association ranging.

An MS shall generate MOB_SCN-REQ messages in the format shown in Table 109h.

**Table 109h—MOB_SCN-REQ message format**

| Syntax | Size | Notes |
|---|---|---|
| MOB_SCN-REQ_Message_format() { | — | — |
| **Management Message Type = 54** | 8 bits | — |
| **Scan duration** | 8 bits | Units are in frames. |
| **Interleaving interval** | 8 bits | Units are frames. |
| **Scan Iteration** | 8 bits | In frames |
| **N_Recommended_BS_Index** | 8 bits | Number of neighboring BS to be scanned or associated, which are using BS index that corresponds to the position of BS in MOB_NBR-ADV message |
| If(N_Recommended_BS_Index!=0){ | | |
| **Configuration change count for MOB_NBR-ADV** | 8 bits | Configuration Change Count value of referring MOB_NBR-ADV message |
| } | — | — |
| For(j=0;j<N_Recommended_BS_Index;j++){ | — | — |
| **Neighbor_BS_Index** | 8 bits | BS index corresponds to position of BS in MOB_NBR-ADV message |
| **Scanning type** | 3 bits | 0b000:Scanning without Association.<br>0b001:Scanning with Association level 0: association without coordination<br>0b010:Scanning with Association level 1: association with coordination.<br>0b011: Scanning with Association level 2: network assisted association<br>0b100–0b111: *Reserved* |
| } | — | — |
| **N_Recommended_BS_Full** | 8 bits | Number of neighboring BS to be scanned or associated, which are using full 48 bits BS ID. |
| For(j=0;j< N_Recommended_BS_Full;j++){ | — | — |
| **Recommended BS ID** | 48 bits | — |

**Table 109h—MOB_SCN-REQ message format *(continued)***

| | | |
|---|---|---|
| **Scanning type** | 3 bits | 0b000:Scanning without Association.<br>0b001:Scanning with Association level 0: association without coordination<br>0b010:Scanning with Association level 1: association with coordination.<br>0b011: Scanning with Association level 2: network assisted association<br>0b100–0b111: *Reserved* |
| } | — | — |
| *Padding* | *variable* | If needed for alignment to byte boundary. |
| **TLV encoded information** | *variable* | — |
| } | — | — |

The following parameters shall be included in the MOB_SCN-REQ message:

**Scan duration**
Duration (in units of frames) of the requested scanning period.

**Interleaving Interval**
The period of MS's Normal Operation which is interleaved between Scanning Durations.

**Scan Iteration**
The requested number of iterating scanning interval by an MS.

**N_Recommended_BS_Index**
Number of neighboring BS to be scanned or associated, which are included in MOB_NBR-ADV message. The number could be larger than zero only when NBR_BS_Index_Validity_Time is larger than the difference of MOB_SCN-REQ message transmitting time and MOB_NBR-ADV message receiving time (MOB_NBR-ADV message should be referred).

**Configuration Change Count for MOB_NBR-ADV**
The value of Configuration Change Count in MOB_NBR-ADV message referred in order to compress neighbor BSID.

**Neighbor_BS_Index**
BS index corresponds to position of BS in MOB_NBR-ADV message.

**Scanning type**
Type of scanning or association to be used by the MS and coordinated by the Serving BS (if Association type >=0b011).

**N_Recommended_BS_Full**
Number of neighboring BS to be scanned or associated, which are using full 48 bits BS ID.

**Recommended BS ID**
BS IDs of those BSs the MS plans to scan with or without association.

The MOB_SCN-REQ message shall include the following parameters encoded as TLV tuples:

**HMAC/CMAC Tuple (See 11.1.2.)**

The HMAC/CMAC Tuple shall be the last attribute in the message.

***Insert new subclause 6.3.2.3.49:***

### 6.3.2.3.49 Scanning Interval Allocation Response (MOB_SCN-RSP) message

A MOB_SCN-RSP message shall be transmitted by the BS either unsolicited or in response to an MOB_SCN-REQ message sent by an MS. A BS may transmit MOB_SCN-RSP to start MS scan reporting with or without scanning allocation. A BS may allocate the scanning allocation for MS scanning with Scanning type = 0b000, or MS non-contention Association ranging with Scanning type = 0b010 or 0b011. The message shall be transmitted on the Basic CID.

If the Report mode is event-triggered, the MS shall respond once according to the trigger action specified in the MOB_NBR-ADV (see 11.1.7) or the serving BS DCD (see 11.4.1). A subsequent MOB_SCN RSP message may be sent to reset the trigger procedure.

The format of the MOB_SCN-RSP message is depicted in Table 109i.

**Table 109i—MOB_SCN-RSP message format**

| Syntax | Size | Notes |
|---|---|---|
| MOB_SCN-RSP_Message_format() { | — | — |
| **Management Message Type = 55** | 8 bits | — |
| **Scan duration** | 8 bits | In units of frames. When Scan Duration is set to zero, no scanning parameters are specified in the message. When MOB_SCN-RSP is sent in response to MOB_SCN-REQ, setting Scan Duration to zero denies MOB_SCN-REQ. |
| **Report mode** | 2 bits | 0b00: No report<br>0b01: Periodic report<br>0b10: Event-triggered report<br>0b11: *Reserved* |
| *Reserved* | 6 bits | Shall be set to zero. |
| **Report period** | 8 bits | Available when the value of Report Mode is set to 0b01. Report period in frames. |
| **Report metric** | 8 bits | Bitmap indicating metrics on which the corresponding triggers are based:<br>Bit 0: BS CINR mean<br>Bit 1: BS RSSI mean<br>Bit 2: Relative delay<br>Bit 3: BS RTD; this metric shall be only measured on serving BS/anchor BS.<br>Bits 4–7: *Reserved*; shall be set to zero. |
| if (Scan Duration !=0) { | — | — |
| **Start frame** | 4 bits | — |
| *Reserved* | 1 bit | Shall be set to zero. |
| **Interleaving interval** | 8 bits | Duration in frames. |
| **Scan iteration** | 8 bits | — |
| *padding* | 3 bits | Shall be set to zero. |

**Table 109i—MOB_SCN-RSP message format *(continued)***

| | | |
|---|---|---|
| **N_Recommended_BS_Index** | 8 bits | Number of neighboring BS to be scanned or associated, which are using BS index that corresponds to the position of BS in MOB_NBR-ADV message. |
| **If(N_Recommended_BS_Index!=0){** | | |
| **Configuration change count for MOB_NBR-ADV** | 8 bits | Configuration Change Count value of referring MOB_NBR-ADV message. |
| **}** | | |
| **For(j=0;j<N_Recommended_BS_Index;j++){** | | |
| **Neighbor_BS_Index** | 8 bits | BS index corresponds to position of BS in MOB_NBR-ADV message. |
| **Scanning type** | 3 bits | 0b000: Scanning without Association<br>0b001: Scanning with Association level 0: association without coordination.<br>0b010: Scanning with Association level 1: association with coordination.<br>0b011: Scanning with Association level 2: network assisted association<br>b100–0b111: *Reserved* |
| If (Scanning type == 0b010) OR (Scanning type == 0b011) { | — | — |
| **Rendezvous time** | 8 bits | Units are frames. |
| **CDMA code** | 8 bits | From initial ranging codeset. |
| **Transmission_opportunity offset** | 8 bits | Units are transmission opportunity. |
| } | — | — |
| } | — | — |
| **N_Recommended_BS_Full** | 8 bits | Number of neighboring BS to be scanned or associated, which are using full 48 bits BS ID. |
| For(j=0;j< N_Recommended_BS_Full;j++){ | — | — |
| **Recommended BS ID** | 48 bits | BS IDs of BSs that MS shall scan. |
| **Scanning type** | 3 bits | 0b000: Scanning without Association-Scanning<br>0b001: Scanning with Association level 0: association without coordination<br>0b010: Scanning with Association level 1: association with coordination<br>0b011: Scanning with Association level 2: network assisted association<br>0b100–0b111: *Reserved* |
| If ( Scanning type == 0b010) OR ( Scanning type == 0b011) { | — | — |
| **Rendezvous time** | 8 bits | Units are frames. |
| **CDMA_code** | 8 bits | From initial ranging codeset. |
| **Transmission_opportunity offset** | 8 bits | Units are transmission opportunity. |

### Table 109i—MOB_SCN-RSP message format *(continued)*

| | | |
|---|---|---|
| } | — | — |
| } | — | — |
| *Padding* | *variable* | — |
| } | — | — |
| **TLV encoded information** | *variable* | — |
| } | — | — |

The following parameters shall be included in the MOB_SCN-RSP message:

**Scan duration**
Duration (in units of frames) where the MS may perform scanning or association for Available BSs. When MOB_SCN-RSP is sent in response to MOB_SCN-REQ, setting Scan duration to zero indicates the request for an allocation of scanning interval is denied.

**Report mode**
Action code for an MS's report of CINR measurement:
0b00:The MS measures channel quality of the Available BSs without reporting.
0b01:The MS reports the result of the measurement to Serving BS periodically. The period of reporting is different from that of scanning.
0b10:The MS reports the result of the measurement to Serving BS after each measurement.
0b11:*Reserved*

**Report period**
The period of MS's report of CINR measurement when the MS is required to report the value periodically.

**Report metric**
Bitmap indicator of trigger metrics that the serving BS requests the MS to report. Serving BS shall indicate only the trigger metrics agreed during SBC-REQ/RSP negotiation. Each bit indicates whether reports will be initiated by trigger based on the corresponding metric:
Bit 0: BS CINR mean
Bit 1: BS RSSI mean
Bit 2: Relative delay
Bit 3: BS RTD; this metric shall be only measured on serving BS/anchor BS
Bits 4–7: *Reserved*; shall be set to zero

**Start Frame**
Measured from the frame in which this message was received. A value of zero means that first Scanning Interval starts in the next frame.

**Interleaving interval**
The period interleaved between Scanning Intervals when MS shall perform Normal Operation.

**Scan iteration**
The number of iterating scanning interval.

**Configuration Change Count for MOB_NBR-ADV**
The value of Configuration Change Count in MOB_NBR-ADV message referred in order to compress neighbor BSID

**N_Recommended_BS_Index**
Number of neighboring BS to be scanned or associated, which are included in MOB_NBR-ADV message. The number could be larger than zero only when NBR_BS_Index_Validity_Time is larger than the difference of MOB_SCN-RSP message

transmitting time and MOB_NBR-ADV message receiving time (MOB_NBR-ADV message should be referred).

**Neighbor_BS_Index**

BS index corresponds to position of BS in MOB_NBR-ADV message

**Scanning type**

Type of scanning or association used by the MS and coordinated by the Serving BS (if scanning type >=0b010).

**N_Recommended_BS_Full**

Number of neighboring BS to be scanned or associated that are using full 48 bits BS ID.

**Recommended BS ID**

Recommended BS ID list for scan with or without association.

If Scanning type > 0b001 then Serving BS may request, over the backbone, from Recommended BS allocation of non-contention-based ranging opportunity for MS association activity. When conducting initial ranging to Recommended BS, MS shall use allocated non-contention-based ranging opportunity, if available.

**Rendezvous time**

This is offset, measured in units of frame duration (of Serving BS), when the corresponding Recommended BS is expected to provide non-contention-based ranging opportunity for the MS. The offset is calculated from the frame where MOB_SCN-RSP message is transmitted. In case Scanning type = 0b000 or 0b001the parameter is not applicable and shall be encoded as 0. The Recommended BS is expected to provide non-contention-based Ranging opportunity at the frame specified by Rendezvous time parameter.

**CDMA code**

A unique code assigned to the MS, to be used for association with the neighbor BS. Code is from the initial ranging codeset.

**Transmission opportunity offset**

A unique transmission opportunity assigned to the MS, to be used for association with the Target BS in units of symbol duration.

The MOB_SCN-RSP message shall include the following parameters encoded as TLV tuples:

**HMAC/CMAC Tuple (See 11.1.2.)**

The HMAC/CMAC Tuple shall be the last attribute in the message.

***Insert new subclause 6.3.2.3.50:***

### 6.3.2.3.50 Scanning Result Report (MOB_SCN-REP) message

When the Report Mode is 0b10 (i.e., event triggered) in the most recently received MOB_SCN-RSP, the MS shall transmit a MOB_SCN-REP message to report the scanning results to its servicing BS after each scanning period at the time indicated in the MOB_SCN-RSP message. The MS may transmit a MOB_SCN-REP message to report the scanning results to its serving BS at anytime. The message shall be transmitted on the Primary Management CID. (See Table 109j.)

### Table 109j—MOB_SCN-REP message format

| Syntax | Size | Notes |
|---|---|---|
| MOB_SCN-REP_Message_format() { | — | — |
| **Management Message Type = 60** | 8 bits | — |
| **Report Mode** | 1 bit | 0: Event-triggered report<br>1: Periodic report |
| **Comp_NBR_BSID_IND** | 1 bit | — |
| **N_current_BSs** | 3 bits | When FBSS/MDHO is supported, N_current_BSs is the number of BSs currently in the diversity set; When FBSS/MDHO is not supported or the MS has an empty diversity set, N_current_BSs is set to 1. |
| *Reserved* | 3 bits | |
| **Report metric** | 8 bits | Bitmap indicating presence of certain metrics (threshold values) on which the corresponding triggers are based:<br>Bit 0: BS CINR mean<br>Bit 1: BS RSSI mean<br>Bit 2: Relative delay<br>Bit 3: BS RTD; this metric shall be only measured on serving BS/anchor BS<br>Bits 4–7: *Reserved*; shall be set to zero |
| For (j=0; j<N_current_BSs; j++) { | | |
| **Temp BSID** | 4 bits | Diversity set member ID assigned to this BS. When the MS has an empty diversity set or FBSS/MDHO is not supported, Temp BSID shall be set to 0. |
| *Reserved* | 4 bits | Shall be set to zero. |
| If (Report metric[Bit 0]==1) | — | — |
| **BS CINR mean** | 8 bits | — |
| If (Report metric[Bit 1]==1) | — | — |
| **BS RSSI mean** | 8 bits | — |
| If (Report metric[Bit 2]==1) | — | — |
| **Relative delay** | 8 bits | In case FBSS/MDHO is in progress, this field shall include the relative delay of BSs currently in the diversity set, except for that of the Anchor BS. |
| If (Report metric[Bit 3]==1) | — | — |
| **BS RTD** | 8 bits | This field shall include the RTD of the serving BS/anchor BS. |
| } | — | — |
| **N_Neighbor_BS_Index** | 8 bits | Number of neighboring BS that are included in MOB_NBR-ADV message. |
| If (N_ Neighbor_BS_Index!=0){ | — | — |

**Table 109j—MOB_SCN-REP message format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **Configuration change count for MOB_NBR-ADV** | 8 bits | Configuration Change Count value of referring MOB_NBR-ADV message |
| } | — | — |
| For(j=0;j<N_Neighbor_BS_Index;j++) { | — | — |
| **Neighbor_BS_Index** | 8 bits | BS index corresponds to position of BS in MOB_NBR-ADV message |
| If(Report metric[Bit 0]==1) | — | — |
| **BS CINR mean** | 8 bits | — |
| If(Report metric[Bit 1]==1) | — | — |
| **BS RSSI mean** | 8 bits | — |
| If(Report metric[Bit 2]==1) | — | — |
| **Relative delay** | 8 bits | — |
| } | — | — |
| **N_ Neighbor_BS_Full** | 8 bits | Number of neighboring BS that are using full 48 bits BS ID. |
| For(j=0;j<N_Neighbor_BS_Full;j++) { | — | — |
| **Neighbor BSID** | 48 bits | — |
| If(Report metric[Bit 0]==1) | — | — |
| **BS CINR mean** | 8 bits | — |
| If(Report metric[Bit 1]==1) | — | — |
| **BS RSSI mean** | 8 bits | — |
| If(Report metric[Bit 2]==1) | — | — |
| **Relative delay** | 8 bits | — |
| } | — | — |
| **TLV encoded information** | *variable* | Optional |
| } | — | — |

An MS shall generate MOB_SCN-REP messages in the format shown in Table 109j. The following parameters shall be included in the MOB_SCN-REP message:

**Report mode**

Action code for an MS’s scan report of its measurement:

0: Event triggered report
1: Periodic report according to Scan report period of MOB_SCN-RSP

**Report metric**

Bitmap indicator of trigger metrics that the serving BS requests the MS to report. Serving BS shall indicate only the trigger metrics agreed during SBC-REQ/RSP negotiation. For each bit location, a value of ‘0’ indicates the trigger metric is not included, while a value of '1' indicates the trigger metric is included in the message. The bitmap interpretation for the metrics shall be:

Bit 0: BS CINR mean
Bit 1: BS RSSI mean
Bit 2: Relative delay
Bit 3: BS RTD; this metric shall be only measured on serving BS/anchor BS
Bits 4–7: *Reserved*; shall be set to zero

**N_current_BSs**
When FBSS/MDHO is supported, N_current_BSs is the number of BSs currently in the diversity set; when FBSS/MDHO is not supported or the MS has an empty diversity set, N_current_BSs is set to 1 (= serving /anchor BS).

**Temp BSID**
Diversity set member ID assigned to this BS. When the MS has an empty diversity set or FBSS/MDHO is not supported, Temp BSID shall be set to 0.

**N_Neighbor_BS_Index**
Number of neighboring BS reported in this message and which are included in MOB_NBR-ADV message. The number could be larger than zero only when NBR_BS_Index_Validity_Time is larger than the difference of MOB_SCN-REP message transmitting time and MOB_NBR-ADV message receiving time (MOB_NBR-ADV message should be referred).

**N_Neighbor_BS_Full**
Number of neighboring BS reported in this message that are using full 48 bits BS ID.

For each neighbor BS included in this message, the following parameters shall be included:

**Configuration Change Count for MOB_NBR-ADV**
The value of Configuration Change Count in MOB_NBR-ADV message referred in order to compress neighbor BSID.

**Neighbor_BS_Index**
BS index corresponds to position of BS in MOB_NBR-ADV message.

**Neighbor BSID**
Same as the Base Station ID parameter in the DL-MAP message of neighbor BS.

According to Report metric that MS indicates, the MOB_SCN-REP message may include the following parameters:

**BS CINR mean**
The BS CINR mean parameter indicates the CINR measured by the MS from the particular BS. The value shall be interpreted as a signed byte with units of 0.5 dB. The measurement shall be performed on the subcarriers of the frame preamble that are active in the particular BS's segment and averaged over the measurement period.

**BS RSSI mean**
The BS RSSI mean parameter indicates the Received Signal Strength measured by the MS from the particular BS. The value shall be interpreted as an unsigned byte with units of 0.25 dB, such that 0x00 is interpreted as –103.75 dBm, an MS shall be able to report values in the range –103.75 dBm to –40 dBm. The measurement shall be performed on the frame preamble and averaged over the measurement period.

**Relative delay**
This parameter indicates the delay of neighbor DL signals relative to the serving BS, as measured by the MS for the particular BS. The value shall be interpreted as a signed integer in units of samples.

**BS RTD**
The BS RTD parameter indicates the round trip delay (RTD) measured by the MS from the serving BS. RTD can be given by the latest time advance taken by MS. The value shall be interpreted as an unsigned byte with units of 1/Fs (see 10.3.4.3). This parameter shall be only measured on serving BS/anchor BS.

TLV tuples specified in 11.19 may be included into MOB_SCN-REP message. Information provided by *N*-th TLV of this type is related to *N*-th BS listed in the message.

The MOB_SCN-REP message shall include the following parameters encoded as TLV tuples:

**HMAC/CMAC Tuple (See 11.1.2.)**

The HMAC/CMAC Tuple shall be the last attribute in the message.

***Insert new subclause 6.3.2.3.51:***

### 6.3.2.3.51 Association Result Report (MOB_ASC-REP) message

When association level 2 is used, the MS does not have to wait for RNG-RSP from the Target BS after sending RNG-REQ or ranging code to the Target BS. Instead, the RNG-RSP info may be sent by each Target BS to the Serving BS (over the backbone). The Serving BS may aggregate all the RNG-RSP messages to a single MOB_ASC-REP message, which the Serving BS then sends to the MS. This message is transmitted using the primary management CID (Table 109k).

Table 109k—MOB_ASC-REP message format

| Syntax | Type | Size | Notes |
|---|---|---|---|
| MOB_ASC_REPORT_Message_format() { | — | — | — |
| **Management Message Type = 66** | — | 8 bits | — |
| **N_Recommended_BS_Index** | — | 8 bits | Number of neighboring BS, which are using BS index that corresponds to the position of BS in MOB_NBR-ADV message |
| If(N_Recommended_BS_Index!=0){ | — | — | — |
| **Configuration change count for MOB_NBR-ADV** | — | — | Configuration Change Count value of referring MOB_NBR-ADV message |
| } | — | — | — |
| For(j=0;j< N_Recommended_BS_Index;j++){ | — | — | — |
| **Neighbor_BS_Index** | — | 8 bits | — |
| **Timing adjust** | 1 | 32 bits | — |
| **Power level adjust** | 2 | 8 bits | — |
| **Offset frequency adjust** | 3 | 32 bits | — |
| **Ranging status** | 4 | 8 bits | — |
| **Service level prediction** | 5 | 8 bits | — |
| } | — | — | — |
| **N_Recommended_BS_Full** | — | 8 bits | Number of neighboring BS that are using full 48 bits BS ID. |
| For(j=0;j< N_Recommended_BS_Full;j++){ | — | — | — |
| **Neighbor_BS_ID** | — | 48 bits | — |
| **Timing adjust** | 1 | 32 bits | — |

Table 109k—MOB_ASC-REP message format *(continued)*

| Syntax | Type | Size | Notes |
|---|---|---|---|
| **Power level adjust** | 2 | 8 bits | — |
| **Offset frequency adjust** | 3 | 32 bits | — |
| **Ranging status** | 4 | 8 bits | — |
| **Service level prediction** | 5 | 8 bits | — |
| } | — | — | — |
| } | — | — | — |

The following parameters shall be included in the MOB_ASC-REP message:

**N_Recommended_BS_Index**
Number of neighboring BSs reported in this message and which are included in MOB_NBR-ADV message. The number could be larger than zero only when NBR_BS_Index_Validity_Time is larger than the difference of MOB_ASC-REP message transmitting time and MOB_NBR-ADV message receiving time (MOB_NBR-ADV message should be referred).

**Configuration Change Count for MOB_NBR-ADV**
The value of Configuration Change Count in MOB_NBR-ADV message referred in order to compress neighbor BSID.

**Neighbor_BS_Index**
BS index corresponds to position of BS in MOB_NBR-ADV message.

**N_Recommended_BS_Full**
Number of neighboring BSs reported in this message that are using full 48 bits BS ID.

**Neighbor_BS_ID**
BS_ID of the neighboring BS with which the MS is associated.

**Timing adjust**
The time required to advance MS transmissions so frames arrive at the expected time instance at the neighbor BS.

**Power level adjust**
The power level offset adjustment required so that MS transmissions arrive at the desired level at the neighbor BS.

**Offset frequency adjust**
The relative frequency adjustment required so that MS transmissions arrive at the desired frequency at the neighbor BS.

**Ranging status**
Used to indicate whether MS ranging attempt is within acceptable limits of the neighbor BS.

**Service level prediction**
The service level prediction value indicates the level of service the MS can expect from this neighbor BS. The following encodings apply:
0 = No service possible for this MS
1 = Some service is available for one or several service flows authorized for the MS.
2 = For each authorized service flow, a MAC connection can be established with QoS specified by the AuthorizedQoSParamSet.
3 = No service level prediction available.

***Insert new subclause 6.3.2.3.52:***

### 6.3.2.3.52 BS HO Request (MOB_BSHO-REQ) message

The BS may transmit a MOB_BSHO-REQ message when it wants to initiate an HO. An MS receiving this message may scan recommended neighbor BSs in this message. The message shall be transmitted on the basic CID.

**Table 109l—MOB_BSHO-REQ message format**

| Syntax | Size | Notes |
|---|---|---|
| MOB_BSHO-REQ_Message_format() { | — | — |
| **Management Message Type = 56** | 8 bits | — |
| **Network Assisted HO supported** | 1 bit | Indicates that the serving BS supports Network Assisted HO |
| **Mode** | 3 bits | 0b000: HO request<br>0b001: MDHO/FBSS request: Anchor BS update with CID update<br>0b010: MDHO/FBSS request: Anchor BS update without CID update<br>0b011: MDHO/FBSS request: Diversity Set update with CID update<br>0b100: MDHO/FBSS request: Diversity Set update without CID update<br>0b101: MDHO/FBSS request: Diversity Set update with CID update for newly added BS<br>0b110: MDHO/FBSS request: Diversity Set update with CID update and CQICH allocation for newly added BS<br>0b111: *Reserved* |
| *Padding* | 4 bits | Shall be set to zero. |
| If (Mode == 0b000) { | — | — |
| **HO operation mode** | 1 bit | 0: Recommended HO request.<br>1: Mandatory HO request. |
| **N_Recommended** | 8 bits | — |
| **Resource Retain Flag** | 1 bit | 0: MS resource release.<br>1: MS resource retain. |
| *Padding* | 6 bits | Shall be set to zero. |
| for (j=0 ; j<N_Recommended ; j++) { | — | N_Recommended can be derived from the known length of the message. |
| **Neighbor BSID** | 48 bits | — |
| **Service level prediction** | 8 bits | — |
| **Preamble index/Subchannel Index** | 8 bits | |
| **HO process optimization** | 8 bits | |
| **Network Assisted HO supported** | 1 bit | Indicates that the BS supports Network Assisted HO. |
| **HO_ID_included_indicator** | 1 bit | To indicate if the field HO_IND is included. |

### Table 109I—MOB_BSHO-REQ message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **HO_authorization policy indicator** | 1 bit | To indicate if authorization negotiation is used in HO procedure.<br>0: EAP authorization and the value of the MAC mode field in the current BS (default)<br>1: The authorization policy for the target BS is negotiated. |
| ***Padding*** | 1 bit | To ensure nibble alignment. |
| If (HO_ID_included_indicator == 1) { | — | — |
| **HO_ID** | 8 bits | ID assigned for use in initial ranging to the target BS once this BS is selected as the target BS (see 6.3.20.5). |
| } | — | — |
| If (HO_authorization policy indicator == 1) { | — | — |
| **HO_authorization_policy_support** | 8 bits | Bit #0: RSA authorization<br>Bit #1: EAP authorization<br>Bit #2: Authenticated-EAP authorization<br>Bit #3: HMAC supported<br>Bit #4: CMAC supported<br>Bit #5: 64-bit Short-HMAC<br>Bit #6: 80-bit Short-HMAC<br>Bit #7: 96-bit Short-HMAC |
| } | — | — |
| } | — | — |
| } | — | — |
| else if (Mode == 0b001) { | — | — |
| **TEMP_BSID** | 3 bits | TEMP_BS–ID of the recommended Anchor BS. |
| **AK Change Indicator** | 1 bit | To indicate whether the AK being used should change when switching to a new Anchor BS.<br>If set to 0, the MS should continue to use the AK currently in use.<br>If set to 1, the MS should use the AK derived for use with the new Anchor BS. |
| **N_CIDs** | 8 bits | Number of CIDs that need to be reassigned. For MDHO, N_CIDs shall be set to zero. |
| for (i= 0;i<N_CIDs;i++) { | — | — |
| **New CID** | 16 bits | New CID to be used after Diversity Set is updated. |
| } | — | — |
| **N_SAIDs** | 8 bits | Number of SAIDs that need to be reassigned. |
| For(i=0; i<N_SAIDs; i++){ | | |
| **New SAID** | 16 bits | New SAID to be used after Anchor BS is updated. |
| } | — | — |

### Table 109l—MOB_BSHO-REQ message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| } | — | — |
| else if (Mode == 0b010) { | — | — |
| **TEMP_BS–ID** | 3 bits | TEMP_BS–ID of the recommended Anchor BS. |
| **AK Change Indicator** | 1 bit | To indicate whether the AK being used should change when switching to a new Anchor BS.<br>If set to 0, the MS should continue to use the AK currently in use.<br>If set to 1, the MS should use the AK derived for use with the new Anchor BS. |
| } | — | — |
| else if (Mode == 0b011) { | — | — |
| **N_new_BSs** | 3 bits | Number of new BSs that are recommended to be added to the Diversity Set of the MS. |
| for (j=0 ; j<N_new_BSs ; j++) { | — | — |
| **Neighbor BSID** | 48 bits | — |
| **Temp BSID** | 3 bits | Diversity Set member ID assigned to this BS. |
| } | — | — |
| **N_current_BSs** | 3 bits | Number of BSs currently in the Diversity Set of the MS, which are recommended to be remained in the Diversity Set. |
| for (j=0 ; j<N_current_BSs ; j++) { | — | — |
| **Temp BSID** | 3 bits | Diversity Set member ID assigned to this BS. |
| } | — | — |
| **TEMP_BS–ID_Anchor** | 3 bits | Temp BSID for Anchor BS. |
| **AK Change Indicator** | 1 bit | To indicate whether the AK being used should change when switching to a new Anchor BS.<br>If set to 0, the MS should continue to use the AK currently in use.<br>If set to 1, the MS should use the AK derived for use with the new Anchor BS. |
| **N_CIDs** | 8 bits | Number of CIDs that need to be reassigned |
| for (j=0 ; j<N_CIDs ; j++) { | — | — |
| **New_CID** | 16 bits | New CID to be used after Diversity Set is updated |
| } | — | — |
| **N_SAIDs** | 8 bits | Number of SAIDs that need to be reassigned. |
| For(i=0; i<N_SAIDs; i++){ | | |
| **New SAID** | 16 bits | New SAID to be used after Diversity Set is updated. |
| } | — | — |
| } | — | — |

### Table 109l—MOB_BSHO-REQ message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| else if (Mode == 0b100) { | — | — |
| **N_new_BSs** | 3 bits | Number of new BSs that are recommended to be added to the Diversity Set of the MS. |
| for (j=0 ; j<N_new_BSs ; j++) { | — | — |
| **Neighbor BSID** | 48 bits | — |
| **Temp BSID** | 3 bits | Diversity Set member ID assigned to this BS. |
| } | — | — |
| **N_current_BSs** | 3 bits | Number of BSs currently in the Diversity Set of the MS, which are recommended to be remained in the Diversity Set. |
| for (j=0 ; j<N_current_BSs ; j++) { | — | — |
| **Temp_ BSID** | 3 bits | Diversity Set member ID assigned to this BS. |
| } | — | — |
| **TEMP_BS–ID_Anchor** | 3 bits | Temp_ BSID for Anchor BS |
| **AK Change Indicator** | 1 bit | To indicate whether the AK being used should change when switching to a new Anchor BS.<br>If set to 0, the MS should continue to use the AK currently in use.<br>If set to 1, the MS should use the AK derived for use with the new Anchor BS. |
| } | — | — |
| else if (Mode == 0b101) { | — | — |
| **N_new_BSs** | 3 bits | Number of new BSs that are recommended to be added to the Diversity Set of the MS. |
| **N_CIDs** | 8 bits | Number of CIDs that need to be reassigned |
| **N_SAIDs** | 8 bits | Number of SAIDs that need to be reassigned. |
| for ( i= 0; i < N_new_BSs; i++) { | — | — |
| **Neighbor BS_ID** | 48 bits | — |
| **TEMP_BS–ID** | 3 bits | Diversity Set member ID assigned to this BS. |
| for (j= 0;j<N_CIDs;j++) { | — | — |
| **New CID for BS_i** | 16 bits | New CID to be used for new BS_i. |
| } | — | — |
| For(i=0; i<N_SAIDs; i++){ | — | — |
| **New SAID for BS_i** | 16 bits | New SAID to be used for new BS_i. |
| } | — | — |
| } | — | — |

### Table 109I—MOB_BSHO-REQ message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **N_current_BSs** | 3 bits | Number of BSs currently in the Diversity Set of the MS, which are recommended to be remained in the Diversity Set. |
| for (i=0;i< N_current_BSs;i++) { | — | — |
| **TEMP_BS–ID** | 3 bits | Diversity Set member ID assigned to this BS. |
| } | — | — |
| **TEMP_BS–ID_Anchor** | 3 bits | Temp_BSID for Anchor BS. |
| **AK Change Indicator** | 1 bit | To indicate whether the AK being used should change when switching to a new Anchor BS.<br>If set to 0, the MS should continue to use the AK currently in use.<br>If set to 1, the MS should use the AK derived for use with the new Anchor BS. |
| } | — | — |
| else if (Mode == 0b110) { | — | — |
| **N_new_BSs** | 3 bits | Number of new BSs that are recommended to be added to the Diversity Set of the MS. |
| **N_CIDs** | 8 bits | Number of CIDs that need to be allocated. |
| **N_SAIDs** | 8 bits | Number of SAIDs that need to be reassigned. |
| for ( i= 0; i < N_new_BSs; i++) { | — | — |
| **Neighbor BS_ID** | 48 bits | — |
| **TEMP_BS–ID** | 3 bits | Diversity Set member ID assigned to this BS. |
| **for (j= 0;j<N_CIDs;j++) {** | — | — |
| **New CID for BS_i** | 16 bits | New CID to be used for new BS_i. |
| } | — | — |
| for(i=0; i<N_SAIDs; i++){ | | |
| **New SAID for BS_i** | 16 bits | New SAID to be used for new BS_i. |
| } | — | — |
| **CQICH_ID** | *variable* | Index to uniquely identify he CQICH resource assigned to the MS after the MS switched to the new anchor BS. |
| **Feedback channel offset** | 6 bits | Index to the fast-feedback channel region of the new Anchor BS marked by UIUC. |
| **Period (*p*)** | 2 bits | A CQI feedback is transmitted on the CQICH every $2^p$ frames. |
| **Frame offset** | 3 bits | The MS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the MS should start reporting in eight frames. |

### Table 109I—MOB_BSHO-REQ message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Duration (*d*)** | 3 bits | A CQI feedback is transmitted on the CQI channels indexed by the CQICH_ID for 10×$2^d$ frames.<br>If $d$ == 0b000, the CQI-CH is de-allocated.<br>If $d$ == 0b111, the MS should report until the BS command for the MS to stop. |
| **MIMO_permutation_feedback_cycle** | 2 bits | 0b00 = No MIMO and permutation mode feedback<br>0b01 = the MIMO and permutation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 4 CQICH transmission opportunities allocated to the MS in this message. The first indication is sent on the 4th CQICH transmission opportunity allocated to the MS in this message.<br>0b10 = the MIMO mode and permultation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 8 CQICH transmission opportunities allocated to the MS in this message. The first indication is sent on the 8th CQICH transmission opportunity allocated to the MS in this message.<br>0b11 = the MIMO mode and permultation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 16 CQICH transmission opportunities allocated to the MS in this message. The first indication is sent on the 16th CQICH transmission opportunity allocated to the MS in this message. |
| } | — | — |
| **N_current_BSs** | 3 bits | Number of BSs currently in the Diversity Set of the MS, which are recommended to be remained in the Diversity Set. |
| for (i=0;i< N_current_BSs;i++) { | — | — |
| **TEMP_BS–ID** | 3 bits | Diversity Set member ID assigned to this BS. |
| } | — | — |
| **TEMP_BS–ID_Anchor** | 3 bits | Temp BSID for Anchor BS. |
| **AK Change Indicator** | 1 bit | To indicate whether the AK being used should change when switching to a new Anchor BS.<br>If set to 0, the MS should continue to use the AK currently in use.<br>If set to 1, the MS should use the AK derived for use with the new Anchor BS. |
| } | — | — |
| **Action time** | 7 bits | — |
| *padding* | *variable* | Padding bits to ensure byte aligned. |
| TLV encoded information | *variable* | TLV specific. |
| } | — | — |

A BS shall generate MOB_BSHO-REQ messages in the format shown in Table 109l. The following parameters shall be included in the MOB_BSHO-REQ message:

**Mode**
Indicates which HO mode is for this handover request.
0b000: HO request
0b001: MDHO/FBSS request: Anchor BS update with CID update
0b010: MDHO/FBSS request: Anchor BS update without CID update
0b011: MDHO/FBSS request: Diversity Set update with CID update
0b100: MDHO/FBSS request: Diversity Set update without CID update
0b101: MDHO/FBSS request: Diversity Set update with CID update for newly added BS
0b110: MDHO/FBSS request: Diversity Set update with CID update and CQICH allocation for newly added BS
0b111: *Reserved*

**HO operation mode**
Indicate the operation mode of this HO request as initiated and prescribed by BS.
0: Recommended HO request
1: Mandatory HO request. If HO operation mode is set to 1, BS shall include at least one recommended BS in the message (N_Recommended >= 1).

**Resource Retain Flag**
The Resource Retain Flag indicates whether the serving BS will retain or delete the connection information of the MS upon receiving MOB_HO-IND with HO_IND_type=0b00. If the flag is set to 1, the serving BS will retain the MS's connection information during the time in Resource Retain Time field. If Resource Retain Flag=1 and Resource Retain Time is not included as a TLV item in the message, then the serving BS and MS shall use the System Resource Retain Time timer. If the flag is set to 0, the serving BS will discard the MS's connection information.

**Action Time**
For HO, this value is defined as number of frames until the Target BS allocates a dedicated transmission opportunity for RNG-REQ message to be transmitted by the MS using Fast_Ranging_IE. Dedicated allocation for transmission of RNG-REQ means that channel parameters learned by the MS during Association of that BS stay valid and can be reused during actual Network Re-entry without preceding CDMA-based Initial Ranging. This parameter is decided by the Serving BS based on the information obtained from potential Target BSs over the backbone.

For MDHO/FBSS, this is the time of update of Anchor BS and/or Diversity Set. A value of zero in this parameter signifies that this parameter should be ignored.

For Mode=0b00, for each recommended neighbor BS, the following parameters shall be included:

**Network Assisted HO supported**
Indicates that the BS supports Network Assisted HO, 1=supported, 0=not supported

**Neighbor BSID**
Same as the Base Station ID parameter in the DL-MAP message of neighbor BS. This may include the serving BS.

**Preamble index/ Subchannel Index**
For the SCa and OFDMA PHY this parameter defines the PHY specific preamble for the neighbor BS. For the OFDM PHY the 5 LSB contain the DL subchannel index (as defined in Table 211) used in the Neighbor BS' sector. The 3 MSB shall be Reserved and set to 0b000.

**Service level prediction**
The service level prediction value indicates the level of service the MS can expect from this BS. The following encodings apply:
0 = No service possible for this MS
1 = Some service is available for one or several service flows authorized for the MS.

2 = For each authorized service flow, a MAC connection can be established with QoS specified by the AuthorizedQoSParamSet.
3 = No service level prediction available.

**HO process optimization**

HO Process Optimization is provided as part of this message is indicative only. HO process requirements may change at time of actual HO. For each Bit location, a value of '0' indicates the associated reentry management messages shall be required, a value of '1' indicates the reentry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the target BS may send unsolicited SBC-RSP and/ or REG-RSP management messages:

Bit #0: Omit SBC-REQ/RSP management messages during re-entry processing
Bit #1: Omit PKM Authentication phase except TEK phase during current re-entry processing
Bit #2: Omit PKM TEK creation phase during re-entry processing
Bit #3: Omit REG-REQ/RSP management during current re-entry processing
Bit #4: Omit Network Address Acquisition management messages during current re-entry processing
Bit #5: Omit Time of Day Acquisition management messages during current reentry processing
Bit #6: Omit TFTP management messages during current re-entry processing
Bit #7: Full service and operational state transfer or sharing between serving BS and target BS (ARQ, timers, counters, MAC state machines, etc…)

For Mode != 0b000, the following parameters shall be included:

**N_new_BSs**

Number of new BSs that are recommended to be added to the Diversity Set of the MS.

**N_CID**

Number of CIDs that need to be allocated.

**TEMP BSID**

Index to diversity set for active BS ranging from 0 to 7.

**New CID**

The New CIDs shall be set according to the followings: the first CID in the list shall be basic CID; the second CID in the list shall be primary management CID, the third CID in the list shall be Secondary Management CID if secondary management connection is established for the MS at the current serving BS. The remaining CIDs shall be transport CIDs, multicast CIDs are enumerated by the ascending order of corresponding current SFIDs. The MS shall store the CIDs associated with the newly added BS and using the CIDs when the newly added BS becomes the anchor BS.

**N_SAIDs**

Number of SAIDs that need to be assigned.

**New SAID**

New SAIDs are enumerated by the ascending order of corresponding current SAIDs. The MS shall store the SAIDs associated with the newly added BS and using the SAIDs when the newly added BS becomes the anchor BS.

**HO_ID included indicator**

Indicates whether HO_ID is included or not in this message.

**HO_ID**

ID assigned for use in initial ranging to the target BS once this BS is selected as the target BS (see 6.3.20.5).

**AK Change Indicator**

Indicates whether the AK being used should change when switching to a new Anchor BS. If set to 0, the MS should continue to use the AK currently in use; if set to 1, the MS should use the AK derived for use with the new Anchor BS.

The MOB_BSHO-REQ may contain the following TLV:

**Resource Retain Time (see 11.15.1)**

The MOB_BSHO-REQ message shall include the following parameter encoded as TLV tuples:

**HMAC/CMAC Tuple (see 11.1.2)**

The HMAC/CMAC Tuple shall be the last attribute in the message.

***Insert new subclause 6.3.2.3.53:***

### 6.3.2.3.53 MS HO Request (MOB_MSHO-REQ) message

The MS may transmit an MOB_MSHO-REQ message when it wants to initiate an HO. The message shall be transmitted on the basic CID (Table 109m).

Table 109m—MOB_MSHO-REQ message format

| Syntax | Size | Notes |
|---|---|---|
| MOB_MSHO-REQ_Message_format() { | — | — |
| **Management Message Type = 57** | 8 bits | — |
| **Report metric** | 8 bits | Bitmap indicating presence of metric in message<br>Bit #0: BS CINR mean<br>Bit #1: BS RSSI mean<br>Bit #2: Relative delay<br>Bit #3: BS RTD; this metric shall be only measured on serving BS/anchor BS.<br>Bits #4–7: *Reserved*; shall be set to zero. |
| **N_New_BS_Index** | 8 bits | Number of new recommended BSs which are included in MOB_NBR-ADV message. |
| If(N_New_BS_Index!=0){ | | |
| **Configuration change count for MOB_NBR-ADV** | 8 bits | Configuration Change Count value of referring MOB_NBR-ADV message. |
| } | | |
| For(j=0;j< N_New_BS_Index;j++){ | | |
| **Neighbor_BS_Index** | 8 bits | |
| **Preamble index/ Preamble Present and Subchannel Index** | 8 bits | For the SCa and OFDMA PHY this parameter defines the PHY specific preamble for the neighbor BS. For the OFDM PHY the 5 LSB contain the active DL subchannel index for the neighbor BS. The 3 MSB shall be *Reserved* and set to '0b000'. |
| If(Report metric[Bit#0]==1) | | |
| **BS CINR mean** | 8 bits | |
| If(Report metric[Bit#1]==1) | | |

### Table 109m—MOB_MSHO-REQ message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **BS RSSI mean** | 8 bits | |
| If(Report metric[Bit#2]==1) | | |
| **Relative delay** | 8 bits | |
| **Service level prediction** | 3 bits | |
| **Arrival Time Difference Indication** | 1 bit | If the MS is transmitting this message to request HO or MDHO/FBSS is not supported by either BS or MS, this bit shall be set to 0. |
| If (Arrival Time Difference Indication == 1) { | | |
| **Arrival Time Difference (t)** | 4 bits | Relative difference in arrival time between the neighbor BS and the anchor BS, in terms of fraction of CP. |
| } | | |
| } | | |
| **N_New_BS_Full** | | |
| For(j=0;j< N_New_BS_Full;j++){ | | |
| **Neighbor_BS_ID** | 8 bits | |
| **Preamble index/ Preamble Present and Subchannel Index** | 8 bits | For the SCa and OFDMA PHY this parameter defines the PHY specific preamble for the neighbor BS. For the OFDM PHY the 5 LSB contain the active DL subchannel index for the neighbor BS. The 3 MSB shall be Reserved and set to ‘0b000’. |
| If (Report metric [Bit#0] == 1) | — | — |
| **BS CINR mean** | 8 bits | — |
| If(Report metric[Bit#1]==1) | — | — |
| **BS RSSI mean** | 8 bits | — |
| If(Report metric[Bit#2]==1) | — | — |
| **Relative delay** | 8 bits | — |
| **Service level prediction** | 3 bits | — |
| **Arrival Time Difference Indication** | 1 bit | If the MS is transmitting this message to request HO or MDHO/FBSS is not supported by either BS or MS, this bit shall be set to 0. |
| If (Arrival Time Difference Indication == 1) { | — | — |
| **Arrival Time Difference (t)** | 4 bits | Relative difference in arrival time between the neighbor BS and the anchor BS, in terms of fraction of CP. |
| } | — | — |
| } | — | — |

**Table 109m—MOB_MSHO-REQ message format** ***(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **N_current_BSs** | 3 bits | When FBSS/MDHO is supported and the MS has non-empty diversity set, N_current_BSs is the number of BSs that are currently in the Diversity Set of the MS When FBSS/MDHO is not supported or the MS has an empty diversity set, N_current_BSs is set to 1. |
| **Padding** | 1 bit | Shall be set to zero. |
| For (j=0 ; j<N_current_BSs ; j++) { | — | — |
| **Temp BSID** | 4 bits | Diversity Set member ID assigned to this BS. When the MS has an empty diversity set or FBSS/MDHO is not supported, Temp BSID shall be set to 0. |
| If(Report metric[Bit#0]==1) | — | — |
| **BS CINR mean** | 8 bits | — |
| If(Report metric[Bit#1]==1) | — | — |
| **BS RSSI mean** | 8 bits | — |
| If(Report metric[Bit#2]==1) | — | — |
| **Relative delay** | 8 bits | Only when FBSS/MDHO is in progress, this field will include the relative delay of BSs currently in the diversity set, except anchor BS. |
| If(Report metric[Bit#3]==1) | — | — |
| **BS RTD** | 8 bits | This field will include the RTD of the serving BS/anchor BS. |
| } | — | — |
| *Padding* | *variable* | Padding bits to ensure byte aligned. |
| **TLV encoded information** | *variable* | |
| } | — | — |

An MS shall generate MOB_MSHO-REQ messages in the format shown in Table 109m. The following parameters shall be included in the MOB_MSHO-REQ message:

**Report metric**

Bitmap indicator of trigger metrics that the MS reports in this message. MS shall indicate only the trigger metrics agreed during SBC-REQ/RSP negotiation For each bit location, a value of ‘0’ indicates the trigger metric should not be included, while a value of '1' indicates the trigger metric should be included in the message. The bitmap interpretation for the metrics shall be:

Bit 0: BS CINR mean
Bit 1: BS RSSI mean
Bit 2: Relative delay
Bit 3: BS RTD; this metric shall be only measured on serving BS/anchor BS
Bits 4–7: *Reserved*; shall be set to zero

**N_New_BS_Index**

Number of neighboring BSs to be considered for handover, which are included in MOB_NBR-ADV message. The number could be larger than zero only when NBR_BS_Index_Validity_Time is larger than the difference of MOB_MSHO-REQ message transmitting time and MOB_NBR-ADV message receiving time (MOB_NBR-ADV message should be referred).

**N_New_BS_Full**

Number of neighboring BSs to be scanned or associated, which are not included in MOB_NBR-ADV message.

For each recommended neighbor BS, the following parameters shall be included,

**Configuration Change Count for MOB_NBR-ADV**

The value of Configuration Change Count in MOB_NBR-ADV message referred in order to compress neighbor BSID.

**Neighbor_BS_Index**

BS index corresponds to position of BS in MOB_NBR-ADV message.

**Neighbor BSID**

Same as the Base Station ID parameter in the DL-MAP message of the Neighbor BS.

**Preamble index/ Subchannel Index**

For the SCa and OFDMA PHY this parameter defines the PHY specific preamble for the neighbor BS. For the OFDM PHY the 5 LSB contain the DL subchannel index (as defined in Table 211) used in the Neighbor BS' sector. The 3 MSB shall be Reserved and set to 0.

According to Report metric that MS indicates, the MOB_MSHO-REQ message includes the following parameters:

**BS CINR mean**

The BS CINR mean parameter indicates the CINR in dB measured at the MS on the downlink signal of a particular BS. The value shall be interpreted as a signed byte with the resolution of 0.5 dB. The measurement shall be performed on the subcarriers of the frame preamble that are active in the particular BS's segment and averaged over the measurement period.

**BS RSSI mean**

The BS RSSI mean parameter indicates the Received Signal Strength measured by the MS from the particular BS. The value shall be interpreted as an unsigned byte with units of 0.25 dB, such that 0x00 is interpreted as –103.75 dBm, an MS shall be able to report values in the range –103.75 dBm to –40 dBm. The measurement shall be performed on the frame preamble and averaged over the measurement period.

**Relative delay**

This parameter indicates the delay of neighbor DL signals relative to the serving BS, as measured by the MS for the particular BS. The value shall be interpreted as a signed integer in units of samples.

**BS RTD**

The BS RTD parameter indicates the round trip delay (RTD) measured by the MS from the serving BS. RTD can be RTD can be given by the latest time advance taken by MS. The value shall be interpreted as an unsigned byte with units of 1/Fs (see 10.3.4.3). This parameter shall be only measured on serving BS/anchor BS.

**Service level prediction**

The service level prediction value indicates the level of service the MS can expect from this BS. The following encodings apply:

0 = No service possible for this MS

1 = Some service is available for one or several service flows authorized for the MS

2 = For each authorized service flow, a MAC connection can be established with QoS specified by the AuthorizedQoSParamSet.
3 = No service level prediction available.

**Arrival Time Difference**

The Arrival Time Difference parameter indicates the delay of downlink signal relative to the serving BS, as measured by the MS for the neighbor BS. For SCa PHY mode, this value shall be interpreted as a signed byte with the resolution of PS. For OFDM and OFDMA PHY mode, this value shall be interpreted as a signed fraction with a range of +7/8 to –1 one cyclic prefix time of the serving BS. A positive value indicates that the signal of the neighbor BS arrived after that of the serving BS (for example, the value of 0x02 indicates that the neighbor signal is delayed by 25% ±6.25% of the CP).

When the MS supports FBSS/MDHO and has a non-empty diversity set, the MS shall include the following parameters for each active BS. When the MS does not support FBSS/MDHO or has an empty active, the MS shall include the following parameters for the current serving BS.

**Temp BSID**

When the MS support FBSS/MDHO and has a non-empty diversity set, Temp BSID is the diversity set member ID. When the MS does not support FBSS/MDHO or has an empty diversity set, Temp BSID shall be set to 0.

**BS CINR mean**

The BS CINR mean parameter indicates the CINR in dB measured at the MS on the downlink signal of a particular BS. The value shall be interpreted as a signed byte with the resolution of 0.5 dB. The measurement shall be performed on the frame preamble and averaged over the measurement period.

The MOB_MSHO-REQ message shall include the following parameters encoded as TLV tuples:

**HMAC/CMAC Tuple (See 11.1.2.)**

The HMAC/CMAC Tuple shall be the last attribute in the message.

*Insert new subclause 6.3.2.3.54:*

### 6.3.2.3.54 BS HO Response (MOB_BSHO-RSP) message

The BS shall transmit an MOB_BSHO-RSP message upon reception of MOB_MSHO-REQ message. The message shall be transmitted on the basic CID.

**Table 109n—MOB_BSHO-RSP message format**

| Syntax | Size | Notes |
|---|---|---|
| MOB_BSHO-RSP_Message_format() { | — | — |
| **Management Message Type = 58** | 8 bits | — |

**Table 109n—MOB_BSHO-RSP message format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **Mode** | 3 bits | 0b000: HO request<br>0b001: MDHO/FBSS request: Anchor BS update with CID update<br>0b010: MDHO/FBSS request: Anchor BS update without CID update<br>0b011: MDHO/FBSS request: Diversity Set update with CID update<br>0b100: MDHO/FBSS request: Diversity Set update without CID update<br>0b101: MDHO/FBSS request: Diversity Set update with CID update for newly added BS<br>0b110: MDHO/FBSS request: Diversity Set update with CID update and CQICH allocation for newly added BS<br>0b111: MS handover request not recommended (BS in list unavailable) |
| *Reserved* | 5 bits | Shall be set to zero. |
| If (Mode == 0b000) { | — | — |
| **HO operation mode** | 1 bit | 0: Recommended HO response.<br>1: Mandatory HO response. |
| **N_Recommended** | 8 bits | — |
| **Resource Retain Flag** | 1 bit | 0: Release connection information.<br>1: Retain connection information. |
| ***Reserved*** | 7 bits | Shall be set to zero. |
| For (j=0 ; j<N_Recommended ; j++) { | — | Neighbor base stations shall be presented in an order such that the first presented is the one most recommended and the last presented is the least recommended. |
| **Neighbor BSID** | 48 bits | — |
| **Preamble index/ Preamble Present and Subchannel Index** | 8 bits | For the SCa and OFDMA PHY this parameter defines the PHY specific preamble for the neighbor BS. For the OFDM PHY the 5 LSB contain the active DL subchannel index for the neighbor BS. The 3 MSB shall be Reserved and set to '0b000'. |
| **Service level prediction** | 8 bits | — |
| **HO process optimization** | 8 bits | — |
| **Network Assisted HO supported** | 1 bit | Indicates that the BS supports Network Assisted HO. |
| **HO_ID_included_indicator** | 1 bit | Indicates if the field HO_IND is included. |
| If (HO_ID_included_indicator == 1) { | — | — |
| **HO_ID** | 8 bits | ID assigned for use in initial ranging to the target BS once this BS is selected as the target BS. |
| } | — | — |

### Table 109n—MOB_BSHO-RSP message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **HO_authorization policy indicator** | 1 bit | To indicate if authorization negotiation is used in HO procedure.<br>0: EAP authorization and the value of the MAC mode field in the current BS (default)<br>1: The authorization policy for the target BS is negotiated. |
| *Reserved* | 4 bits | Shall be set to zero. |
| If (HO_authorization policy indicator == 1) { | — | — |
| **HO_authorization_policy_support** | 8 bits | Bit #0: RSA authorization<br>Bit #1: EAP authorization<br>Bit #2: Authenticated-EAP authorization<br>Bit #3: HMAC supported<br>Bit #4: CMAC supported<br>Bit #5: 64-bit Short-HMAC<br>Bit #6: 80-bit Short-HMAC<br>Bit #7: 96-bit Short-HMAC |
| } | | |
| } | — | — |
| } | — | — |
| else if (Mode == 0b001) { | — | — |
| **Temp BSID** | 3 bits | TEMP_BSID of the recommended Anchor BS. |
| **AK Change Indicator** | 1 bit | To indicate whether the AK being used should change when switching to a new Anchor BS.<br>If set to 0, the MS should continue to use the AK currently in use.<br>If set to 1, the MS should use the AK derived for use with the new Anchor BS. |
| **N_CIDs** | 8 bits | Number of CIDs that need to be reassigned. For MDHO, N_CIDs shall be set to zero. |
| For (i= 0;i<N_CIDs;i++) { | — | — |
| **New CID** | 16 bits | New CID to be used after Diversity Set is updated. |
| } | — | — |
| **N_SAIDs** | 8 bits | Number of SAIDs that need to be reassigned. |
| For(i=0; i<N_SAIDs; i++){ | | |
| **New SAID** | 16 bits | New SAID to be used after Anchor BS is updated. |
| } | — | — |
| } | — | — |
| else if (Mode == 0b010) { | — | — |
| **Temp BSID** | 3 bits | TEMP_BSID of the recommended Anchor BS. |

### Table 109n—MOB_BSHO-RSP message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **AK Change Indicator** | 1 bit | To indicate whether the AK being used should change when switching to a new Anchor BS.<br>If set to 0, the MS should continue to use the AK currently in use.<br>If set to 1, the MS should use the AK derived for use with the new Anchor BS. |
| } | — | — |
| else if (Mode == 0b011) { | — | — |
| **N_new_BSs** | 3 bits | Number of new BSs that are recommended to be added to the Diversity Set of the MS. |
| For (j=0 ; j<N_new_BSs ; j++) { | — | — |
| **Neighbor BSID** | 48 bits | — |
| **Temp BSID** | 3 bits | Diversity Set member ID assigned to this BS |
| } | — | — |
| **N_current_BSs** | 3 bits | Number of BSs currently in the Diversity Set of the MS that are recommended to remain in the Diversity Set |
| For (j=0 ; j<N_current_BSs ; j++) { | — | — |
| **Temp BSID** | 3 bits | Diversity Set member ID assigned to this BS. |
| } | — | — |
| **TEMP_BS–ID_Anchor** | 3 bits | Temp BSID for Anchor BS |
| **AK Change Indicator** | 1 bit | To indicate whether the AK being used should change when switching to a new Anchor BS.<br>If set to 0, the MS should continue to use the AK currently in use.<br>If set to 1, the MS should use the AK derived for use with the new Anchor BS. |
| **N_CIDs** | 8 bits | Number of CIDs that need to be reassigned. |
| For (j=0 ; j<N_CIDs ; j++) { | — | — |
| **New_CID** | 16 bits | New CID to be used after Diversity Set is updated. |
| } | — | — |
| **N_SAIDs** | 8 bits | Number of SAIDs that need to be reassigned. |
| For(i=0; i<N_SAIDs; i++){ | | |
| **New SAID** | 16 bits | New SAID to be used after Diversity Set is updated. |
| } | — | — |
| } | — | — |
| else if (Mode == 0b100) { | — | — |
| **N_new_BSs** | 3 bits | Number of new BSs that are recommended to be added to the Diversity Set of the MS. |
| For (j=0 ; j<N_new_BSs ; j++) { | — | — |

### Table 109n—MOB_BSHO-RSP message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Neighbor BSID** | 48 bits | — |
| **Temp BSID** | 3 bits | Diversity Set member ID assigned to this BS. |
| } | — | — |
| **N_current_BSs** | 3 bits | Number of BSs currently in the Diversity Set of the MS, which are recommended to be remained in the Diversity Set. |
| For (j=0 ; j<N_current_BSs ; j++) { | — | — |
| **Temp BSID** | 3 bits | Diversity Set member ID assigned to this BS. |
| } | — | — |
| **TEMP_BSID_Anchor** | 3 bits | Temp BSID for Anchor BS. |
| **AK Change Indicator** | 1 bit | To indicate whether the AK being used should change when switching to a new Anchor BS.<br>If set to 0, the MS should continue to use the AK currently in use.<br>If set to 1, the MS should use the AK derived for use with the new Anchor BS. |
| } | — | — |
| else if (Mode == 0b101) { | — | — |
| **N_new_BSs** | 3 bits | Number of new BSs that are recommended to be added to the Diversity Set of the MS. |
| **N_CIDs** | 8 bits | Number of CIDs that need to be reassigned. |
| for ( i= 0; i < N_new_BSs; i++) { | — | — |
| **Neighbor BSID** | 48 bits | — |
| **TEMP_BSID** | 3 bits | Diversity Set member ID assigned to this BS. |
| for (j= 0;j<N_CIDs;j++) { | — | — |
| **New CID for BS_i** | 16 bits | New CID to be used for new BS_i. |
| } | — | — |
| } | — | — |
| **N_current_BSs** | 3 bits | Number of BSs currently in the Diversity Set of the MS that are recommended to remain in the Diversity Set. |
| for (i=0;i< N_current_BSs;i++) { | — | — |
| **TEMP_BSID** | 3 bits | Diversity Set member ID assigned to this BS. |
| } | — | — |
| **TEMP_BSID_Anchor** | 3 bits | Temp BSID for Anchor BS. |
| **AK Change Indicator** | 1 bit | To indicate whether the AK being used should change when switching to a new Anchor BS.<br>If set to 0, the MS should continue to use the AK currently in use.<br>If set to 1, the MS should use the AK derived for use with the new Anchor BS. |
| } | — | — |

**Table 109n—MOB_BSHO-RSP message format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| else if (Mode == 0b110) { | — | — |
| **N_new_BSs** | 3 bits | Number of new BSs that are recommended to be added to the Diversity Set of the MS. |
| **N_CIDs** | 8 bits | Number of CIDs that need to be reassigned. |
| **N_SAIDs** | 8 bits | Number of SAIDs need to be reassigned.. |
| for ( i= 0; i < N_new_BSs; i++) { | — | — |
| **Neighbor BSID** | 48 bits | — |
| **TEMP_BSID** | 3 bits | Diversity Set member ID assigned to this BS. |
| **for (j= 0;j<N_CIDs;j++) {** | — | — |
| **New CID for BS_i** | 16 bits | New CID to be used for new BS_i. |
| } | — | — |
| For(i=0; i<N_SAIDs; i++){ | — | — |
| **New SAID for BS_i** | 16 bits | New SAID to be used for new BS_i. |
| } | — | — |
| **CQICH_ID** | *variable* | Index to uniquely identify the CQICH resource assigned to the MS after the MS switched to the new anchor BS. |
| **Feedback channel offset** | 6 bits | Index to the fast-feedback channel region of the new Anchor BS marked by UIUC. |
| **Period (=p)** | 2 bits | A CQI feedback is transmitted on the CQICH every $2^p$ frames. |
| **Frame offset** | 3 bits | The MS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the MS should start reporting in eight frames. |
| **Duration (=d)** | 3 bits | A CQI feedback is transmitted on the CQI channels indexed by the CQICH_ID for $10\times2^d$ frames.<br>If d == 0b000, the CQI-CH is de-allocated.<br>If d == 0b111, the MS should report until the BS command for the MS to stop. |

### Table 109n—MOB_BSHO-RSP message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **MIMO_permutation_feedback_cycle** | 2 bits | 0b00 = No MIMO and permutation mode feedback<br>0b01 = the MIMO and permutation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every four CQICH transmission opportunities allocated to the MS in this message. The first indication is sent on the 4th CQICH transmission opportunity allocated to the MS in this message.<br>0b10 = the MIMO mode and permultation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every eight CQICH transmission opportunities allocated to the MS in this message. The first indication is sent on the 8th CQICH transmission opportunity allocated to the MS in this message.<br>0b11 = the MIMO mode and permultation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 16 CQICH transmission opportunities allocated to the MS in this message. The first indication is sent on the 16th CQICH transmission opportunity allocated to the MS in this message. |
| } | — | — |
| **N_current_BSs** | 3 bits | Number of BSs currently in the Diversity Set of the MS that are recommended to remain in the Diversity Set. |
| for (i=0;i< N_current_BSs;i++) { | — | — |
| **TEMP_BSID** | 3 bits | Diversity Set member ID assigned to this BS. |
| } | — | — |
| **TEMP_BSID_Anchor** | 3 bits | Temp BSID for Anchor BS. |
| **AK Change Indicator** | 1 bit | To indicate whether the AK being used should change when switching to a new Anchor BS.<br>If set to 0, the MS should continue to use the AK currently in use.<br>If set to 1, the MS should use the AK derived for use with the new Anchor BS. |
| } | — | — |
| **Action time** | 8 bits | — |
| *padding* | *variable* | Padding bits to ensure byte aligned. |
| **TLV encoded information** | 2 bits | TLV specific See 11.16.1. |
| } | | |

A BS shall generate MOB_BSHO-RSP messages in the format shown in Table 109n. The following parameters shall be included in the MOB_BSHO-RSP message:

**HO operation mode**

Indicate the operation mode of this HO response as prescribed by BS.

0: Recommended HO response.

1: Mandatory HO response. If HO operation mode is set to 1, BS shall include at least one recommended BS in the message (N_Recommended >= 1).

**Action Time**

For HO, this value is defined as number of frames until the Target BS allocates a dedicated transmission opportunity for RNG-REQ message to be transmitted by the MS using Fast Ranging IE. Non-zero value of this parameter means that potential Target BS estimates that channel parameters learned by the MS during Association of that BS stay valid and can be reused during actual Network Re-entry without preceding CDMA-based Initial Ranging. This parameter is decided by the Serving BS based on the information obtained from potential Target BSs over the backbone.

For MDHO/FBSS, this is the time of update of Anchor BS and/or Diversity Set. A value of zero in this parameter signifies that this parameter should be ignored.

For MS handover request not recommended (Mode == 0b111), Action Time is the number of frames that the BS suggests MS wait before transmitting a next MOB_MSHO-REQ or MOB_HO-IND. If the action timer is equal to 0, MS may transmit a revised MOB_MSHO-REQ or MOB_HO-IND immediately.

**Resource Retain Flag**

The Resource Retain Flag indicates whether the serving BS will retain or delete the connection information of the MS upon receiving MOB_HO-IND with HO_IND_type=0b00. If the flag is set to 1, the serving BS will retain the MS's connection information during the time in Resource Retain Time field. If Resource Retain Flag=01 then the serving BS and MS shall use the System Resource Retain Time timer. If the flag is set to 0, the serving BS will discard the MS's connection information.

For Mode=0b000 for each recommended neighbor BS, the following parameters shall be included,

**NeighborBSID**

Same as the **Base Station ID** parameter in the DL-MAP message of neighbor BS. This may include the serving BS.

**Preamble index/ Subchannel Index**

For the SCa and OFDMA PHY this parameter defines the PHY specific preamble for the neighbor BS. For the OFDM PHY the 5 LSB contain the DL subchannel index (as defined in Table 211) used in the Neighbor BS' sector. The 3 MSB shall be Reserved and set to 0.

**Service level prediction**

The service level prediction value indicates the level of service the MS can expect from this BS. The following encodings apply:

0 = No service possible for this MS

1 = Some service is available for one or several service flows authorized for the MS.

2 = For each authorized service flow, a MAC connection can be established with QoS specified by the AuthorizedQoSParamSet.

3 = No service level prediction available.

**HO process optimization**

HO Process Optimization is provided as part of this message is indicative only. HO process requirements may change at time of actual HO. For each Bit location, a value of '0' indicates the associated reentry management messages shall be required, a value of '1' indicates the reentry management message may be omitted. Regardless of the HO Process Optimization TLV settings, the target BS may send unsolicited SBC-RSP and/ or REG-RSP management messages:

Bit #0: Omit SBC-REQ/RSP management messages during re-entry processing

Bit #1: Omit PKM Authentication phase except TEK phase during current re-entry processing
Bit #2: Omit PKM TEK creation phase during re-entry processing
Bit #3: Omit REG-REQ/RSP management during current re-entry processing
Bit #4: Omit Network Address Acquisition management messages during current reentry processing
Bit #5: Omit Time of Day Acquisition management messages during current reentry processing
Bit #6: Omit TFTP management messages during current re-entry processing
Bit #7: Full service and operational state transfer or sharing between serving BS and target BS (ARQ, timers, counters, MAC state machines, etc…)

**HO_ID_included_indicator**
Indicates whether HO_ID is included or not in this message.

The MOB_BSHO-RSP may contain the following TLV:

**Resource Retain Time (See 11.15.1.)**

The MOB_BSHO-RSP message shall include the following parameter encoded as TLV tuples:

**HMAC/CMAC Tuple (See 11.1.2.)**

The HMAC/CMAC Tuple shall be the last attribute in the message.

For Mode != 0b000, the following parameter shall be included:

**AK Change Indicator**
Indicates whether the AK being used should change when switching to a new Anchor BS. If set to 0, the MS should continue to use the AK currently in use; if set to 1, the MS should use the AK derived for use with the new Anchor BS.

***Insert new subclause 6.3.2.3.55:***

#### 6.3.2.3.55 HO Indication (MOB_HO-IND) message

An MS shall transmit a MOB_HO-IND message for final indication that it is about to perform a HO. When the MS cancels or rejects the HO, the MS shall transmit a MOB_HO-IND message with appropriate HO_IND_type field. The message shall be transmitted on the basic CID.

**Table 109o—MOB_HO-IND message format**

| Syntax | Size | Notes |
|---|---|---|
| MOB_HO-IND_Message_format() { | — | — |
| **Management Message Type = 59** | 8 bits | — |
| *Reserved* | 6 bits | *Reserved*; shall be set to zero |
| **Mode** | 2 bits | 0b00: HO<br>0b01: MDHO/FBSS: Anchor BS update<br>0b10: MDHO/FBSS: Diversity Set update<br>0b11: *Reserved* |
| if (Mode == 0b00) { | — | — |

### Table 109o—MOB_HO-IND message format *(continued)*

| | | |
|---|---|---|
| **HO_IND_type** | 2 bits | 0b00: serving BS release<br>0b01: HO cancel<br>0b10: HO reject<br>0b11: *Reserved* |
| **Ranging_Params_valid_indication** | 2 bits | 0b00: No indication. BS ignores this field (Default)<br>0b01: MS ranging parameters for Target BS, which is specified in this message are valid<br>0b10: MS has no valid ranging parameters for Target BS, which is specified in this message<br>0b11: *Reserved* |
| ***Reserved*** | 4 bits | Shall be set to zero. |
| if (HO_IND_type == 0b00) { | — | — |
| **Target_BS_ID** | 48 bits | Applicable only when HO_IND_type is set to 0b00. |
| } | — | — |
| } | — | — |
| if (Mode == 0b01) { | — | — |
| **MDHOFBSS_IND_Type** | 2 bits | 0b00: Confirms Anchor BS update<br>0b01: Anchor BS update cancel<br>0b10: Anchor BS update reject<br>0b11: *Reserved* |
| if (MDHOFBSS_IND_Type == 0b00) { | — | — |
| **Anchor BSID** | 3 bits | TEMP_BSID of the Anchor BS |
| **Action time** | 8 bits | Action time when the Anchor BS shall be updated. |
| } | — | — |
| } | — | — |
| if (Mode == 0b10) { | — | — |
| **MDHOFBSS_IND_Type** | 2 bits | 0b00: Confirms Diversity Set update<br>0b01: Diversity Set update cancel<br>0b10: Diversity set update reject<br>0b11: *Reserved* |
| if (MDHOFBSS_IND_Type == 0b00) { | — | — |
| **Diversity Set Included Indicator** | 1 bit | 1: Final decision of Diversity Set members included in the message<br>0: Diversity Set members are as specified in MOB_BSHO_RSP message. No Diversity Set information included in this message. |
| if (Diversity Set Included Indicator == 1) { | 3 bits | — |
| **Anchor BSID** | 3 bits | TEMP_BSID of the Anchor BS. |
| **N_BSs** | 3 bits | Number of BS in the Diversity Set, excluding the Anchor BS. |
| For (j=0 ; j<N_BSs ; j++) { | — | — |

### Table 109o—MOB_HO-IND message format *(continued)*

| | | |
|---|---|---|
| **Temp BSID** | 3 bits | Diversity Set member ID assigned. |
| } | — | — |
| } | 8 bits | — |
| **Action time** | 8 bits | Action time when the Anchor BS shall be updated. |
| } | — | — |
| } | — | — |
| **Preamble index/ Subchannel Index** | 8 bits | For the SCa and OFDMA PHY this parameter defines the PHY specific preamble for the target BS. For the OFDM PHY the 5 LSB contain the active DL subchannel index for the target BS. The 3 MSB shall be Reserved and set to '0b000'. |
| *Padding* | *variable* | Padding bits to ensure byte aligned. Shall be set to zero. |
| **TLV encoded information** | *variable* | — |
| } | — | — |

The MS shall use the handover mode signaled by the BS in the previous MOB_BSHO-REQ or MOB_BSHO-RSP message to perform handover.

An MS shall generate MOB_HO-IND messages in the format shown in Table 109o. The following parameters shall be included in the message:

**Ranging Params valid indication**

Indicator that shows whether ranging parameters acquired by the MS during preceding Association with selected Target BS are still valid. This indicator may be used by Target BS in decision to allocate dedicated transmission opportunity by Fast Ranging IE.
0b00: No indication. BS ignores this field (Default)
0b01: MS ranging parameters for Target BS, which is specified in this message are valid
0b10: MS has no valid ranging parameters for Target BS, which is specified in this message
0b11: *Reserved*

**Target_BS_ID**

Same as the Base Station ID parameter in the DL-MAP message of target BS.

**Preamble Index/ Subchannel Index**

For the SCa and OFDMA PHY this parameter defines the PHY specific preamble for the target BS. For the OFDM PHY the 5 LSB contain the DL subchannel index (as defined in Table 211) used in the target BS sector. The 3 MSB shall be Reserved and set to 0.

The MOB_HO-IND message shall include the following parameter encoded as TLV tuples:

**HMAC/CMAC Tuple (See 11.1.2.)**

The HMAC/CMAC Tuple shall be the last attribute in the message.

***Insert new subclause 6.3.2.3.56:***

### 6.3.2.3.56 BS Broadcast Paging (MOB_PAG-ADV) message

The MOB_PAG-ADV message shall be sent on the Broadcast CID or Idle mode multicast CID during the BS Paging Interval.

The MAC Management Message Type for this message is given in Table 14. The format of the message is shown in Table 109p.

**Table 109p—BS Broadcast Paging (MOB_PAG-ADV) message format**

| Syntax | Size | Notes |
|---|---|---|
| MOB_PAG-ADV_Message_format() { | — | — |
| Management Message Type=62 | 8 bits | — |
| Num_Paging_Group_IDs | 16 bits | Number of Paging Group IDs in this message |
| For (i=0; i<Num_Paging_Group_IDs; i++) { | — | — |
| Paging Group ID | 16 bits | — |
| } | — | — |
| Num_MACs | 8 bits | Number of MS MAC addresses |
| For (j=0; j<Num_MACs; j++) { | — | — |
| MS MAC Address hash | 24 bits | The hash is obtained by computing a CRC24 on the MS 48-bit MAC address. The polynomial for the calculation is 0x1864CFB |
| Action Code | 2 bits | Paging action instruction to MS<br>0b00=No Action Required<br>0b01=Perform Ranging to establish location and acknowledge message<br>0b10=Enter Network<br>0b11=Reserved |
| Reserved | 6 bits | — |
| } | — | — |
| *padding* | *variable* | Padding bits to ensure octet aligned |
| TLV Encoded Information | *variable* | TLV specific |
| } | — | — |

A BS shall generate MOB_PAG-ADV including the following parameters:

**Paging Group ID (16 bit)**
One or more logical affiliation groupings of BS.

**MS MAC Address hash**
This is a 24-bit field used to hash the MS 48-bit MAC address. The hash value shall be the remainder of the division (Modulo 2) of the 48-bit MAC address multiplied by the polynomial D24 with the generator polynomial

$g(D) = D^{24}+D^{23}+D^{18}+D^{17}+D^{14}+D^{11}+D^{10}+D^{7}+D^{6}+D^{5}+D^{4}+D^{3}+D+1$ (hex=1864cfb) (Example: [MS 48-bit MAC address]= 00:D0:59:0F:E2:2E, hash should then be set to 0x51efe3).

**Action Code**

Paging action instruction to the MS to perform the following action:
0b00=No Action Required
0b01=Perform Ranging to establish location and acknowledge message
0b10=Enter Network
0b11=*Reserved*

For OFDMA PHY, when a BS pages multiple MSs, the BS may assign dedicated CDMA codes to one or more MS being paged. The BS shall first list the MAC Address Hash of those MSs that are assigned dedicated CDMA codes, followed by the MSs that are not assigned dedicated CDMA codes.

For OFDMA PHY, the following TLV may be included in the MOB_PAG-ADV management message:

**CDMA code and transmission opportunity assignment (11.17.1)**

OFDMA-PHY specific parameter used to indicate CDMA code and transmission opportunity assigned to one or more MSs being paged in this message. One CDMA code and transmission opportunity assignment in the TLV corresponds to one MS paged. The order of the assignments is the same as the order of appearance of MS MAC address hash except with action code "No Action Required" in this message.

For OFDMA PHY, the following TLV may be included in the MOB_PAG-ADV management message. If a CDMA code assignment TLV is included, the Page-Response window TLV shall be included. There shall be no more than one occurrence of the Page-Response window TLV.

**Page-Response window (11.17.2)**

OFDMA-PHY specific parameter used to indicate the time window (in unit of frames) during which the MS shall transmit the CDMA code at the transmission opportunity assigned in the CDMA code and transmission opportunity assignment TLV. The start of the window is the next frame after receiving the MOB_PAG-ADV.

***Insert new subclause 6.3.2.3.56:***

### 6.3.2.3.57 Multicast Broadcast Service Map (MBS_MAP) message

The BS may send an MBS_MAP message on an MBS portion to describe the MBS connections serviced by the MBS portion. When a MBS_MAP is sent, the connections need be described in the DL-MAP, but a MBS_MAP_IE() shall be substituted instead. The MBS MAP message format is presented in Table 109q. This message includes the MBS_DATA_IE and Extended_MBS_DATA_IE, which define the access information for the downlink and uplink MBS burst.

Table 109q—MBS_MAP

| Syntax | Size | Notes |
|---|---|---|
| MBS_MAP Message format (){ | — | — |
| **Management Message Type =** | 4 bits | 62 |
| **Frame number** | 4 bits | The frame number is identical to the 4 LSBs of the frame number in the DL-MAP |
| **MBS_DIUC_Change_Count** | 8 bits | — |
| **#MBS_DATA_IE** | 4 bits | The number of included MBS_DATA_IE |

### Table 109q—MBS_MAP *(continued)*

| | | |
|---|---|---|
| For (i = 0; i<*n*; i++){ | — | *n* = #MBS_DATA_IE |
| **MBS_DATA_IE** | *variable* | — |
| } | — | — |
| **#Extended_MBS_DATA_IE** | — | The number of included Extended_MBS_DATA_IE |
| For(i=0;i<*n*;i++) { | — | *n* = #Extended_MBS_DATA_IE |
| **Extended_MBS_DATA_IE()** | *variable* | — |
| } | | — |
| **#MBS_DATA_Time_Diversity_IE** | 4 bits | The number of included MBS_DATA_Time_Diversity_IE |
| For(i=0; i<*m*; i++){ | — | *m* = #MBS_DATA_Time diversity_IE |
| **MBS_DATA_Time_Diversity_IE()** | *variable* | — |
| } | — | — |
| If(!byte boundary){ | — | — |
| **Padding Nibble** | 4 bits | — |
| } | | — |
| **TLV encoding element** | — | — |
| } | — | — |

**MBS DIUC Change Count**
It is used to notify the Burst Profile used for Multi-BS-MBS data has been changed. If MBS_DIUC_Change_Count change, MS should wait until receiving DCD message unless Downlink Burst Profile TLV is included in MBS_MAP message.

The following TLV may be included in MBS_MAP message.

**Downlink Burst Profile**
Downlink Burst Profile is used for the definition of MBS DIUC.

### Table 109r—MBS_MAP_Type

| MBS_MAP_Type | Description |
|---|---|
| 0 | MBS_DATA_IE |
| 1 | MBS_DATAA_Time_Diversity_IE |
| 2 | Extended MBS_DATAA_IE |
| 3~255 | *Reserved* |

### Table 109s—MBS_DATA_IE

| Syntax | Size | Notes |
|---|---|---|
| MBS_DATA_IE{ | — | — |
| **MBS_MAP Type = 0** | 2 bits | MBS_DATA_IE |
| **MBS Burst Frame Offset** | 2 bits | This indicates the burst located by this IE will be shown after MBS Burst Frame Offset + 2 frames. |
| **Next MBS MAP change indication** | 1 bit | This indicates whether the size of MBS MAP message of next MB S frame for these Multicast CIDs included this IE will be different from the size of this MBS MAP message. |
| **No. of Multicast CID** | 3 bits | — |
| For(i=0; i< No. of Multicast CID; i++){ | — | — |
| **Multicast CID** | 12 bits | 12 LSBs of CID for multicast. |
| } | — | — |
| **MBS DIUC** | 4 bits | — |
| **OFDMA Symbol Offset** | 8 bits | OFDMA symbol offset with respect to start of next (MBS Burst Frame offset + 2)th frame. |
| **Subchannel offset** | 6 bits | OFDMA subchannel offset with respect to start of the next (MBS Burst Frame offset +2)th frame. |
| **Boosting** | 3 bits | Refer to Table 273. |
| **No. OFDMA Symbols** | 7 bits | The size of MBS data. |
| **No. Subchannels** | 6 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00 - No repetition coding<br>0b01 - Repetition coding of 2 used<br>0b10 - Repetition coding of 4 used<br>0b11 - Repetition coding of 6 used |
| **Next MBS frame offset** | 8 bits | The Next MBS frame offset value is lower 8 bits of the frame number in which the BS shall transmit the next MBS frame. |
| **Next MBS OFDMA Symbol offset** | 8 bits | The offset of the OFDMA symbol in which the next MBS portion starts, measured in OFDMA symbols from the beginning of the downlink frame in which the MBS_MAP is transmitted. |
| If (Next MBS MAP change indication=1){ | — | — |
| **Next MBS No. OFDMA symbols** | 2 bits | It is to indicate the size of MBS_MAP message in Next MBS portion where the BS shall transmit the next MBS frame for multicast CIDS in this IE. |
| **Next MBS No. OFDMA subchannels** | 6 bits | It is to indicate the size of MBS_MAP message in Next MBS portion where the BS shall transmit the next MBS frame for multicast CIDs in this IE. |
| } | — | — |
| } | — | — |

## Table 109t—Extended_MBS_DATA_IE

| Syntax | Size | Notes |
|---|---|---|
| MBS_DATA_IE() { | — | — |
| **MBS MAP Type = 2** | 2 bits | MBS_DATA_IE |
| **MBS_Burst_Frame_Offset** | 2 bits | This indicates the burst indicated by this IE will be shown after MBS Burst Frame offset + 2 frames. |
| **Next MBS MAP change indication** | 1 bit | This indicates whether the size of MBS MAP message of next MBS frame for these multicast CIDs included this IE will be different from the size of this MBS MAP message. |
| **No. of Multicast CID** | 3 bits | — |
| For(i=0; i<No. of Multicast CIDs; i++) { | — | — |
| **Multicast CID** | 12 bits | 12 LSBs of CID for multicast. |
| **No. of Logical Channel ID** | 4 bits | — |
| For(j=0; j<No. of Logical Channel ID; j++) { | — | — |
| **Logical Channel ID** | 8 bits | — |
| } | — | — |
| } | — | — |
| **MBS DIUC** | 4 bits | — |
| **OFDMA symbol offset** | 8 bits | OFDMA symbol offset with respect to start of the next (MBS_Burst_Frame_offset + 2)-th frame. |
| **Subchannel offset** | 6 bits | OFDMA subchannel offset with respect to start of the next (MBS_Burst_Frame_offset + 2)-th frame. |
| **Boosting** | 3 bits | — |
| **No. OFDMA symbols** | 7 bits | The size of MBS data. |
| **No. subchannels** | 6 bits | — |
| **Repetition coding indication** | 2 bits | 0b00 = No repetition coding<br>0b01 = Repetition coding of 2 used<br>0b10 = Repetition coding of 4 used<br>0b11 = Repetition coding of 6 used |
| **Next MBS frame offset** | 8 bits | The Next MBS frame offset value is lower 8 bits of the frame number in which the BS shall transmit the next MBS frame. |
| **Next MBS OFDMA symbol offset** | 8 bits | The offset of the OFDMA symbol in which the next MBS portion starts, measured in OFDMA symbols from the beginning of the downlink frame in which the MBS_MAP is transmitted. |
| If (Next MBS MAP change indication = 1){ | — | — |

### Table 109t—Extended_MBS_DATA_IE *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Next MBS No. OFDMA symbols** | 2 bits | It is to indicate the size of MBS_MAP message in Next MBS portion where the BS shall transmit the next MBS frame for multicast CIDs in this IE. |
| **Next MBS No. OFDMA subchannels** | 6 bits | It is to indicate the size of MBS_MAP message in Next MBS portion where the BS shall transmit the next MBS frame for multicast CIDs in this IE. |
| } | — | — |
| } | — | — |

**Multicast CID**
CID that is used for MBS connections

**Logical Channel ID**
This field is used to distinguish logical MBS connections which belong to the same Mulitcast CID. It is allocated to each logical MBS connection (i.e., MBS contents) in DSA-RSP message during Dynamic Service Addition procedure as described in 11.13.36.

### Table 109u—MBS_DATA_Time_Diversity_IE

| Syntax | Size | Notes |
|---|---|---|
| MBS_DATA_Time_Diversity_IE() { | — | — |
| **MBS_MAP Type = 1** | 2 bits | — |
| **MBS Burst Frame Offset** | 2 bits | This indicates the burst located by this IE will be shown after MBS Burst Frame offset + 2 frames |
| **Multicast CID** | 12 bits | 12 LSBs of CID for multicast. |
| **OFDMA symbol offset** | 8 bits | This indicates starting position of the region of MBS Bursts with respect to start of the next (MBS Burst Frame offset + 2)-th frame. |
| **N_EP code** | 4 bits | — |
| **N_SCH code** | 4 bits | — |
| **AI_SN** | 1 bit | — |
| **SPID** | 2 bits | — |
| **ACID** | 4 bits | — |
| **Next MBS MAP change indication** | 1 bit | This indicates whether the size of MBS MAP message of next MBS frame for these multicast CIDs included this IE will be different from the size of this MBS MAP message. |
| **Next MBS frame offset** | 8 bits | — |
| **Next MBS OFDMA Symbol offset** | 8 bits | — |
| If (Next MBS MAP change indication = 1) { | — | — |

**Table 109u—MBS_DATA_Time_Diversity_IE *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **Next MBS No. OFDMA symbols** | 2 bits | It is to indicate the size of MBS_MAP message in Next MBS portion where the BS shall transmit the next MBS frame for multicast CIDs in this IE. |
| **Next MBS No. OFDMA subchannels** | 6 bits | It is to indicate the size of MBS_MAP message in Next MBS portion where the BS shall transmit the next MBS frame for multicast CIDs in this IE. |
| } | — | — |
| } | — | — |

**OFDMA symbol offset**

This indicates starting position of the region for MBS Bursts at the next (MBS_Burst_Frame_offset + 2)-th frame. The region begins from the first subchannel of the OFDM symbol and in this region, MBS bursts, indicated by MBS_DATA_Time_Diversity_IE at the same MBS_MAP message, are allocated in a one-dimensional way in the order of MBS_DATA_Time_Diversity_IE at a MBS_MAP message.

**$N_{EP}$ code, $N_{SCH}$ code**

The combination of $N_{EP}$ code and $N_{SCH}$ code indicates the number of allocated subchannels and scheme of coding and modulation for the DL burst.

**AI_SN**

Defines ARQ Identifier Sequence Number. This is toggled between 0 and 1 on successfully transmitting each encoder packet with the same ARQ channel.

**SPID**

Defines SubPacket ID, which is used to identify the four subpackets generated from an encoder packet.

**ACID**

Defines ARQ Channel ID for TimeDiversity MBS packet. Each TimeDiversity MBS connection can have multiple ARQ channels, each of which may have an encoder packet transaction pending.

MBS_DATA_Time_Diversity_IE presents when MBS only for HARQ enabled MS is provided.

The MBS burst indicated by the MBS_DATA_Time_Diversity_IE is encoded at the same way of HARQ. But it does not need the acknowledgement from MS.

***Insert new subclause 6.3.2.3.58:***

### 6.3.2.3.58 Power control mode change request (PMC_REQ) message

This subclause is applicable to the OFDM and OFDMA PHY modes. The decision of the change of the power control mode between the open loop power control and closed loop power control is done at BS and the decision is indicated by the PMC_RSP MAC message. Before the frame start specified in PMC_RSP, the MS shall transmit PMC_REQ in response to receipt of an PMC_RSP from the BS directing a change to uplink power control mode. Further, PMC_REQ can be used to request to change the power control mode. On the receipt of the PMC_REQ from MS, BS may send PMC_RSP in T47. The closed and open loop power control schemes are described in 8.3.7.4 (for OFDM) and 8.4.10.3 (for OFDMA). Before the first PMC_RSP message from BS, the default power control mode shall be the closed power control scheme.

### Table 109v—PMC_REQ message format

| Syntax | Size | Notes |
|---|---|---|
| PMC_REQ message format{ | — | — |
| **Management Message Type = 63** | 8 bits | Type = 63 |
| **Power control mode change** | 2 bits | 0b00: Closed loop power control mode<br>0b01: *Reserved*<br>0b10: Open loop power control passive mode<br>0b11: Open loop power control active mode |
| **UL Tx power** | 8 bits | UL Tx power level for the burst that carries this header (11.1.1). When the Tx power is different from slot to slot, the maximum value is reported. |
| **Confirmation** | 1 bit | 0: Request<br>1: Confirmation |
| *Reserved* | 5 bits | Shall be set to zero |
| } | — | — |

CID shall be the basic CID of MS. MS shall generate the PMC_REQ message including the following parameters:

**Power control mode change**
0: Closed loop power control mode
1: Open loop power control mode
**UL Tx power**
UL Tx power level for the burst that carries this header (11.1.1). When the Tx power is different from slot to slot, the maximum value is reported.
**Confirmation**
0: MS requests to change the power control mode.
1: MS confirms the receipt of PMC_RSP from BS.

***Insert new subclause 6.3.2.3.58:***

### 6.3.2.3.59 Power control mode change response (PMC_RSP) message

For OFDM and OFDMA PHY modes, PMC_RSP is sent from BS as a confirmation of MS's uplink power control change intention with PMC_REQ message or it is sent unsolicited manner to command MS to change the uplink power control mode as indicated in the PMC_RSP. When the open loop power control is indicated, $\text{Offset\_BS}_{\text{perMS}}$ is included. When the closed loop power control is indicated, power adjust can be signaled. Before the first PMC_RSP message from BS, the default power control mode shall be the closed power control scheme (Table 109w).

### Table 109w—PMC_RSP message format

| Syntax | Size | Notes |
|---|---|---|
| PMC_RSP message format { | — | — |
| **Management Message Type = 64** | 8 bits | Type = 64 |
| **Power control mode change** | 2 bits | 0b00: Closed loop power control mode<br>0b01: Reserved<br>0b10: Open loop power control passive mode<br>0b11: Open loop power control active mode |
| **Start frame** | 6 bits | 6 LSBs of frame number when the indicated power control mode is activated. When it is same with the current frame number, the mode change shall be applied from the current frame. |
| If (Power control mode change==0) { | — | — |
| **Power adjust** | 8 bits | Signed integer, which expresses the change in power level (in multiples of 0.25 dB) that the MS shall apply to its current transmission power. When subchannelization is employed, the subscriber shall interpret the power offset adjustment as a required change to the transmitted power density. |
| } else { | — | — |
| **Offset_BS$_{\mathbf{perMS}}$** | 8 bits | Signed integer, which expresses the change in power level (in multiples of 0.25 dB) that the MS shall apply to the open loop power control formula in 8.4.10.3.2. |
| } | — | — |
| } | — | — |

CID shall be the basic CID of MS. MS shall generate the PMC_RSP message including the following parameters:

**Power control mode change**
0b00: Closed loop power control mode
0b01: Reserved
0b10: Open loop power control passive mode
0b11: Open loop power control active mode

**Start frame**
6 LSBs of frame number when the indicated power control mode is activated. When it is same with the current frame number, the mode change shall be applied from the current frame.

**Power adjust**
Signed integer, which expresses the change in power level (in multiples of 0.25 dB) that the MS shall apply to its current transmission power. When subchannelization is employed, the subscriber shall interpret the power offset adjustment as a required change to the transmitted power density.

**Offset_BS$_{\mathbf{perMS}}$**
Signed integer, which expresses the change in power level (in multiples of 0.25 dB) that the MS shall apply to the open loop power control formula in 8.4.10.3.2.

***Insert new subclause 6.3.2.3.60:***

### 6.3.2.3.60 OFDMA Sub downlink/uplink map (SUB-DL-UL-MAP) message

The placement of SUB-DL-UL-MAP messages within a frame is shown in Figure 23b.

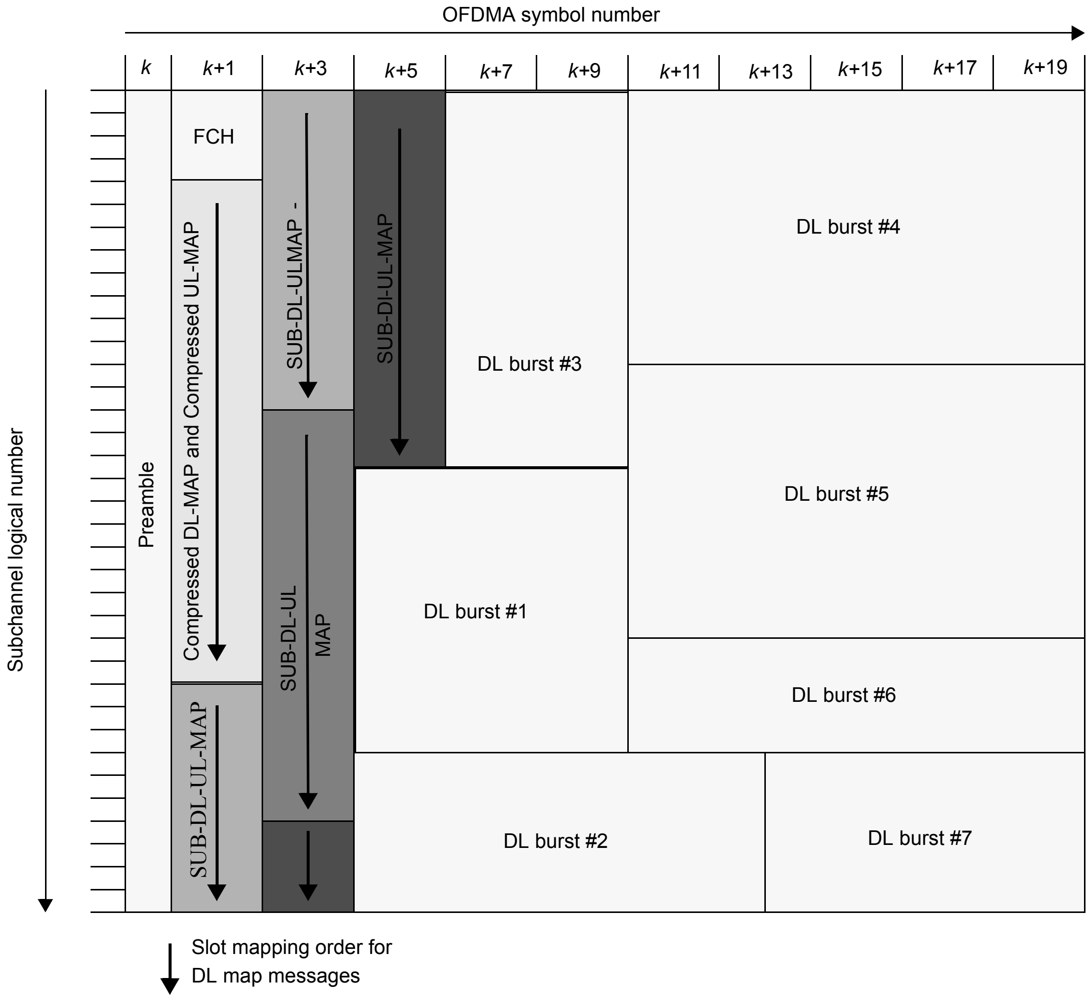

OFDMA symbol number
k
k+1
k+3
k+5
k+7
k+9
k+11
k+13
k+15
k+17
k+19
Subchannel logical number
Preamble
FCH
Compressed DL-MAP and Compressed UL-MAP
SUB-DL-UL-MAP
SUB-DL-ULMAP -
SUB-DL-UL MAP
SUB-DI-UL-MAP
DL burst #1
DL burst #2
DL burst #3
DL burst #4
DL burst #5
DL burst #6
DL burst #7
Slot mapping order for
DL map messages

**Figure 23b—Sub-MAP Burst**

This message shall only apply to OFDMA PHY.

The SUB-DL-UL-MAP message shall appear in a compressed form, in which the generic MAC header is omitted. This is indicated by setting the two most significant bits of the first data byte in the message's PHY burst to 1 (an invalid combination for a generic MAC header).

The SUB-DL-UL-MAP format is presented in Table 109x.

### Table 109x—SUB-DL-UL-MAP message format

| Syntax | Size | Notes |
|---|---|---|
| SUB-DL-UL-MAP() { | — | — |
| **Compressed map indicator** | 3 bits | Set to 0b111 |
| **Map message length** | 10 bits | — |
| **RCID_Type** | 2 bits | 0b00 = Normal CID<br>0b01 = RCID11<br>0b10 = RCID7<br>0b11 = RCID3 |
| **HARQ ACK offset indicator** | 1 bit | — |
| If (HARQ ACK offset indicator == 1){ | — | — |
| **DL HARQ ACK offset** | 8 bits | — |
| **UL HARQ ACK offset** | 8 bits | — |
| } | — | — |
| **DL IE Count** | 8 bits | — |
| For (i=1; i <= DL IE Count; i++) | — | — |
| **DL-MAP_IE()** | *variable* | — |
| } | — | — |
| **OFDMA Symbol offset** | 8 bits | This value indicates start Symbol offset of subsequent sub-bursts in this UL Allocation start IE |
| **Subchannel offset** | 7 bits | This value indicates start Subchannel offset of subsequent sub-bursts in this UL Allocation start IE |
| *Reserved* | 1 bit | Shall be set to 0 |
| while (map data remains){ | — | — |
| **UL-MAP_IE()** | *variable* | — |
| } | — | — |
| If !(byte boundary) { | — | — |
| **Padding Nibble** | *variable* | Padding to reach byte boundary |
| } | — | — |
| } | — | — |

**Map message length**

The length of the submap message in bytes including the compressed map indicator and the CRC.

**HARQ ACK offset indicator**

A field that indicates the inclusion of HARQ offsets. If this field is 0, then the ACK offsets shall be follow the last allocation made by previous maps. An MS that failed to decode any of the previous maps shall disregard all HARQ allocations made by this map, if HARQ ACK offset indicator is 0.

**DL HARQ ACK offset**
Indicates the ACK channel in the ACKCH Region that corresponds to the first HARQ enabled downlink burst specified in this map message.

**UL HARQ ACK offset**
Indicates the ACK bit index in the DL HARQ ACK IE that corresponds to the first HARQ enabled uplink burst specified in this map message.

**RCID_TYPE**
The RCID type used for RCID_IEs specified in DL-MAP_IEs that are described in this SUB-DL-UL-MAP.

**DL IE Count**
The number of DL-MAP_IE-s.

A CCITT CRC 16 value is appended to the end of the burst. The CRC is computed across all bytes of the SUB-DL-UL-MAP message.

SUB-DL-UL-MAP message shall be pointed only through compressed DL MAP and appended compressed UL MAP.

The order of DL-MAP_IEs in the SUB-DL-UL-MAP message shall conform to the order defined for the DL-MAP message in 6.3.2.3.2

The logical order in which MAC PDUs are mapped to the PHY layer bursts in the downlink is defined as the order of increasing start time of all PHY bursts in the frame regardless of the MAP message in which they are described. If two or more PHY bursts have the same start time, the logical order is determined according to the order of appearance in the concatenation of DL-MAP and all SUB-DL-UL-MAP messages.

The logical order in which MAC PDUs are mapped to the PHY layer bursts in the uplink is defined as the order of UL-MAP_IEs in the SUB-DL-UL-MAP message.

The SUB-DL-UL-MAP message can be located in the first zone of the frame or in any of the zones within the frame. The sub-map capability for the first zone or other zones are specified and negotiated using SBC-REQ/RSP messages. In each zone, the SUB-DL-UL-MAP messages shall be allocated consecutively using the same uni-dimensional frequency-first slot mapping order used for the DL-MAP and HARQ MAP bursts. For the first zone in the frame, the first burst containing a SUB-DL-UL-MAP message shall be allocated immediately following the bursts containing HARQ MAP messages, or following the DL-MAP if no HARQ MAPs exist in the frame. For all subsequent zones, the first burst containing a SUB-DL-UL-MAP message shall be allocated starting at the first subchannel of the first OFDMA symbol in the zone. DL-MAP_IEs that appear in an SUB-DL-UL-MAP message shall only describe allocations whose starting OFDMA symbol is equal to or later than the first OFDMA symbol of the zone in which the SUB-DL-UL-MAP message is located. The bursts containing the SUB-DL-UL-MAP messages shall only be described by a SUB-MAP Pointer IE. This IE (if exists) shall immediately follow a STC_Zone_IE to describe SUB-DL-UL-MAP messages that are located in that zone.

The INC_CID flag shall be reset to 0 in the beginning of each SUB-DL-UL-MAP message.

The physical modifier (PHY-MOD) shall be reset at the beginning of each SUB-DL-UL-MAP message and before the first UL-MAP_IE.

All DL and UL zone switch IEs (Extended DIUC 0x01, Extended UIUC 0x04) shall be defined in the main DL and UL MAPs. SUB-DL-UL-MAP shall comply with the main DL and UL MAP zone switch. The SUB-DL-UL-MAP shall not include the downlink zone switch IE. Instead, the zone shall be identified by the symbol number (indicated in DL-MAP_IE and other IE-s defining allocations).

The zone in which an UL allocation occurs is identified by the "OFDMA Symbol Offset" field in the SUB-DL-UL-MAP or the UL_Allocation_start_IE (see 8.4.5.4.26). Allocations within a non-AAS zone shall start at the subchannel/symbol offset defined by the SUB-DL-UL-MAP or UL_Allocation_start_IE. Allocations made in an UL AAS zone shall be defined by the slot offset field of the UL-MAP_IE referenced to the start of the AAS zone. In this case, the subchannel/symbol offset is only used to specify that the allocation occurs in the AAS zone and is not used as a starting point for the UL allocation.

The DL-MAP_IEs in the SUB-DL-UL-MAP shall be ordered in the increasing order of the transmission start time of the relevant PHY burst/allocation. The uplink allocations in the SUB-DL-UL-MAP shall be ordered in increasing order of zones

The maximum number of SUB-DL-UL-MAP messages per frame is three.

SUB-DL-UL-MAP message shall be used only with compressed DL and appended UL MAP structure.

***Insert new subclause 6.3.2.3.61:***

### 6.3.2.3.61 MIMO precoding setup/tear-down

The BS can setup long-term precoding with feedback from a particular MS by sending the MAC-manage message PRC-LT-CTRL to the MS. The BS can also use the same MAC-management message to tear-down the long-term precoding with feedback.

The precoding feedback delay of the base station, in number of frames, should be signaled from the BS to the MS in the PRC-LT-CTRL MAC-management message.

**Table 109y—Setup/Tear-down of long-term MIMO precoding (PRC-LT-CTRL) message format**

| Syntax | Size | Notes |
|---|---|---|
| PRC-LT-CTRLformat(){ | — | — |
| Management message type = 65 | 8 bits | — |
| Setup/Tear-down long-term precoding with feedback | 1 bit | 0=Turn off<br>1=Turn on |
| BS precoding application delay | 2 bits | *k*, delay in number of frames beyond the minimal delay of 1 frame for when precoding information fed back from the MS to the BS can or will be applied. |
| } | — | — |

### 6.3.3 Construction and transmission of MAC PDUs

### 6.3.3.3 Fragmentation

***Change the first sentence of the first paragraph as indicated:***

Fragmentation is the process by which a MAC SDU (or MAC Management message) is divided into one or more MAC PDUs.

***Insert new text after the second paragraph:***

The size of the FSN field in fragmentation subheaders is fixed per connection. The fragmentable broadcast connection shall use 11-bit FSN. BS and SS shall support 11-bit FSN. BS and SS may support 3-bit FSN. All management connections shall use 11-bit FSN. The size of the FSN used on non-ARQ fragmentable transport connections is determined during connection set-up (see 11.13.22).

### 6.3.3.3.1 Non-ARQ Connections

***Change the second sentence of the first paragraph as indicated:***

The sequence number assigned to each fragment allows the receiver to recreate the original payload and to detect the loss of any intermediate ~~packets~~fragments.

### 6.3.3.4 Packing

### 6.3.3.4.2 Packing for ARQ-enabled connections

***Change the second paragraph as indicated:***

The packing of variable-length MAC SDUs for the ARQ-enabled connections is similar to that of non-ARQ connections, when fragmentation is enabled. The BSN of the Packing subheader shall be used by the ARQ protocol to identify and retransmit ~~lost fragments~~ARQ blocks.

### 6.3.3.5 CRC calculation

***Change the subclause as indicated:***

A service flow may require that a CRC be added to each MAC PDU carrying data for that service flow (11.13.12). In this case, for each MAC PDU with HT = 0, a CRC32 (as defined in ~~IEEE Std 802.3~~6.3.3.5.1 for SC, SCa and OFDM mode and 6.3.3.5.2 for OFDMA mode), shall be appended to the payload of the MAC PDU; i.e., request MAC PDUs are unprotected. The CRC shall cover the generic MAC header and the Payload of the MAC PDU. The CRC shall be calculated after encryption; i.e., the CRC protects the Generic Header and the ciphered Payload.

***Insert new subclause 6.3.3.5.1:***

### 6.3.3.5.1 CRC32 calculation for SC, SCa, and OFDM mode

The data (input) bytes shall be flipped (for each byte exchange bit0 ↔ bit7, bit1 ↔ bit6, bit2 ↔ bit5, and bit3 ↔ bit4)

The CRC32 shall be calculated using the following standard generator polynomial of degree 32:

$$G(x) = x^{32} + x^{26} + x^{23} + x^{22} + x^{16} + x^{12} + x^{11} + x^{10} + x^{8} + x^{7} + x^{5} + x^{4} + x^{2} + x + 1$$

(where, the hexadecimal representation of truncated $G(x)$ is "0x04c11db7")

The CRC32 is the 1’s complement of the sum (modulo 2) of the following:

1) The remainder of $x^k \ (x^{31} + x^{30} + x^{29} + \ldots + x^2 + x + 1)$ divided (modulo 2) by $G(x)$, where $k$ is the number of bits in the input data, and
2) The remainder after multiplication of the bit-flipped input data (treated as a polynomial) by $x^{32}$ and then division by $G(x)$.

The CRC32 field shall then be transmitted bit-flipped commencing with the most significant byte. (The first transmitted byte will have in its bit 7 the coefficient of $x^{24}$ and in bit 0 the coefficient of $x^{31}$.) The fourth byte will have the coefficient of $x^0$ in bit 7 and the coefficient of $x^7$ in bit 0).

As a typical implementation, at the transmitter, the initial remainder of the division is preset to all 1's and is then modified by division of the bit-flipped data by the generator polynomial $G(x)$. The 1's complement of this remainder is then bit flipped byte after byte when transmitted, with the most significant byte first.

At the receiver, the initial remainder is preset to all 1's and the input bytes shall be flipped first and then treated as coefficient of a polynomial. When divided by $G(x)$, this polynomial shall results in the absence of transmission errors, in a unique nonzero remainder value. The unique remainder value is the polynomial:

$$x^{31}+x^{30}+x^{26}+x^{25}+x^{24}+x^{18}+x^{15}+x^{14}+x^{12}+x^{11}+x^{10}+x^{8}+x^{6}+x^{5}+x^{4}+x^{3}+x+1$$

(or as its hexadecimal representation 0xC704DD7B)

***Insert new subclause 6.3.3.5.1.1:***

### 6.3.3.5.1.1 CRC32 test vectors for SC, SCa, and OFDM mode

The following is an example of CRC calculation in SC, SCa and OFDM mode:

Generic MAC Header (Hex) = 40 40 1A 06 C4 5A
Payload (Hex) = BC F6 57 21 E7 55 36 C8 27 A8 D7 1B 43 2C A5 48
CRC32 for SC, SCa and OFDM mode (Hex) = CB B6 5F 48

***Insert new subclause 6.3.3.5.2:***

### 6.3.3.5.2 CRC32 calculation for OFDMA mode

The data (input) bytes shall not be flipped as in OFDM mode.

The CRC32 shall be calculated using the following standard generator polynomial of degree 32:

$$G(x) = x^{32}+x^{26}+x^{23}+x^{22}+x^{16}+x^{12}+x^{11}+x^{10}+x^{8}+x^{7}+x^{5}+x^{4}+x^{2}+x+1$$

(where, the hexadecimal representation of truncated *G(x)* is "0x04c11db7")

At the transmitter, the following procedure is applied;

1) First 32 bits are complemented, which is equivalent to setting the initial value of the CRC register as 0xFFFFFFFF.
2) The first bit of the first field (MSB of the first byte of the MAC header) corresponds to the $x^{n-1}$ term and the last bit of the last field corresponds to the $x^0$ term, where $n$ is the number of bits in the input data sequence.
3) The resulting polynomial multiplied by $x^{32}$ is divided by $G(x)$.
4) The remainder bit sequence is complemented.
5) The 32 bits of the CRC value are placed in the CRC field so that the $x^{31}$ term is the left-most bit of the first byte, and the $x^0$ term is the right most bit of the last byte.
6) The resulting CRC field is sent MSB first (6.3.3.1).

At the receiver, the initial remainder is preset to all 1's and the input bytes shall be fed into the CRC engine MSB first. When divided by $G(x)$, this polynomial shall result in the absence of transmission errors, in a unique nonzero remainder value. The unique remainder value is the polynomial:

$$x^{31}+x^{30}+x^{26}+x^{25}+x^{24}+x^{18}+x^{15}+x^{14}+x^{12}+x^{11}+x^{10}+x^{8}+x^{6}+x^{5}+x^{4}+x^{3}+x+1$$

(or as its hexadecimal representation 0xC704DD7B)

***Insert new subclause 6.3.3.5.2.1:***

### 6.3.3.5.2.1 CRC32 test vectors for OFDMA mode

The following is an example of CRC calculation in OFDMA mode:

Generic MAC Header (Hex) = 40 40 1A 06 C4 5A
Payload (Hex) = BC F6 57 21 E7 55 36 C8 27 A8 D7 1B 43 2C A5 48
CRC32 for OFDMA mode (Hex) = 1B D1 BA 21

### 6.3.4 ARQ mechanism

***Change the last paragraph of the subclause as indicated:***

The ARQ feedback information can be sent as a standalone MAC management message on the appropriate basic management connection, or piggybacked on an existing connection. ARQ feedback cannot be fragmented. ~~The implementation of ARQ is optional.~~

### 6.3.4.2 ARQ Feedback IE format

***Change the description of "BSN" field below Table 111 as indicated:***

**BSN**

If (ACK Type == 0x0): BSN value corresponds to the most significant bit of the first 16-bit ARQ ACK map and follows an MSB first approach with the BSN incremented by 1 for each bit in the ARQ ACK map, following through for the subsequent ARQ ACK maps.

If (ACK Type == 0x1): BSN value indicates that its corresponding block and all blocks with lesser (see 6.3.4.6.1) values within the transmission window have been successfully received.

If (ACK Type == 0x2): Combines the functionality of types 0x0 and 0x1.

If (ACK Type == 0x3): Combines the functionality of type 0x1 with the ability to acknowledge reception of ARQ blocks in terms of block sequences. A block sequence is defined as a set of ARQ blocks with consecutive BSN values. With this option, members of block sequences are identified and associated with the same reception status indication.

### 6.3.4.3 ARQ parameters

*Change subclause 6.3.4.3.4 as indicated:*

#### 6.3.4.3.4 ARQ_RETRY_TIMEOUT

ARQ_RETRY_TIMEOUT is the minimum time interval a transmitter shall wait before retransmission of an unacknowledged block for retransmission. The interval begins when the ARQ block was last transmitted. On connections that use both HARQ and ARQ, the ARQ_RETRY_TIMEOUT value shall be set accordingly to allow HARQ retransmission operation of the ARQ block to be completed before ARQ retransmission occurs. An ARQ block is unacknowledged if it has been transmitted but no acknowledgment has been received.

### 6.3.4.6 ARQ operation

#### 6.3.4.6.2 Transmitter state machine

*Change the first paragraph as indicated:*

An ARQ block may be in one of the following four states—not-sent, outstanding, discarded, and waiting-for- retransmission. Any ARQ block begins as not-sent. After it is sent it becomes outstanding for a period of time termed ~~ACK~~ARQ_RETRY_TIMEOUT. While a block is in outstanding state, it is either acknowledged and discarded, or transitions to waiting-for-retransmission after ~~ACK~~ARQ_RETRY_TIMEOUT or NACK. An ARQ block can become waiting-for-retransmission before the ~~ACK~~ARQ_RETRY_TIMEOUT period expires if it is negatively acknowledged. An ARQ block may also change from waiting-for-retransmission to discarded when an ACK message for it is received or after a timeout ARQ_BLOCK_LIFETIME.

*Change the ninth paragraph as indicated:*

A bitmap entry not indicating acknowledgement shall be considered a NACK for the corresponding blocks.

NOTE—Selective ACK bit-maps are referenced to a specific BSN, which indicates to absolute number of the block referenced by the first bit in the bit-map. It is the responsibility of the ARQ feedback sender to assign the BSN such that all bits in the bit define either ACK or NAK for a specific ARQ block. This can be achieved by assigning the BSN number low enough (modulo $2^{11}$), such that every bit in the bit map provides correct feedback information.

*Change the thirteenth paragraph as indicated:*

The actions to be taken by the transmitter state machine when it wants to initiate a reset of the receiver ARQ state machine are provided in Figure 34. The actions to be taken by the ~~transmitter~~ receiver state machine when it initiates an ARQ Reset message ~~is received~~ are ~~also~~ provided in ~~Figure 34~~ Figure 35.

***Replace Figure 34 with the following figure:***

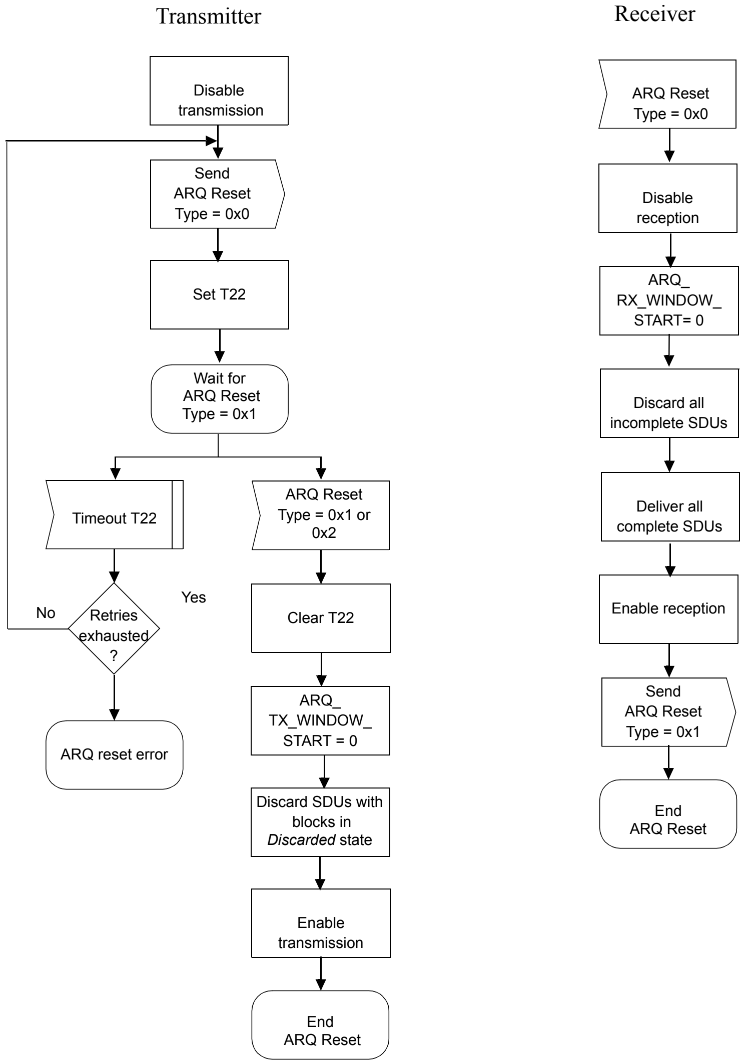

Transmitter
Receiver
Disable transmission
Send ARQ Reset Type = 0x0
Set T22
Wait for ARQ Reset Type = 0x1
Timeout T22
ARQ Reset Type = 0x1 or 0x2
No
Yes
Retries exhausted ?
ARQ reset error
Clear T22
ARQ_ TX_WINDOW_ START = 0
Discard SDUs with blocks in Discarded state
Enable transmission
End ARQ Reset
ARQ Reset Type = 0x0
Disable reception
ARQ_ RX_WINDOW_ START= 0
Discard all incomplete SDUs
Deliver all complete SDUs
Enable reception
Send ARQ Reset Type = 0x1
End ARQ Reset

**Figure 34—ARQ Reset message dialog—transmitter initiated**

***Change the last sentence of the paragraph below Figure 34 as indicated:***

When the timer exceeds the value of ARQ_SYNC_LOSS_TIMEOUT, the transmitter state machine shall initiate a reset of the connection’s state machines as described in Figure ~~35~~34.

*Replace Figure 35 with the following figure:*

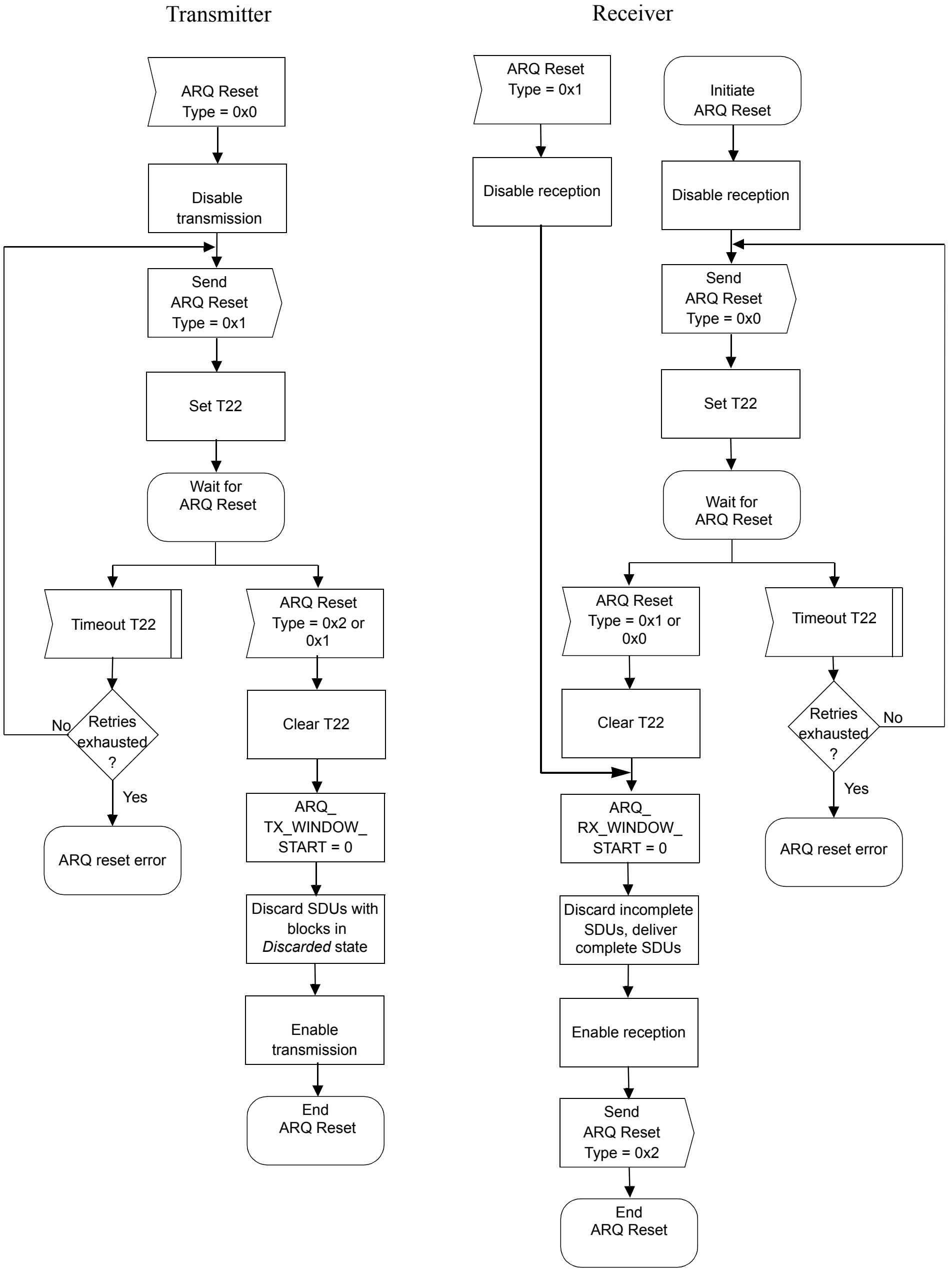

Transmitter
Receiver
ARQ Reset Type = 0x0
Disable transmission
Send ARQ Reset Type = 0x1
Set T22
Wait for ARQ Reset
Timeout T22
ARQ Reset Type = 0x2 or 0x1
No
Retries exhausted ?
Yes
ARQ reset error
Clear T22
ARQ_ TX_WINDOW_ START = 0
Discard SDUs with blocks in *Discarded* state
Enable transmission
End ARQ Reset
ARQ Reset Type = 0x1
Initiate ARQ Reset
Disable reception
Disable reception
Send ARQ Reset Type = 0x0
Set T22
Wait for ARQ Reset
ARQ Reset Type = 0x1 or 0x0
Timeout T22
Clear T22
Retries exhausted ?
No
Yes
ARQ reset error
ARQ_ RX_WINDOW_ START = 0
Discard incomplete SDUs, deliver complete SDUs
Enable reception
Send ARQ Reset Type = 0x2
End ARQ Reset

**Figure 35—ARQ Reset message dialog—receiver initiated**

*Insert the following sentence below Figure 35:*

When in ARQ reset error state in Figure 34 and Figure 35, the SS shall re-initialize its MAC, the behaviour for BS is implementation dependant.

### 6.3.4.6.3 Receiver state machine

***Replace Figure 36 with the following figure:***

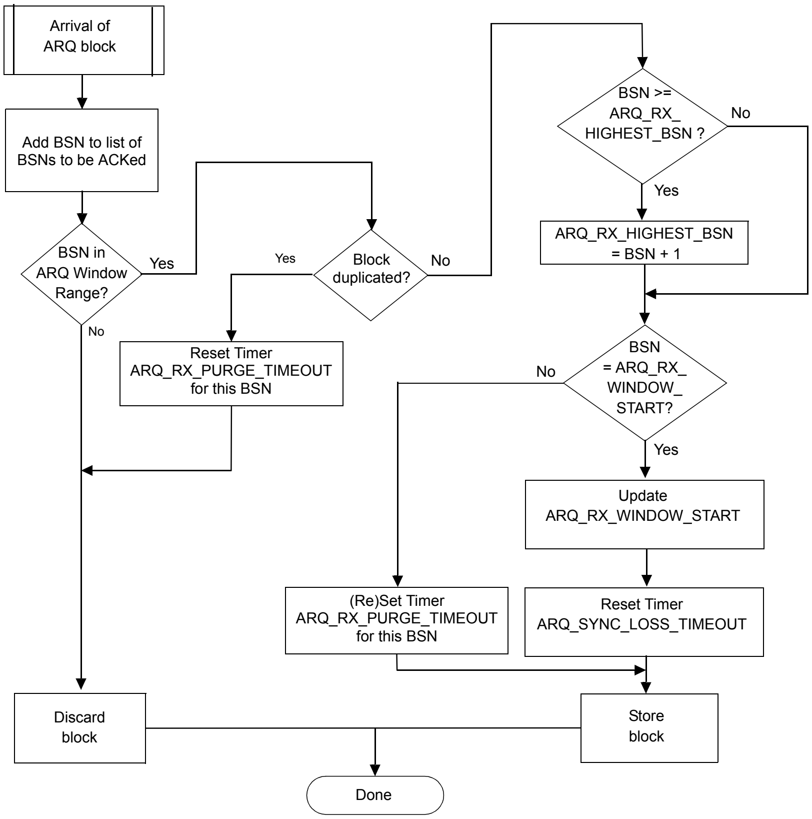

Arrival of ARQ block
Add BSN to list of BSNs to be ACKed
BSN in ARQ Window Range?
Yes
No
Block duplicated?
Yes
No
Reset Timer ARQ_RX_PURGE_TIMEOUT for this BSN
BSN >= ARQ_RX_ HIGHEST_BSN ?
No
Yes
ARQ_RX_HIGHEST_BSN = BSN + 1
BSN = ARQ_RX_ WINDOW_ START?
No
Yes
Update ARQ_RX_WINDOW_START
(Re)Set Timer ARQ_RX_PURGE_TIMEOUT for this BSN
Reset Timer ARQ_SYNC_LOSS_TIMEOUT
Discard block
Store block
Done

**Figure 36—ARQ block reception**

***Change the first sentence of second paragraph below Figure 36 as indicated:***

~~As each block is received, a timer is started for that block.~~ When a block does not result in an advance of the ARQ_RX_WINDOW_START the ARQ_RX_PURGE_TIMEOUT for that block shall be started.

### 6.3.5 Scheduling services

***Change the first paragraph as indicated:***

Scheduling services represent the data handling mechanisms supported by the MAC scheduler for data transport on a connection. Each connection is associated with a single ~~data~~ scheduling service. ~~Each data~~ A scheduling service is ~~associated with~~ determined by a set of QoS parameters that quantify aspects of its behavior. These parameters are managed using the DSA and DSC message dialogs. ~~Four services (11.13.11) are supported: Unsolicited Grant Service (UGS), Real-time Polling Service (rtPS), Non-real-time Polling Service (nrtPS), and Best Effort (BE). The following text provides a brief description of each of the supported scheduling services, including the mandatory QoS parameters that shall be included in the service flow definition when the scheduling service is enabled for a service flow.~~ A detailed description of each QoS parameter is provided in 11.13.

*Change the second paragraph as indicated:*

Well-known scheduling services can be implemented by specifying a specific set of QoS parameters:

~~The UGS is designed~~ Table 111a describes the QoS parameters that would provide a scheduling service to support real-time data streams consisting of fixed-size data packets issued at periodic intervals, such as T1/E1 and Voice over IP without silence suppression. ~~The mandatory QoS service flow parameters for this scheduling service are Maximum Sustained Traffic Rate (11.13.6), Maximum Latency (11.13.14), Tolerated Jitter (11.13.13), and Request/Transmission Policy (11.13.12). If present, the Minimum Reserved Traffic Rate parameter (11.13.8) shall have the same value as the Maximum Sustained Traffic Rate parameter.~~

*Insert new Table 111a:*

**Table 111a—Example of QoS parameters providing a scheduling service to support real-time constant bit-rate data streams**

| Parameter | Meaning |
|---|---|
| **Tolerated jitter** | As in 11.13.13 |
| If (Fixed length SDU) { | |
| **SDU size** | As in 11.13.16 |
| } | |
| **Minimum reserved traffic rate** | As in 11.13.8 |
| **Maximum Latency** | As in 11.13.14 |
| **Request/Transmission Policy** | As in 11.13.12 |
| If (uplink service flow){ | |
| **Grant Scheduling Type** | UGS as specified in 6.3.5.2.1 |
| **Unsolicited Grant Interval** | As in 11.13.20 |
| } | |

*Change the third paragraph as indicated:*

~~The rtPS is designed~~ Table 111b describes the QoS parameters that would provide a scheduling service to support real-time data streams consisting of variable-sized data packets that are issued at periodic intervals, such as moving pictures experts group (MPEG) video. ~~The mandatory QoS service flow parameters for this scheduling service are Minimum Reserved Traffic Rate (11.13.8), Maximum Sustained Traffic Rate (11.13.6), Maximum Latency (11.13.14), and Request/Transmission Policy (11.13.12).~~

***Insert new Table 111b:***

### Table 111b—Example of QoS parameters providing a scheduling service to support real-time variable-rate data streams

| Parameter | Meaning |
|---|---|
| **Maximum Latency** | As in 11.13.14 |
| **Minimum Reserved Traffic Rate** | As in 11.13.8 |
| **Maximum Sustained Traffic Rate** | Optional. As in 11.13.6 |
| **Traffic Priority** | As in 11.13.5 |
| **Request/Transmission Policy** | As in 11.13.12 |
| If (uplink service flow){ | |
| **Scheduling Type** | rtPS as in 6.3.5.2.2 |
| **Unsolicited Polling Interval** | As in 11.13.21 |
| } | |

***Change the fourth paragraph as indicated:***

~~The nrtPS is designed~~ Table 111c describes the QoS parameters that would provide a scheduling service to support delay-tolerant data streams consisting of variable-sized data packets for which a minimum data rate is required, such as FTP. ~~The mandatory QoS service flow parameters for this scheduling service are Minimum Reserved Traffic Rate (11.13.8), Maximum Sustained Traffic Rate (11.13.6), Traffic Priority (11.13.5), and Request/Transmission Policy (11.13.12).~~

***Insert new Table 111c:***

### Table 111c—Example of QoS parameters providing a scheduling service to support delay-tolerant variable-rate data streams

| Parameter | Meaning |
|---|---|
| **Minimum Reserved Traffic Rate** | As in 11.13.8 |
| **Maximum Sustained Traffic Rate** | Optional. As in 11.13.8 |
| **Traffic Priority** | As in 11.13.5 |
| **Request/Transmission Policy** | As in 11.13.12 |
| If (uplink service flow){ | |
| **Scheduling Type** | nrtPS as in 6.3.5.2.3 |
| } | |

***Change the fifth paragraph as indicated:***

~~The BE service is designed~~ Table 111d describes the QoS parameters that would provide a scheduling service to support data streams for which no minimum service level is required and therefore may be handled on a space-available basis. ~~The mandatory QoS service flow parameters for this scheduling service are Maximum Sustained Traffic Rate (11.13.6), Traffic Priority (11.13.5), and Request/ Transmission Policy (11.13.12).~~

***Insert new Table 111d:***

**Table 111d—Example of QoS parameters providing a scheduling service to support best-effort data streams**

| Parameter | Meaning |
|---|---|
| **Maximum Sustained Traffic Rate** | Optional. As in 11.13.8 |
| **Request/Transmission Policy** | As in 11.13.12 |
| If (uplink service flow){ | |
| **Scheduling Type** | BE as in 6.3.5.2.4 |
| } | |

### 6.3.5.2 Uplink request/grant scheduling

***Change the first paragraph as indicated:***

Uplink request/grant scheduling is performed by the BS with the intent of providing each subordinate SS with bandwidth for uplink transmissions or opportunities to request bandwidth. By specifying a scheduling ~~service~~ type and its associated QoS parameters, the BS scheduler can anticipate the throughput and latency needs of the uplink traffic and provide polls and/or grants at the appropriate times.

***Change the second paragraph as indicated:***

Table 112 summarizes the scheduling ~~services~~ types and the poll/grant options available for each. The following subclauses define service flow scheduling services for uplink operations.

#### 6.3.5.2.1 UGS

***Change the first paragraph as indicated:***

The UGS is designed to support real-time uplink service flows that ~~generate~~ transport fixed-size data packets on a periodic basis, such as T1/E1 and Voice over IP without silence suppression. The service offers fixed-size grants on a real-time periodic basis, which eliminate the overhead and latency of SS requests and assure that grants are available to meet the flow's real-time needs. The BS shall provide Data Grant Burst IEs to the SS at periodic intervals based upon the Maximum Sustained Traffic Rate of the service flow. The size of these grants shall be sufficient to hold the fixed-length data associated with the service flow (with associated generic MAC header and Grant management subheader) but may be larger at the discretion of the BS scheduler. In order for this service to work correctly, the Request/Transmission Policy (see 11.13.12) setting shall be such that the SS is prohibited from using any contention request opportunities for this connection. The mandatory QoS parameters are Maximum Sustained Traffic Rate (11.13.6), Maximum Latency (11.13.14), Tolerated Jitter (11.13.13), Uplink Grant Scheduling Type (11.13.11) and Request/Transmission Policy

(11.13.12). If present, the Minimum Reserved Traffic Rate parameter (11.13.8) shall have the same value as the Maximum Sustained Traffic Rate parameter. ~~The key service IEs are the Maximum Sustained Traffic, Maximum Latency, the Tolerated Jitter, and the Request/Transmission Policy. If present, the Minimum Reserved Traffic Rate parameter shall have the same value as the Maximum Sustained Traffic Rate parameter.~~

***Insert at the end of 6.3.5.2.1***

The FL and FLI fields may be used to provide the BS with information on the synchronization of the MS application that is generating periodic data for UGS/Extended rtPS Service Flows.

The MS may use these fields to detect whether latency experienced by this service flow at the MS exceeds a certain limit, e.g., a single frame duration. If the FL indicates inordinate latency, the BS may shift scheduled grants earlier for this service flow [taking into account the Frame Latency (FL)].

### 6.3.5.2.2 rtPS

***Change the first paragraph as indicated:***

The rtPS is designed to support real-time uplink service flows that ~~generate~~ transport variable size data packets on a periodic basis, such as moving pictures experts group (MPEG) video. The service offers real-time, periodic, unicast request opportunities, which meet the flow's real-time needs and allow the SS to specify the size of the desired grant. This service requires more request overhead than UGS, but supports variable grant sizes for optimum data transport efficiency.

***Change the second paragraph as indicated:***

The BS shall provide periodic unicast request opportunities. In order for this service to work correctly, the Request/Transmission Policy setting (see 11.13.12) shall be such that the SS is prohibited from using any contention request opportunities for that connection. The BS may issue unicast request opportunities as prescribed by this service even if prior requests are currently unfulfilled. This results in the SS using only unicast request opportunities and data transmission opportunities in order to obtain uplink transmission opportunities ~~(the SS could still use unsolicited Data Grant Burst Types for uplink transmission as well)~~. All other bits of the Request/Transmission Policy are irrelevant to the fundamental operation of this scheduling service and should be set according to network policy. The mandatory QoS parameters are Minimum Reserved Traffic Rate (11.13.8), Maximum Sustained Traffic Rate (11.13.6), Maximum Latency (11.13.14), Uplink Grant Scheduling Type (11.13.11) and Request/Transmission Policy (11.13.12). ~~The key service IEs are the Maximum Sustained Traffic Rate, the Minimum Reserved Traffic Rate, the Maximum Latency and the Request/Transmission Policy.~~

***Insert new subclause 6.3.5.2.2.1:***

#### 6.3.5.2.2.1 Extended rtPS

Extended rtPS is a scheduling mechanism which builds on the efficiency of both UGS and rtPS. The BS shall provide unicast grants in an unsolicited manner like in UGS, thus saving the latency of a bandwidth request. However, whereas UGS allocations are fixed in size, ertPS allocations are dynamic.

The BS may provide periodic UL allocations that may be used for requesting the bandwidth as well as for data transfer. By default, size of allocations corresponds to current value of Maximum Sustained Traffic Rate at the connection. The MS may request changing the size of the UL allocation by either using an extended piggyback request field of the Grant Management subheader or using BR field of the MAC signaling headers as described in Table 5a, or sending a codeword (defined in 8.4.5.4.10.13) over CQICH. The BS shall not change the size of UL allocations until receiving another bandwidth change request from the MS.

When the bandwidth request size is set to zero, the BS may provide allocations for only bandwidth request header or no allocations at all. In case that no unicast bandwidth request opportunities are available, the MS may use contention request opportunities for that connection, or send the CQICH codeword to inform the BS of its having the data to send. If the BS receives the CQICH codeword, the BS shall start allocating the UL grant corresponding to the current Maximum Sustained Traffic Rate value.

The key service IEs are the Maximum Sustained Traffic Rate, the Minimum Reserved Traffic Rate, the Maximum Latency, and the Request/Transmission Policy.

The Extended rtPS is designed to support real-time service flows that generate variable size data packets on a periodic basis, such as Voice over IP services with silence suppression.

#### 6.3.5.2.3 nrtPS

***Change the first paragraph as indicated:***

The nrtPS offers unicast polls on a regular basis, which assures that the uplink service flow receives request opportunities even during network congestion. The BS typically polls nrtPS CIDs on an interval on the order of one second or less.

***Change the second paragraph as indicated:***

The BS shall provide timely unicast request opportunities. In order for this service to work correctly, the Request/Transmission Policy setting (see 11.13.12) shall be set such that the SS is allowed to use contention request opportunities. This results in the SS using contention request opportunities as well as unicast request opportunities and ~~unsolicited Data Grant Burst Types~~data transmission opportunities. All other bits of the Request/Transmission Policy are irrelevant to the fundamental operation of this scheduling service and should be set according to network policy. The mandatory QoS parameters for this scheduling service are Minimum Reserved Traffic Rate (11.13.8), Maximum Sustained Traffic Rate (11.13.6), Traffic Priority (11.13.5), Uplink Grant Scheduling Type (11.13.11), and Request/Transmission Policy (11.13.12).

#### 6.3.5.2.4 BE ~~service~~

***Change the subclause as indicated:***

The intent of the BE ~~service~~ grant scheduling type is to provide efficient service for best effort traffic in the uplink. In order for this service to work correctly, the Request/Transmission Policy setting shall be set such that the SS is allowed to use contention request opportunities. This results in the SS using contention request opportunities as well as unicast request opportunities and ~~unsolicited Data Grant Burst Types~~data transmission opportunities. All other bits of the Request/Transmission Policy are irrelevant to the fundamental operation of this scheduling service and should be set according to network policy.

### 6.3.6 Bandwidth allocation and request mechanisms

#### 6.3.6.1 Requests

***Change the second paragraph as indicated:***

Because the uplink burst profile can change dynamically, all requests for bandwidth shall be made in terms of the number of bytes needed to carry the MAC header and payload, but not the PHY overhead. The Bandwidth Request message may be transmitted during any uplink allocation, except during any initial ranging interval. An SS shall not request bandwidth for a connection if it has no PDU to transmit on that connection.

***Change the last three sentences of the third paragraph as indicated:***

The self-correcting nature of the request/grant protocol requires that SSs ~~shall~~may periodically use aggregate Bandwidth Requests~~. The period may be~~as a function of the QoS of a service and of the link quality. Due to the possibility of collisions, contention-based Bandwidth Requests ~~transmitted in broadcast or multicast Request IEs should~~shall be aggregate requests.

***Insert the following paragraph as the end of the subclause:***

Capability of incremental Bandwidth Requests is optional for the SS and mandatory for the BS. Capability of aggregate Bandwidth Requests is mandatory for SS and BS.

### 6.3.6.3 Polling

### 6.3.6.3.1 Unicast

***Change the box with the text "Process UL-MAP and assign bandwidth to the outstanding requests" in Figure 37 to read "Process UL-MAP and assign bandwidth".***

***Change the decision box with the text "Timer for aggregate requests expired?" in Figure 37 to read "Aggregate requests needed?"***

### 6.3.7 MAC support of PHY

### 6.3.7.4 UL-MAP

### 6.3.7.4.3 Uplink interval definition

### 6.3.7.4.3.1 Request IE

***Insert the following sentence at the end of the subclause:***

This subclause does not apply to the OFDMA PHY.

### 6.3.7.4.3.2 Initial Ranging IE

***Insert the following sentence at the end of the subclause:***

This subclause does not apply to the OFDMA PHY, in which CDMA-based ranging is used, as described in 6.3.10.3.

### 6.3.7.4.3.4 End of map IE

***Insert the following sentence at the end of the subclause:***

This IE is not used in OFDMA PHY.

### 6.3.7.5 Map relevance and synchronization

***Change the second paragraph as indicated:***

Information in the DL-MAP pertains to the current frame (the frame in which the message was received). Information carried in the UL-MAP pertains to a time interval starting at the Allocation Start Time measured from the beginning of the current frame and ending after the last specified allocation. For the OFDM PHY with an UL-MAP sent in AAS zone, the allocation start time shall be measured from the start of the AAS zone in which the UL MAP was sent. This timing holds for both the TDD and FDD variants of operation. The TDD variant is shown in Figure 46 and Figure 47. The FDD variant is shown in Figure 48 and Figure 49.

### 6.3.7.5.3 WirelessMAN-OFDM PHY

***Change the second bullet of the subclause as indicated:***

— For TDD, the Allocation Start Time value shall be either the ATDD split, or the ATDD split + $T_f$; and the allocation shall be within a single frame. The allocation start time shall be no smaller than the round trip delay + $T_{proc.}$

***Change the title of subclause 6.3.7.6 as indicated:***

### 6.3.7.6 Optional MAC AAS ~~S~~support of WirelessMAN-SCa, OFDM, and OFDMA

### 6.3.7.6.1 AAS MAC services

***Change the fifth paragraph as indicated:***

For SC, SCa and OFDM systems, ~~T~~the AAS part of the DL frame begins with an AAS specific Preamble, see Figure 52 and Figure 53. Note that this DL preamble does not apply to the OFDMA PHY.

### 6.3.7.6.4 Alerting the BS about presence of a new SS in an AAS system

***Change the second paragraph as indicated:***

Alternatively, for SC, SCa and OFDM systems, an AAS SS may use the following procedure to alert the BS to its presence, so the BS can adapt its antenna array to the SS position.

### 6.3.8 Contention resolution

***Change the seventh paragraph as indicated:***

The SS shall consider the contention transmission lost if no data grant has been ~~given within T16~~ received in the number of subsequent UL-MAP messages specified by the parameter Contention-based reservation timeout (or no response within T3 for initial ranging). The SS shall now increase its backoff window by a factor of two, as long as it is less than the maximum backoff window. The SS shall randomly select a number within its new backoff window and repeat the deferring process described above.

### 6.3.9 Network entry and initialization

***Change the second paragraph below Figure 55 as indicated:***

Implementation of phase e) is optional. This phase shall be performed if both SS and BS support Authorization Policy. Implementation of phases g), h), and i) at the SS is optional. These phases shall only be performed if the SS has indicated in the REG-REQ message that it is a managed SS.

### 6.3.9.1 Scanning and synchronization to the downlink

***Change the first paragraph as indicated:***

On initialization or after signal loss, the SS shall acquire a downlink channel. The SS shall have nonvolatile storage in which the last operational parameters are stored and ~~shall~~may first try to reacquire this downlink channel. If this fails, it shall begin to ~~continuously~~ scan the possible channels of the downlink frequency band of operation until it finds a valid downlink signal.

### 6.3.9.2 Obtain downlink parameters

***Change the first paragraph as indicated:***

The MAC shall search for the DL-MAP MAC management messages. The SS achieves MAC synchronization once it has received at least one DL-MAP message and is able to decode the DL-Burst Profiles contained therein. An SS MAC remains in synchronization as long as it continues to successfully receive the DL-MAP and DCD messages for its Channel. If the Lost DL-MAP Interval (Table 342) has elapsed without a valid DL-MAP message or the T1 interval (Table 342) has elapsed without a valid DCD message, an SS shall try to reestablish synchronization. The process of acquiring synchronization is illustrated in Figure 56. The process of maintaining synchronization is illustrated in Figure 57.

### 6.3.9.3 Obtain uplink parameters

***Change the third paragraph as indicated:***

The SS shall determine from the channel description parameters whether it may use the uplink channel. If the channel is not suitable, then the SS shall continue scanning to find another downlink channel. If the channel is suitable, the SS shall extract the parameters for this uplink from the UCD. ~~It then shall wait for the next DL-MAP message and extract the time synchronization from this message.~~ Then, the SS shall wait for a bandwidth allocation map for the selected channel. It may begin transmitting uplink in accordance with the MAC operation and the bandwidth allocation mechanism.

***Replace Figure 58 with the following figure:***

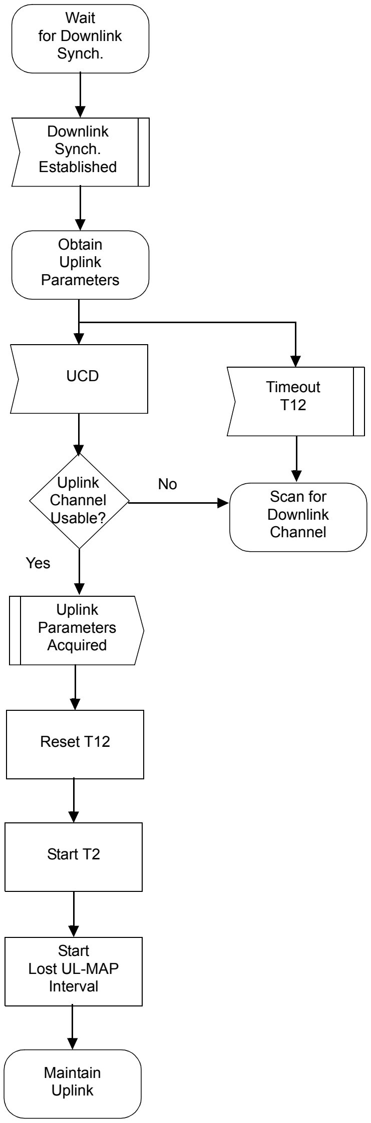

Wait for Downlink Synch.
Downlink Synch. Established
Obtain Uplink Parameters
UCD
Timeout T12
Uplink Channel Usable?
No
Scan for Downlink Channel
Yes
Uplink Parameters Acquired
Reset T12
Start T2
Start Lost UL-MAP Interval
Maintain Uplink

Figure 58—Obtaining uplink parameters

### 6.3.9.5 Initial ranging and automatic adjustments

*Change the title of 6.3.9.5.1 as indicated:*

#### 6.3.9.5.1 Contention-based ~~I~~initial ranging and automatic adjustments

*Change the second paragraph as indicated:*

For SC, SCa, and OFDM PHY, the SS shall put together a RNG-REQ message to be sent in an Initial Ranging Interval. The duration of the burst carrying the RNG-REQ message shall be as specified in the “Ranging

Request Burst Size" TLV (see 11.3.1). The CID field shall be set to the non initialized SS value (zero). For the OFDM PHY, the initial ranging process may include a subchannelized mechanism specified in8.3.7.2. For the OFDMA PHY, the initial ranging process shall begin by sending initial-ranging CDMA codes on the UL allocation dedicated for that purpose (for more details see 6.3.10.3), instead of RNG-REQ messages sent on contention slots.

***Change the seventh paragraph as indicated:***

In the case that the EIR x $P_{IR,max}$ and/or BS_EIRP are/is not known, the SS shall start from ~~the~~its minimum transmit power level~~ defined by the BS~~.

***Change the ninth paragraph as indicated:***

For SC, SCa, and OFDM PHY, the SS shall send the RNG-REQ at a power level below $P_{TX\_IR\_MAX}$, measured at the antenna connector. If the SS does not receive a response, the SS shall resend the RNG-REQ at the next appropriate Initial Ranging transmission opportunity ~~at one step higher~~ and adjust its power level. If the SS receives a response containing the frame number in which the RNG-REQ was transmitted, it shall consider the transmission attempt unsuccessful but implement the corrections specified in the RNG-RSP and issue another RNG-REQ message after the appropriate backoff delay. If the SS receives a response containing its MAC Address, it shall consider the RNG_RSP reception successful. If the SS does not receive a response, the SS shall resend the RNG-REQ at the next appropriate Initial Ranging transmission opportunity and adjust its power level.

***Change the second sentence of the eleventh paragraph as indicated:***

If the SS does not receive a response, the SS shall send a new CDMA code at the next appropriate Initial Ranging transmission opportunity ~~at one step higher~~ and adjust its power level.

***Change the third paragraph below Table 115 as indicated:***

On receiving a RNG-RSP instruction to move to a new downlink frequency ~~and/or uplink channel ID~~, the SS shall consider any previously assigned Basic, Primary Management, and Secondary Management CIDs to be deassigned, and shall obtain new Basic, Primary Management, and Secondary Management CIDs via initial ranging and registration.

***Insert the following text at the end of 6.3.9.5.1:***

For MS that are employing the optional association procedure, and to which the MS and BS are currently Associated, the MS may use its un-expired, previously obtained and retained associated Ranging transmit parameters to set initial ranging values including PTX_IR_MAX power levels.

### 6.3.9.6 Ranging parameter adjustment

***Replace Figure 60 with the following figure:***

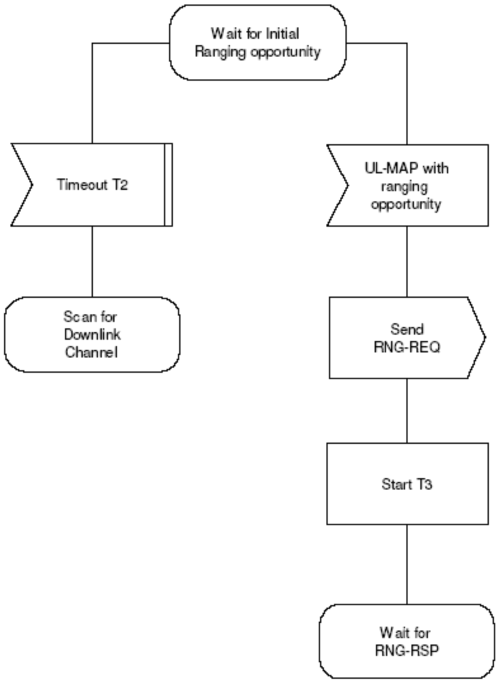
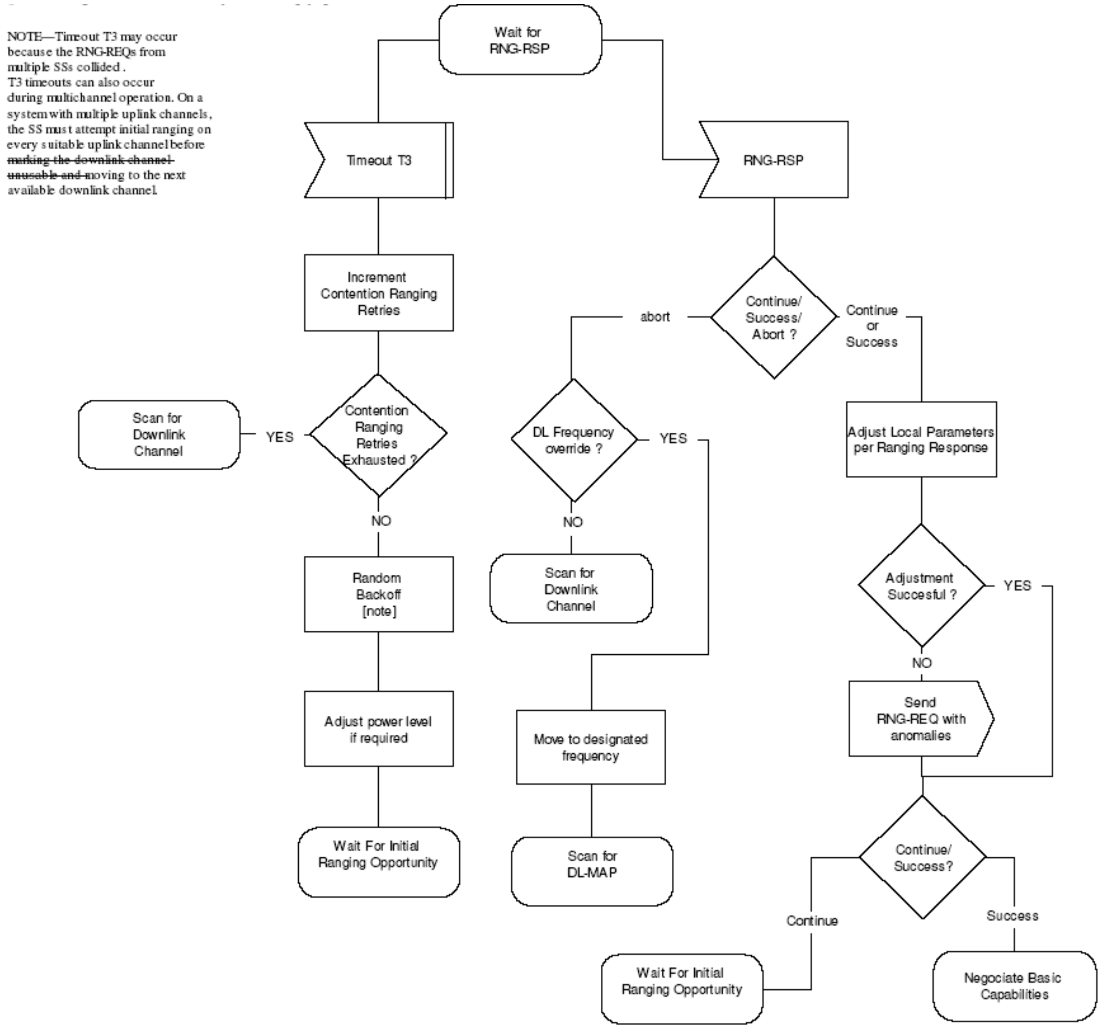

Wait for Initial Ranging opportunity
Timeout T2
UL-MAP with ranging opportunity
Scan for Downlink Channel
Send RNG-REQ
Start T3
Wait for RNG-RSP

Figure 60 – Initial Ranging – SS (part 1)

***Replace Figure 61 with the following figure:***


NOTE—Timeout T3 may occur because the RNG-REQs from multiple SSs collided. T3 timeouts can also occur during multichannel operation. On a system with multiple uplink channels, the SS must attempt initial ranging on every suitable uplink channel before ~~marking the downlink channel unusable and m~~moving to the next available downlink channel.

Wait for RNG-RSP
Timeout T3
RNG-RSP
Increment Contention Ranging Retries
abort
Continue/ Success/ Abort ?
Continue or Success
Scan for Downlink Channel
YES
Contention Ranging Retries Exhausted ?
DL Frequency override ?
YES
Adjust Local Parameters per Ranging Response
NO
NO
Random Backoff [note]
Scan for Downlink Channel
Adjustment Succesful ?
YES
NO
Send RNG-REQ with anomalies
Adjust power level if required
Move to designated frequency
Wait For Initial Ranging Opportunity
Scan for DL-MAP
Continue/ Success?
Continue
Success
Wait For Initial Ranging Opportunity
Negociate Basic Capabilities

Figure 61 – Initial Ranging – SS (part 2)

***Change the text of the "send RNG-RSP (rerange) with Frame Number (and Opportunity)" box of Figure 64 as follows:***

Send RNG-RSP (~~rerange~~continue) with Frame Number (and Opportunity).

### 6.3.9.7 Negotiate basic capabilities

***Replace Figure 66 with the following figure:***

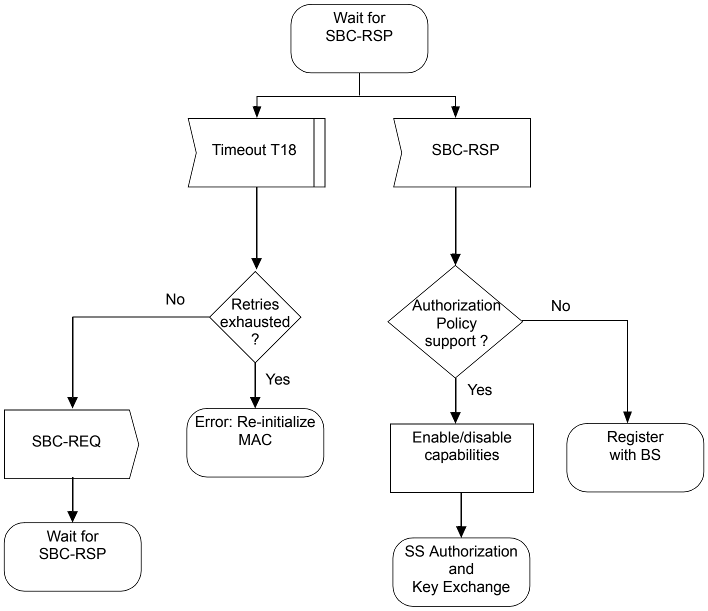

Wait for SBC-RSP
Timeout T18
SBC-RSP
No
Retries exhausted ?
Yes
Authorization Policy support ?
No
Yes
SBC-REQ
Error: Re-initialize MAC
Enable/disable capabilities
Register with BS
Wait for SBC-RSP
SS Authorization and Key Exchange

Figure 66—Wait for SBC-RSP—SS

***Replace Figure 67 with the following figure:***

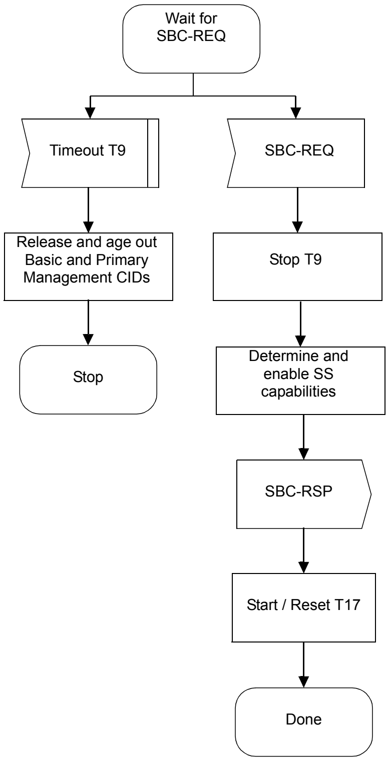

Wait for SBC-REQ
Timeout T9
SBC-REQ
Release and age out Basic and Primary Management CIDs
Stop T9
Stop
Determine and enable SS capabilities
SBC-RSP
Start / Reset T17
Done

**Figure 67—Negotiate Basic Capabilities—BS**

### 6.3.9.8 SS authorization and key exchange

***Change the first paragraph as indicated:***

If PKM is enabled (see 11.7.8.7), ~~T~~the BS and SS shall perform authorization and key exchange as described in 7.2.

### 6.3.9.9 Registration

***Replace Figure 70 with the following figure:***

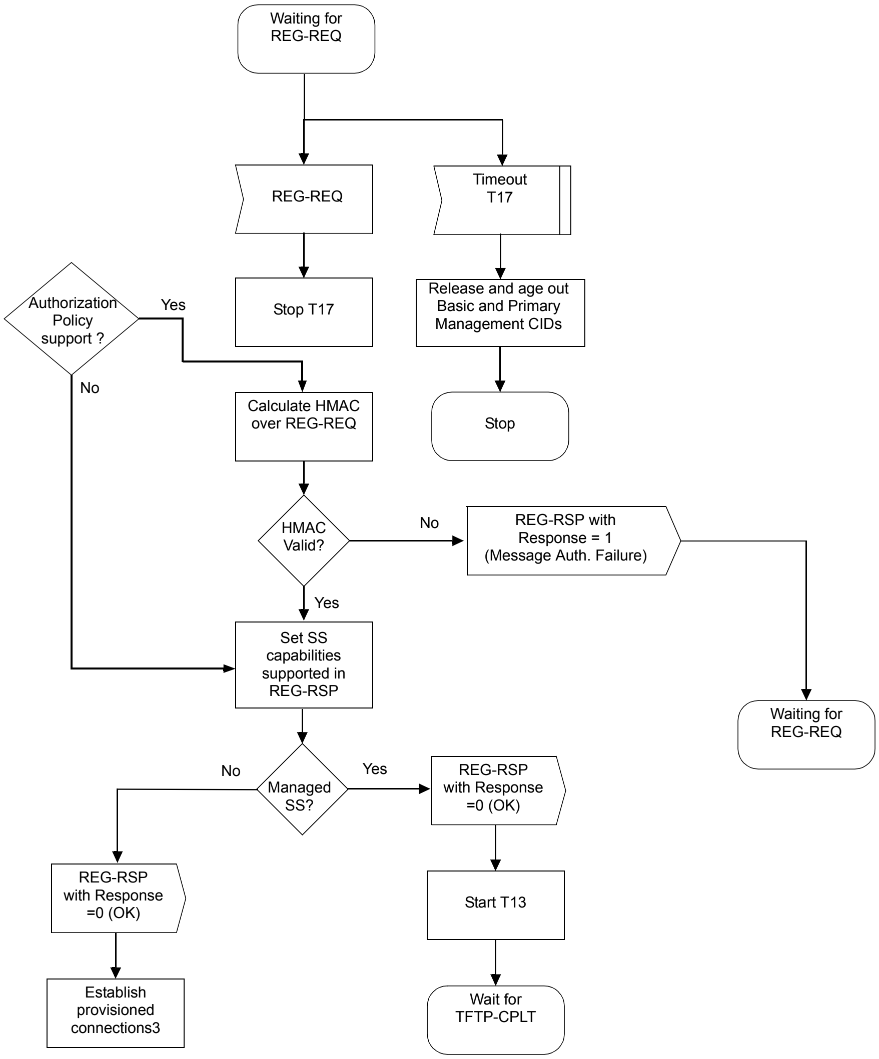

Waiting for REG-REQ
REG-REQ
Timeout T17
Stop T17
Release and age out Basic and Primary Management CIDs
Stop
Authorization Policy support ?
Yes
No
Calculate HMAC over REG-REQ
HMAC Valid?
No
REG-RSP with Response = 1 (Message Auth. Failure)
Yes
Set SS capabilities supported in REG-RSP
Waiting for REG-REQ
Managed SS?
No
Yes
REG-RSP with Response =0 (OK)
REG-RSP with Response =0 (OK)
Start T13
Establish provisioned connections3
Wait for TFTP-CPLT

**Figure 70—Registration—BS**

### 6.3.9.10 Establish IP connectivity

***Replace the first paragraph in 6.3.9.10 with the following:***

For an MS, if mobile IP is being used, the MS may secure its address on the secondary management connection using mobile IP.

Otherwise, for all SS and for MS using IPv4 and not using mobile IP, they shall invoke DHCP mechanisms [IETF RFC 2131] in order to obtain an IP address and any other parameters needed to establish IP connectivity. If the SS has a configuration file, the DHCP response shall contain the name of a file that contains further configuration parameters. For SS using IPv6, they shall either invoke DHCPv6 [IETF RFC 3315] or

IPv6 Stateless Address Autoconfiguration [IETF RFC 2462] based on the value of a TLV tuple in REG-RSP. Establishment of IP connectivity shall be performed on the SS's Secondary Management Connection (see Table 110).

The IP version parameter shall be included in the TLV described in 11.4.2.7.

***Insert new subclause 6.3.9.15:***

### 6.3.9.15 Forcing MSs to perform Network Entry at once

A BS may restart due to a critical error or an operator's intention. The BS has the restart count as the number of times in which the BS restarts. This restart count is incremented by one whenever BS restarts. The restart count as TLV encoding is included in DCD message (refer to Table 358). The BS may intentionally increment the restart count to be included in DCD message for the purpose of forcing all MSs to perform the Network Entry due to some problem at the BS or an operator's purpose.

After the BS restarts, it shall inform the MSs of its restart through the incremented restart count in DCD message. The restart count, which BS sent via DCD message, is saved in MS in order to recognize whether BS restarts or not.

Restart count is updated by every BS Restart Count TLV encoding in DCD message sent by BS. In other words, whenever MS receives DCD message, it shall compare the restart count in DCD message with the old one saved in it. If MS detects the restart count in DCD message different from old one save in MS, it shall perform Network Entry.

MOB_NBR-ADV message shall also include the BS Restart Count TLV for neighbor BS in each DCD_settings of DCD message. MS shall save the restart count of each neighbor BS for HO procedure. MS during HO shall compare the restart count of Target BS through DCD message with the restart count of Target BS saved in MS. As a result, if MS detects the restart of Target BS, it shall perform the Network Entry.

### 6.3.10 Ranging

### 6.3.10.1 Downlink burst profile management

***Insert the following sentence at beginning of the subclause***

This mechanism is not applicable to OFDMA PHY.

***Change the first paragraph as indicated:***

The downlink operational burst profile is determined by the BS according to the quality of the signal that is received by each SS. To reduce the volume of uplink traffic, the SS monitors the CINR and compares the average value against the allowed range of operation. This region is bounded by threshold levels. If the received CINR goes outside of the allowed operating region for the downlink operational profile, the SS requests a change to a new operational burst profile using one of two methods. In the first method the SS uses an allocated data grant to send a DBPC-REQ. In the second method the SS uses the initial ranging interval to send a RNG-REQ. The second method can only be used in context with a request to change to a more robust profile. The SS determines the optimal method. If the first method is used and the SS has been granted uplink bandwidth (a data grant allocation to the SS's Basic CID), the SS shall send a DBPC-REQ message in that allocation. The BS responds with a DBPC-RSP message. If ~~a grant is not available~~ the second method is used and the SS requires a more robust burst profile on the downlink, the SS shall send a RNG-REQ message in an Initial Ranging interval. With either method, the message is sent using the Basic CID of the SS. The coordination of message transmit and receipt relative to actual change of ~~modulation~~ operational burst profile is different depending upon whether an SS is transitioning to a more or less robust burst profile. Figure 79 shows the case where an SS is transitioning to a more robust type. Figure 80 shows transition to a less robust burst profile.

***Change the second paragraph as indicated:***

The SS ~~applies an algorithm~~has full responsibility to determine its optimal burst profile~~ in accordance with the threshold parameters established in the DCD message in accordance with Figure 81~~.

***Replace Figure 79 with the following figure:***

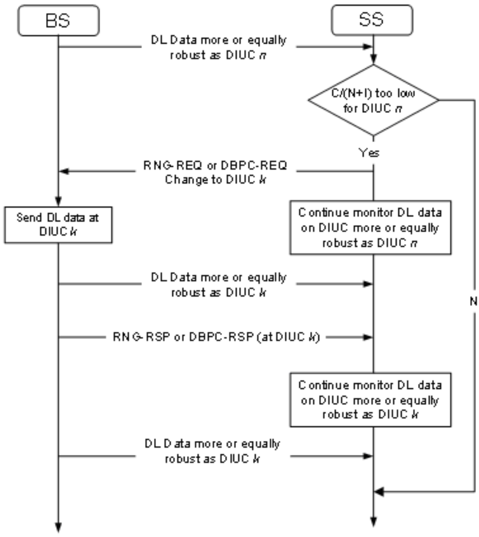

BS
SS
DL Data more or equally robust as DIUC n
C/(N+I) too low for DIUC n
Yes
No
RNG-REQ or DBPC-REQ Change to DIUC k
Send DL data at DIUC k
Continue monitor DL data on DIUC more or equally robust as DIUC n
DL Data more or equally robust as DIUC k
RNG-RSP or DBPC-RSP (at DIUC k)
Continue monitor DL data on DIUC more or equally robust as DIUC k
DL Data more or equally robust as DIUC k

**Figure 79—Transition to a more robust operational burst profile**

***Replace Figure 80 with the following figure:***

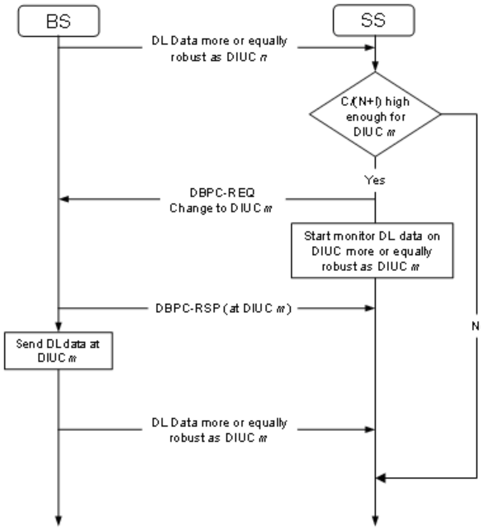

BS
SS
DL Data more or equally robust as DIUC n
C/(N+I) high enough for DIUC m
Yes
No
DBPC-REQ Change to DIUC m
Start monitor DL data on DIUC more or equally robust as DIUC m
DBPC-RSP (at DIUC m)
Send DL data at DIUC m
DL Data more or equally robust as DIUC m

**Figure 80—Transition to a less robust operational burst profile**

*Insert new Figure 80a:*

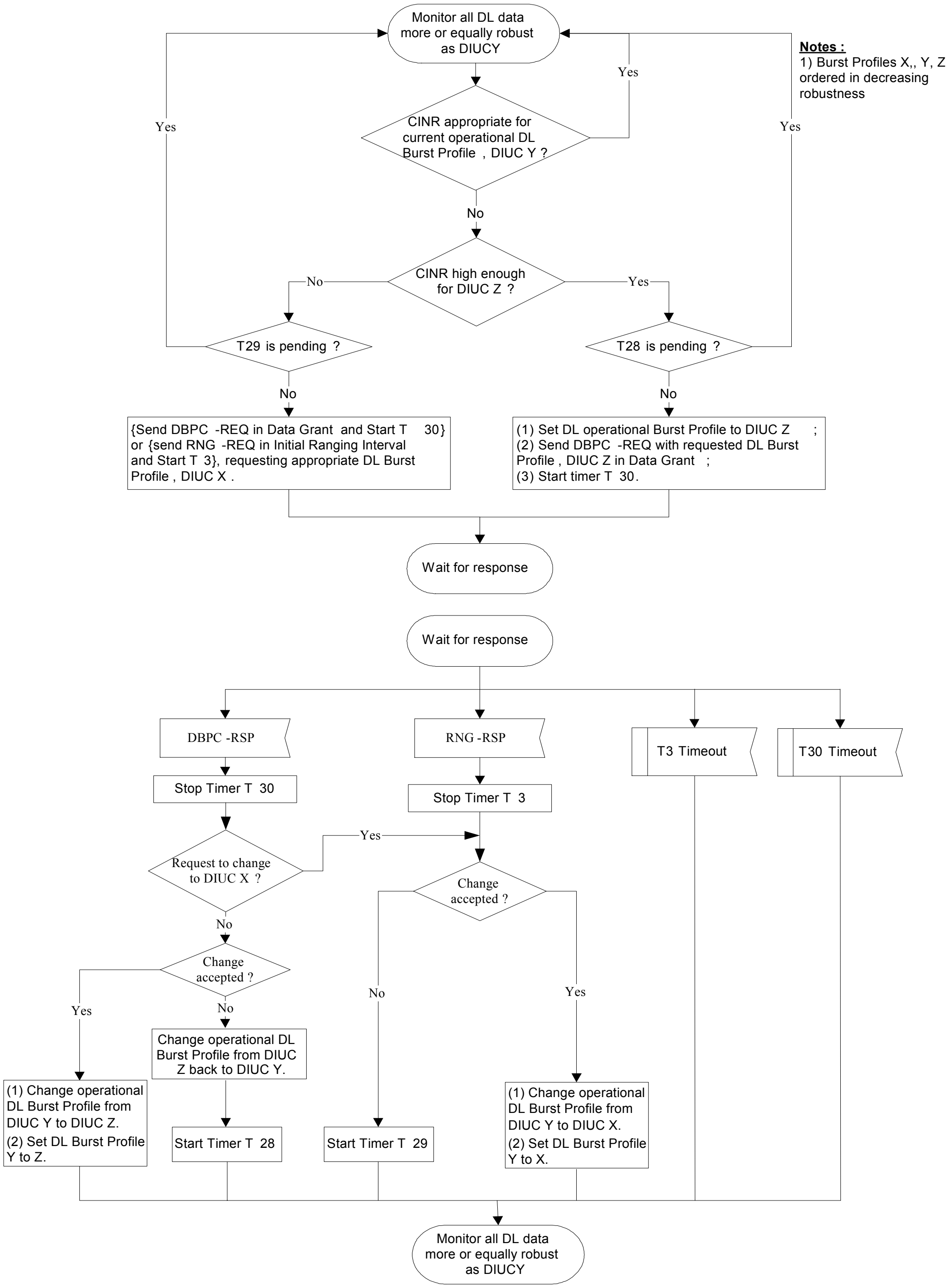

Monitor all DL data more or equally robust as DIUCY
Notes :
1) Burst Profiles X,, Y, Z ordered in decreasing robustness
Yes
Yes
Yes
CINR appropriate for current operational DL Burst Profile , DIUC Y ?
No
CINR high enough for DIUC Z ?
No
Yes
T29 is pending ?
T28 is pending ?
No
No
{Send DBPC -REQ in Data Grant and Start T 30} or {send RNG -REQ in Initial Ranging Interval and Start T 3}, requesting appropriate DL Burst Profile , DIUC X .
(1) Set DL operational Burst Profile to DIUC Z ; (2) Send DBPC -REQ with requested DL Burst Profile , DIUC Z in Data Grant ; (3) Start timer T 30.
Wait for response
Wait for response
DBPC -RSP
RNG -RSP
T3 Timeout
T30 Timeout
Stop Timer T 30
Stop Timer T 3
Yes
Request to change to DIUC X ?
Change accepted ?
No
Change accepted ?
No
Yes
Yes
No
Change operational DL Burst Profile from DIUC Z back to DIUC Y.
(1) Change operational DL Burst Profile from DIUC Y to DIUC Z. (2) Set DL Burst Profile Y to Z.
Start Timer T 28
Start Timer T 29
(1) Change operational DL Burst Profile from DIUC Y to DIUC X. (2) Set DL Burst Profile Y to X.
Monitor all DL data more or equally robust as DIUCY

Figure 80a—State transition diagram for downlink burst profile management—SS

***Delete Figure 81.***

### 6.3.10.2 Uplink periodic ranging

***Change the first and sixth enumerated item of the second paragraph as indicated:***

1) For each SS, the BS shall maintain a T27 timer. At each expiration of the timer, the BS shall grant bandwidth to the SS for an uplink transmission in the form of a data grant or an invited ranging opportunity. The timer is restarted each time a unicast grant is made to the SS. As a result, as long as the SS remains active, the BS does not specifically grant bandwidth to the SS for a ranging opportunity.

6) ~~The SS shall respond to each uplink bandwidth grant addressed to it.~~ When the status of the last RNG-RSP message received is *continue*, ~~the RNG-REQ message shall be included in the transmitted burst~~the SS shall not use the data grant to service its uplink connections except to transmit a RNG-REQ message. ~~When the status of the last RNG-RSP message received is *success*, the SS shall use the grant to service its pending uplink data queues. If no data is pending, the SS shall respond to the grant by transmitting a block of padded data.~~

***Insert new enumerated item to the second paragraph***

7) When the SS cannot apply a correction, it shall send a RNG-REQ reporting the anomaly in the next data grant or invited ranging opportunity.

***Replace Figure 82 with the following figure:***

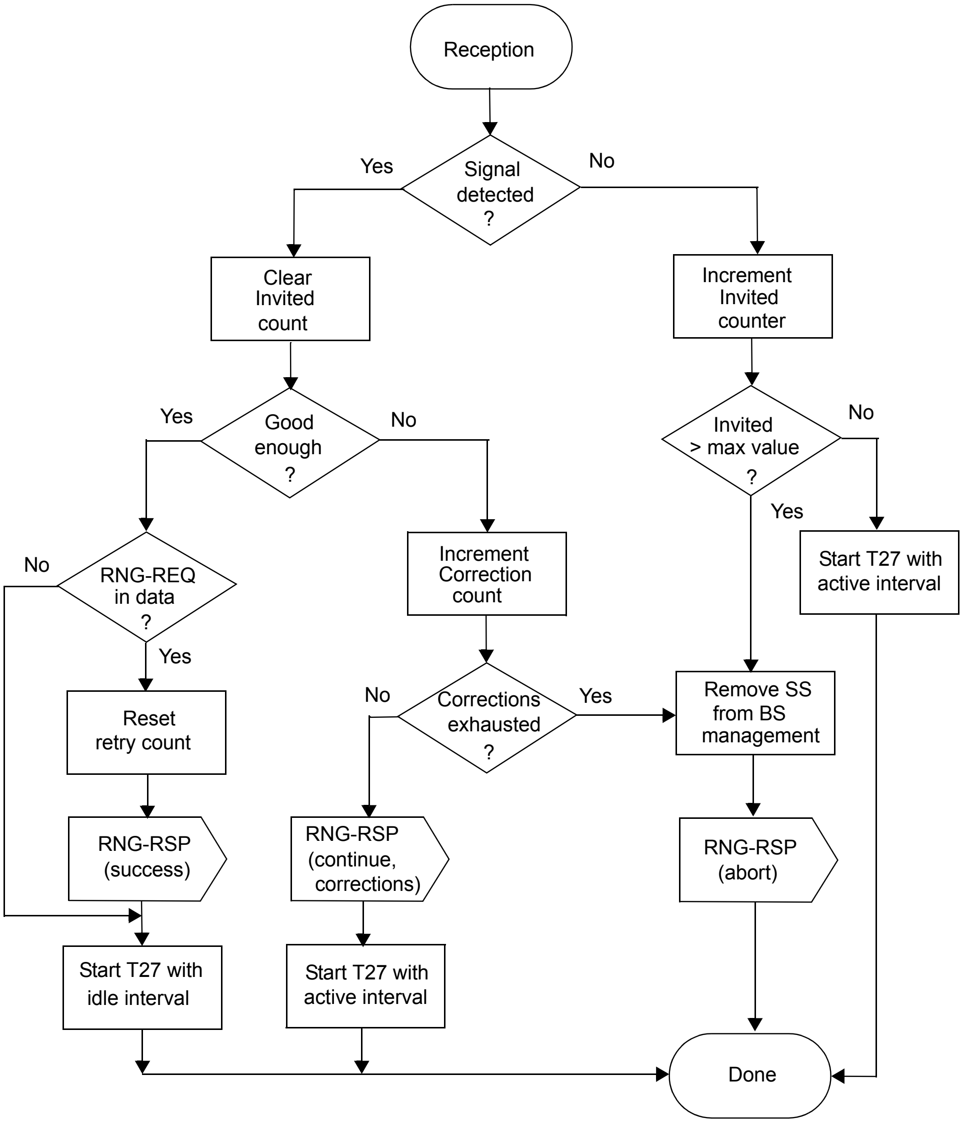

Reception
Signal detected ?
Yes
No
Clear Invited count
Increment Invited counter
Good enough ?
Yes
No
Invited > max value ?
No
Yes
RNG-REQ in data ?
No
Yes
Increment Correction count
Start T27 with active interval
Corrections exhausted ?
No
Yes
Reset retry count
Remove SS from BS management
RNG-RSP (success)
RNG-RSP (continue, corrections)
RNG-RSP (abort)
Start T27 with idle interval
Start T27 with active interval
Done

Figure 82—Periodic Ranging receiver processing—BS

*Replace Figure 84 with the following figure:*

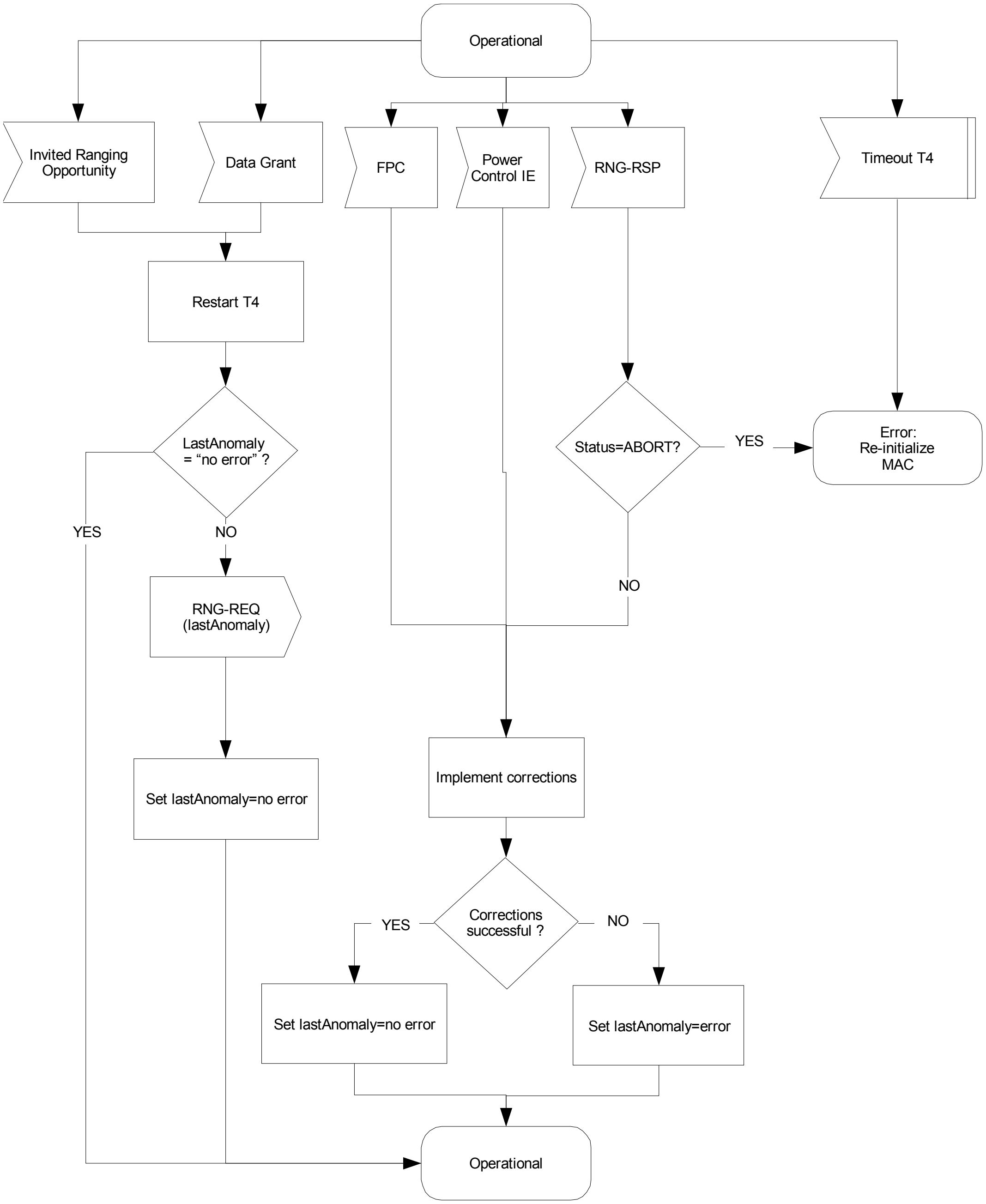

Operational
Invited Ranging Opportunity
Data Grant
FPC
Power Control IE
RNG-RSP
Timeout T4
Restart T4
LastAnomaly = “no error” ?
YES
NO
Status=ABORT?
YES
Error: Re-initialize MAC
NO
RNG-REQ (lastAnomaly)
Set lastAnomaly=no error
Implement corrections
Corrections successful ?
YES
NO
Set lastAnomaly=no error
Set lastAnomaly=error
Operational

**Figure 84—Periodic Ranging—SS**

### 6.3.10.3 OFDMA-based ranging

*Insert the following sentence at the end of the subclause:*

For OFDMA PHY the allocation of ranging opportunity inside a ranging allocation is defined in 8.4.7.4.

### 6.3.10.3.1 Contention-based initial ranging and automatic adjustments

***Change the text as indicated:***

- The SS, after acquiring downlink synchronization and uplink transmission parameters, shall choose randomly a Ranging Slot (with the use of a binary truncated exponent algorithm to avoid possible re-collisions) at the time to perform the ranging, then it chooses randomly a Ranging Code (from the Initial Ranging domain) and sends it to the BS (as a CDMA code).
- The BS cannot tell which SS sent the CDMA ranging request; therefore, upon successfully receiving a CDMA Ranging Code, the BS broadcasts a Ranging Response message that advertises the received Ranging Code as well as the ranging slot (OFDMA symbol number, subchannel, etc.) where the CDMA Ranging code has been identified. This information is used by the SS that sent the CDMA ranging code to identify the Ranging Response message that corresponds to its ranging request. The Ranging Response message contains all the needed adjustment (e.g., time, power, and possibly frequency corrections) and a status notification.
- Upon receiving a Ranging Response message with continue status, the SS shall continue the ranging process as done on the first entry with ranging codes randomly chosen from the Initial Ranging domain sent on the Periodic Ranging region.
- When the BS receives an initial-ranging CDMA code that results in sending an RNG-RSP message with success status, the BS shall provide BW allocation for the SS using the CDMA_Allocation_IE to send an RNG-REQ message.
- Initial ranging process is over after receiving RNG-RSP message, which includes a valid basic CID (following a RNG-REQ transmission on a CDMA_Allocation_IE). If this RNG-RSP message includes 'continue' indication, the ranging process should be continued using the periodic ranging mechanisms.
- The timeout required for SS to wait for RNG-RSP, following or not following CDMA Allocation IE, is defined by T3.
- ~~Upon receiving a Ranging Response message with continue status, the SS shall continue the ranging process as done on the first entry with ranging codes randomly chosen from the Periodic Ranging domain.~~
- Using the OFDMA ranging mechanism, the periodic ranging timer is controlled by the SS, not the BS.

The message sequence chart (Table 121) and flow charts (Figure 85, Figure 86, Figure 86a, and Figure 87) on the following pages define the CDMA initial ranging and adjustment process that shall be followed by compliant SSs and BSs.

***Change Table 121 as indicated:***

**Table 121—CDMA initial Ranging and automatic adjustments procedure**

| BS | | SS |
|---|---|---|
| [Time to send the CDMA Initial Ranging opportunity] | | |
| Send map containing CDMA Initial Ranging IE with a broadcast Connection ID | -----------UL-MAP-----------> | |

**Table 121—CDMA initial Ranging and automatic adjustments procedure *(continued)***

| **BS** | | **SS** |
|---|---|---|
| | <---------Ranging Code------- | Transmit randomly selected Initial Ranging code in a randomly selected Ranging Slot from available Ranging Region |
| [Receive Ranging Code] | | |
| Send RNG-RSP with Time and Power Corrections and original Ranging Code and Ranging Slot<br>Status = Continue | ----------RNG-RSP-------> | |
| | | Receive RNG-RSP message with Ranging Code and Ranging Slot matching sent values Adjust Time and Power parameters |
| [Time to send the CDMA Initial Ranging opportunity] | | |
| Send map containing CDMA Initial Ranging IE with a broadcast Connection ID | -----------UL-MAP------------> | |
| | <---------Ranging Code------- | Transmit randomly selected ~~Periodic~~Initial Ranging code in a randomly selected Ranging Slot from available Periodic Ranging Region |
| [Receive Ranging Code] | | |
| Send RNG-RSP with Time and Power Corrections and original Ranging Code and Ranging Slot<br>Status = Success | ----------RNG-RSP-------> | |
| | | Receive RNG-RSP message with Ranging Code and Ranging Slot matching sent values Adjust Time and Power parameters |
| [Time to send the next map] | | |
| Send map containing anonymous BW allocation with original Ranging Code and Ranging Slot | -----------UL-MAP------------> | |
| | <---------RNG-REQ------- | Transmit RNG-REQ and continue with regular Initial network entry |

*Replace Figure 85 with the following figure:*

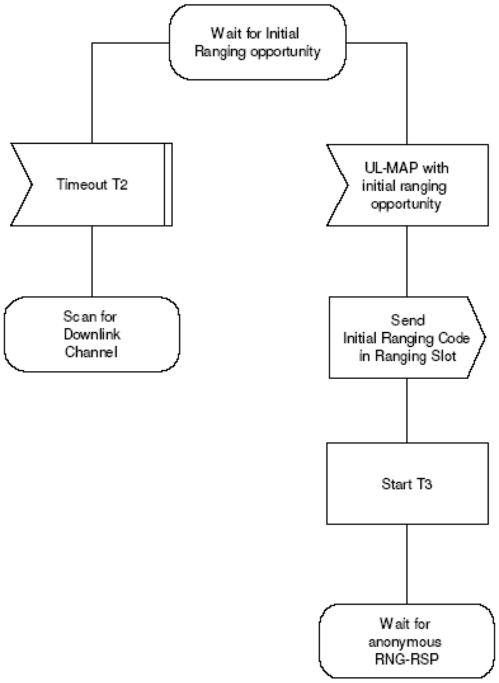

Wait for Initial Ranging opportunity
Timeout T2
UL-MAP with initial ranging opportunity
Scan for Downlink Channel
Send Initial Ranging Code in Ranging Slot
Start T3
Wait for anonymous RNG-RSP

Figure 85 – CDMA Initial Ranging – SS (part 1)

***Replace Figure 86 with the following figure:***

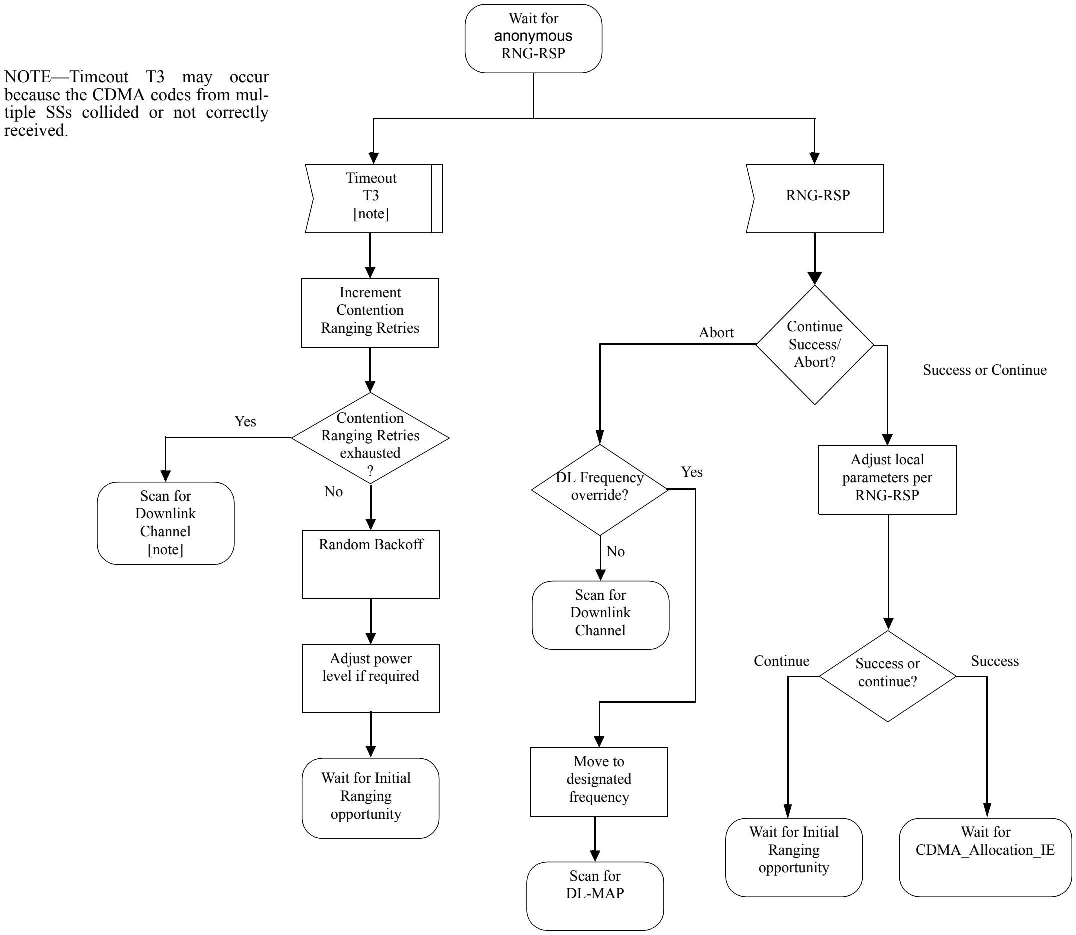

Wait for anonymous RNG-RSP
NOTE—Timeout T3 may occur because the CDMA codes from multiple SSs collided or not correctly received.
Timeout T3 [note]
RNG-RSP
Increment Contention Ranging Retries
Abort
Continue Success/ Abort?
Success or Continue
Yes
Contention Ranging Retries exhausted ?
No
Scan for Downlink Channel [note]
Random Backoff
DL Frequency override?
Yes
No
Adjust local parameters per RNG-RSP
Scan for Downlink Channel
Adjust power level if required
Continue
Success or continue?
Success
Wait for Initial Ranging opportunity
Move to designated frequency
Wait for Initial Ranging opportunity
Wait for CDMA_Allocation_IE
Scan for DL-MAP

Figure 86—CDMA Initial Ranging—SS (part 2)

*Insert the following figure:*

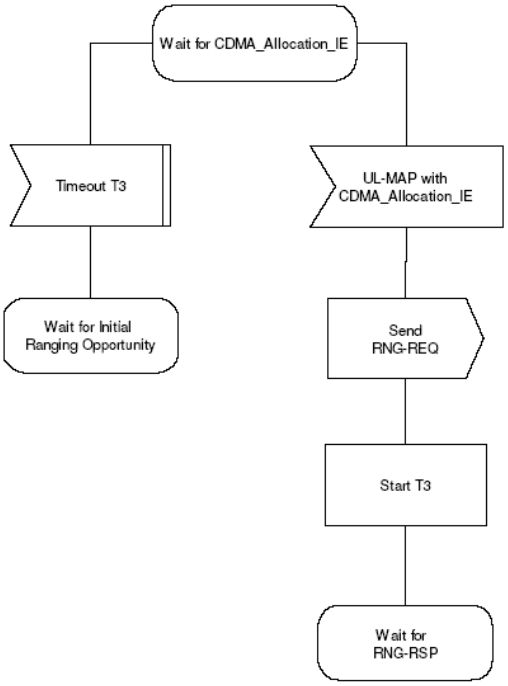
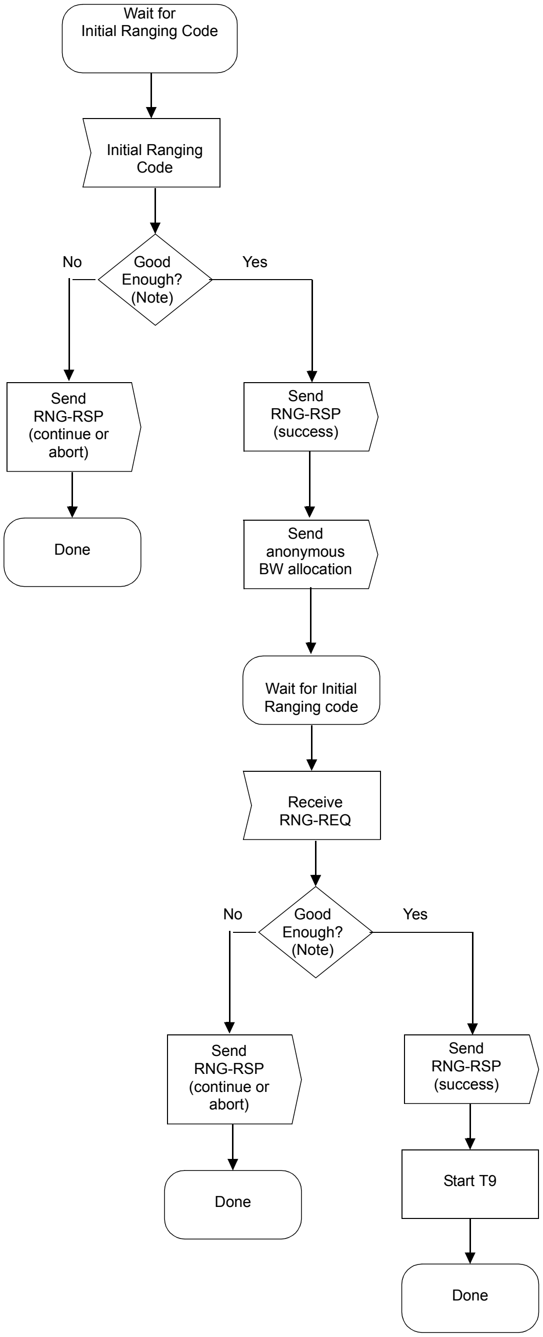

Wait for CDMA_Allocation_IE
Timeout T3
UL-MAP with CDMA_Allocation_IE
Wait for Initial Ranging Opportunity
Send RNG-REQ
Start T3
Wait for RNG-RSP

Figure 86a – CDMA Initial Ranging – SS (part 3)

***Replace Figure 87 with the following figure:***


Wait for Initial Ranging Code
Initial Ranging Code
No
Good Enough? (Note)
Yes
Send RNG-RSP (continue or abort)
Send RNG-RSP (success)
Done
Send anonymous BW allocation
Wait for Initial Ranging code
Receive RNG-REQ
No
Good Enough? (Note)
Yes
Send RNG-RSP (continue or abort)
Send RNG-RSP (success)
Done
Start T9
Done

NOTE —Means ranging is within the tolerable limits of the BS.

Figure 87—CDMA Initial Ranging—SS

***Change subclause 6.3.10.3.2 as indicated:***

### 6.3.10.3.2 Periodic ranging and automatic adjustments

An SS that wishes to perform periodic ranging shall take the following steps:

- The SS, shall choose randomly a Ranging Slot (with the use of a binary truncated exponent algorithm to avoid possible re-collisions) at the time to perform the ranging, then it chooses randomly a Periodic Ranging Code ~~(from the Periodic Ranging domain)~~ and sends it to the BS (as a CDMA code).
- If the MS does not receive a response, the MS may send a new CDMA code at the next appropriate periodic Ranging transmission opportunity and adjust its power level up to PTX_IR_MAX (6.3.9.5.1).
- The BS cannot tell which SS sent the CDMA ranging request; therefore, upon successfully receiving a CDMA Periodic Ranging Code, the BS broadcasts a Ranging Response message that advertises the received Periodic Ranging Code as well as the ranging slot (OFDMA symbol number, subchannel, etc.) where the CDMA Periodic Ranging code has been identified. This information is used by the SS that sent the CDMA Periodic ranging code to identify the Ranging Response message that corresponds to its ranging request. The Ranging Response message contains all the needed adjustment (e.g., time, power, and possibly frequency corrections) and a status notification.
- Upon receiving a Ranging Response message with continue status, the SS shall continue the ranging process with further periodic ranging codes randomly chosen ~~from the Periodic Ranging domain~~.
- Using the OFDMA ranging mechanism, the periodic ranging timer is controlled by the SS, not the BS.
- The BS may send an unsolicited RNG-RSP as a response to a CDMA-based bandwidth-request or any other data transmission from the SS.

***Replace Figure 90 with the following figure:***

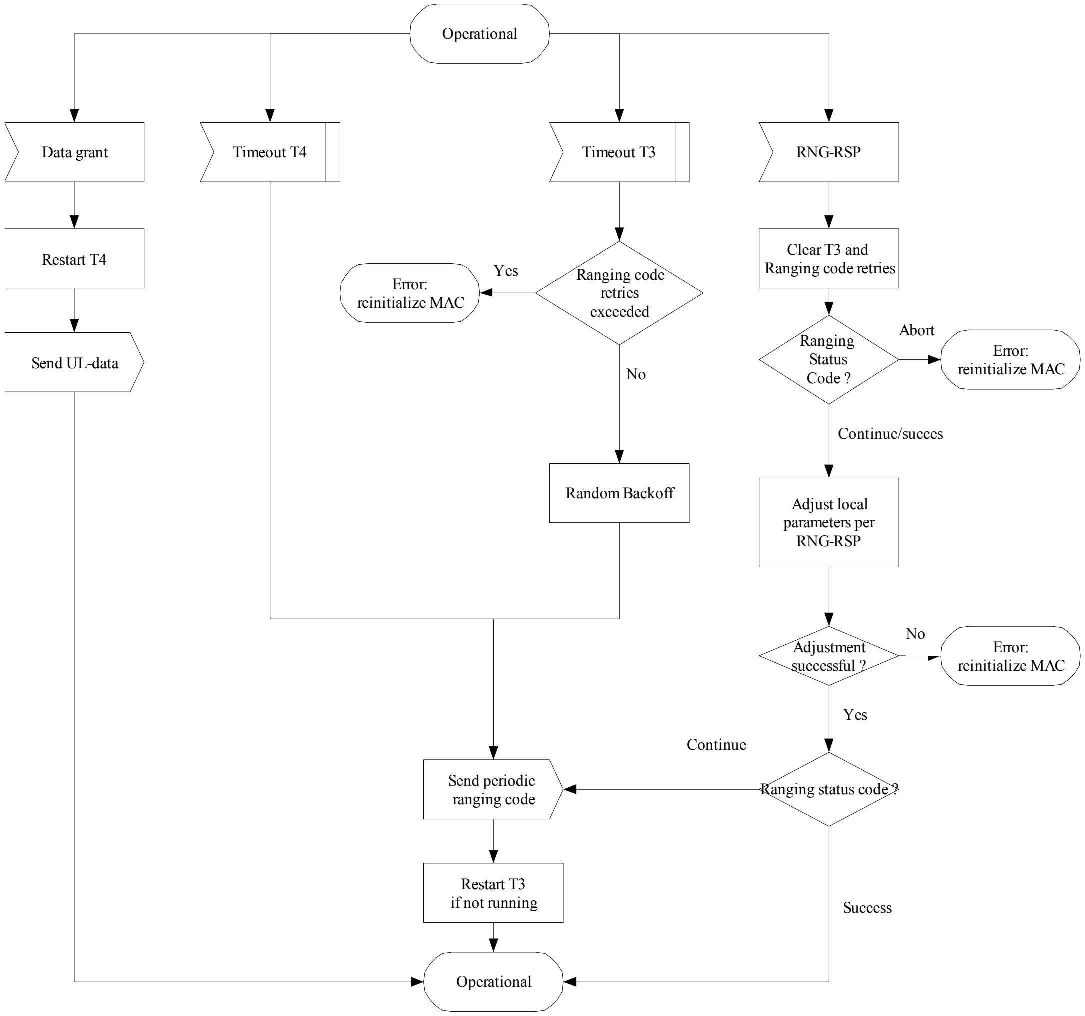

Operational
Data grant
Timeout T4
Timeout T3
RNG-RSP
Restart T4
Send UL-data
Ranging code retries exceeded
Yes
Error: reinitialize MAC
No
Random Backoff
Clear T3 and Ranging code retries
Ranging Status Code ?
Abort
Error: reinitialize MAC
Continue/succes
Adjust local parameters per RNG-RSP
Adjustment successful ?
No
Error: reinitialize MAC
Yes
Continue
Ranging status code ?
Send periodic ranging code
Restart T3 if not running
Success
Operational

**Figure 90—Periodic CDMA ranging—SS**

***Insert new subclause 6.3.10.3.3:***

### 6.3.10.3.3 CDMA handover ranging and automatic adjustment

An MS that wishes to perform handover ranging shall take a process similar to that defined in the initial ranging section with the following modifications.

In CDMA handover ranging process, the CDMA handover ranging code is used instead of the initial ranging code. The code is selected from the handover-ranging domain as defined in 8.4.7.3.

Alternatively, if the BS is pre-notified for the upcoming handover MS, it may provide BW allocation information to the MS using Fast_Ranging_IE to send an RNG-REQ message.

### 6.3.13 Establishment of multicast and broadcast transport connections

***Change the subclause title and the first paragraph as indicated:***

The BS may establish a downlink multicast or broadcast service by creating a connection with each SS to be associated with the service. Any available traffic CID value may be used for the service (i.e., there are no dedicated CIDs for multicast transport connections). To ensure proper multicast operation, the CID used for the service is the same for all SSs on the same channel that participate in the connection. The SSs need not be aware that the connection is a multicast or broadcast transport connection. The data transmitted on the connection with the given CID shall be received and processed by the MAC of each involved SS. Thus, each multicast or broadcast SDU is transmitted only once per BS channel. Since a multicast or broadcast transport connection is associated with a service flow, it is associated with the QoS and traffic parameters for that service flow.

### 6.3.14 QoS

#### 6.3.14.1 Theory of operation

***Change the third paragraph as indicated:***

The principal mechanism for providing QoS is to associate packets traversing the MAC interface into a service flow as identified by the transport CID. A service flow is a unidirectional flow of packets that is provided a particular QoS. The SS and BS provide this QoS according to the QoS Parameter Set defined for the service flow.

#### 6.3.14.2 Service flows

***Change items (a) and (b) of the second paragraph as indicated:***

a) *Service Flow ID:* An SFID is assigned to each existing service flow. The SFID serves as the principal identifier for the service flow ~~in the network~~ between a BS and an SS. A service flow has at least an SFID and an associated direction.

b) *CID:* The connection ID of the transport connection ~~Mapping to an SFID that~~ exists only when the service flow is ~~connection has an~~ admitted or active ~~service flow~~. The relationship between SFID and transport CID, when present, is unique. An SFID shall never be associated with more than one transport CID, and a transport CID shall never be associated with more than one SFID.

***Change footnote 14 as indicated:***

To say that QoS Parameter Set A is a subset of QoS Parameter Set B the following shall be true for all QoS Parameters in A and B:
if (a smaller QoS parameter value indicates less resources, e.g., Maximum Traffic Rate)
A is a subset of B if the parameter in A is less than or equal to the same parameter in B
if (a larger QoS parameter value indicates less resources, e.g., Tolerated Grant Jitter)
A is a subset of B if the parameter in A is greater than or equal to the same parameter in B
if (the QoS parameter is not quantitative~~, e.g., Service Flow Scheduling Type~~)
A is a subset of B if the parameter in A is equal to the same parameter in B

#### 6.3.14.3 Object model

***Change the subclause as indicated:***

The major objects of the architecture are represented by named rectangles in Figure 95. Each object has a number of attributes; the attribute names that uniquely identify it are underlined. Optional attributes are denoted with brackets. The relationship between the number of objects is marked at each end of the association line between the objects. For example, a service flow may be associated with from 0 to *N* (many) PDUs, but a PDU is associated with exactly one service flow. The service flow is the central concept of the MAC protocol. It is uniquely identified by a 32-bit (SFID). Service flows may be in either the uplink or downlink direction. There is a one-to-one mapping between admitted and active service flows (32-bit SFID) and transport connections (16-bit CID). ~~Admitted and active service flows are mapped to a 16-bit CID.~~

Outgoing user data is submitted to the MAC SAP by a CS process for transmission on the MAC interface. The information delivered to the MAC SAP includes the CID identifying the transport connection across which the information is delivered. The service flow for the connection is mapped to MAC transport connection identified by the CID.

A Classifier Rule uniquely maps a packet to its transport connection. The Classifier Rule is associated to zero or one PHS Rules. When creating a PHS Rule the associated Classifier Rule Index is used as a reference. A PHS Rule is associated to a single service flow. PHS Rules associated to the same service flow are uniquely identified by their PHSI. The Classifier Rule uniquely maps packets to its associated PHS Rule.

***Replace Figure 95 with the following figure:***

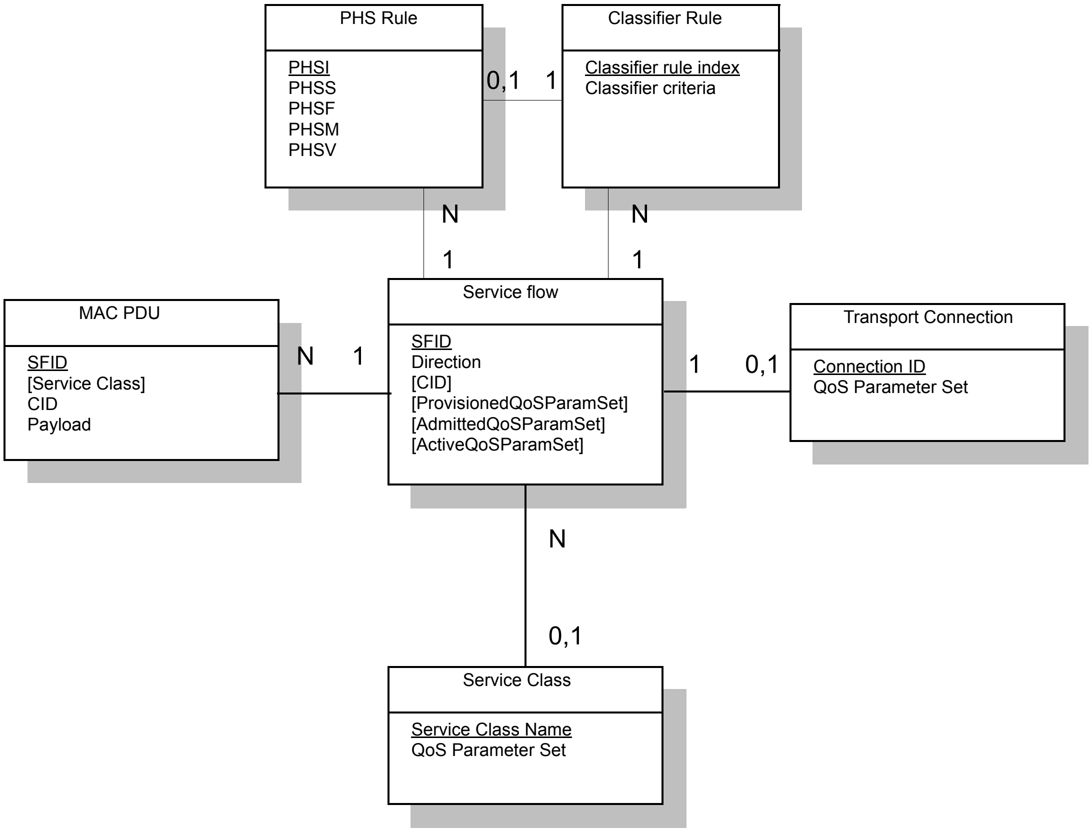

PHS Rule
PHSI
PHSS
PHSF
PHSM
PHSV
0,1
1
Classifier Rule
Classifier rule index
Classifier criteria
N
1
N
1
MAC PDU
SFID
[Service Class]
CID
Payload
N
1
Service flow
SFID
Direction
[CID]
[ProvisionedQoSParamSet]
[AdmittedQoSParamSet]
[ActiveQoSParamSet]
1
0,1
Transport Connection
Connection ID
QoS Parameter Set
N
0,1
Service Class
Service Class Name
QoS Parameter Set

**Figure 95—Theory of Operation Object Model**

### 6.3.14.4 Service classes

***Insert new subclause 6.3.14.4.1:***

#### 6.3.14.4.1 Global service flows

Mobile networks require common definitions of service class names and associated AuthorizedQoSParamSets in order to facilitate operation across a distributed topology. Global service class names shall be supported to enable operation in this context.

In operation, global service class names are employed as a baseline convention for communicating AuthorizedQoSParamSet or AdmittedQoSParamSet. Global service class name is similar in function to service class name except that 1) Global service class name use may not be modified by a BS, 2) Global service class names remain consistent among all BS, and 3) Global service class names are a rules-based naming system whereby the global service class name itself contains referential QoS Parameter codes. In practice, global service class names are intended to be accompanied by extending or modifying QoS Param Set defining parameters, as needed, to provide a complete and expedited method for transferring Authorized- or AdmittedQoSParamSet information.

**Global service class name**—A rules-based, composite name parsed in eight information fields of format ISBRLSPTR, elements reference extensible look-up tables. Each information field placeholder must be an expressed value obtained from Table 124a, as part of the name, and may not be omitted.

**Table 124a—Global service flow class name information field parameters**

| Position | Name | Size (bits) | Value |
|---|---|---|---|
| I | Uplink/Downlink indicator | 1 | 0 or 1:<br>0=uplink;<br>1=downlink |
| S | Maximum sustained traffic rate | 6 | Extensible look-up Table (value 0b111111 indicates TLV to follow) |
| T | Traffic indication preference | 1 | 0 or 1:<br>0=No traffic indication;<br>1=Traffic indication |
| B | Maximum traffic burst | 6 | Extensible look-up Table (value 0b111111 indicates TLV to follow) |
| R | Minimum reserved traffic rate | 6 | Extensible look-up Table (value 0b111111 indicates TLV to follow) |
| L | Maximum latency | 6 | Extensible look-up Table 124c (value 0b111111 indicates TLV to follow) |
| S | Fixed-length versus variable-length SDU indicator | 1 | 0 or 1:<br>0=variable length;<br>1=fixed length |
| P | Paging preference | 1 | 0 or 1:<br>0 = No paging generation<br>1 = Paging generation |
| R | *Reserved* | 4 | Shall be set to 0b0000 |

**Global service flow class name parameters**

**Uplink/Downlink indicator**

The Uplink/Downlink indicator parameter identifies the defined service flow direction from the originating entity.

**Maximum sustained traffic rate**

A parameter that defines the peak information rate of the service. The rate is expressed in bits per second and pertains to the service data units (SDUs) at the input to the system. Explicitly, this parameter does not include transport, protocol, or network overhead such as MAC headers or CRCs, or non-payload session maintenance overhead like SIP, MGCP, H.323 administration, etc. This parameter does not limit the instantaneous rate of the service since this is governed by the physical attributes of the ingress port. However, at the destination network interface in the uplink direction, the service shall be policed to conform to this parameter, on the average, over time. On the network in the downlink direction, it may be assumed that the service was already policed at the ingress to the network. If this parameter is set to zero, then there is no explicitly mandated maximum rate. The maximum sustained traffic rate field specifies only a bound, not a guarantee that the rate is available. The algorithm for policing this parameter is left to vendor differentiation and is outside the scope of the standard.

**Table 124b—Traffic rate and burst values**

| 6-bit Code (binary) | Traffic rate (bits/s) | Burst values (bits) | 6-bit Code (binary) | Traffic rate (bits/s) | Burst values (bits) |
|---|---|---|---|---|---|
| 000000 | No requirement | No requirement | 010000 | 192000 | 192000 |
| 000001 | 1200 | 1200 | 010001 | 256000 | 256000 |
| 000010 | 2400 | 2400 | 010010 | 384000 | 384000 |
| 000011 | 4800 | 4800 | 010011 | 512000 | 512000 |
| 000100 | 9600 | 9600 | 010100 | 768000 | 768000 |
| 000101 | 14400 | 14400 | 010101 | 1024000 | 1024000 |
| 000110 | 19200 | 19200 | 010110 | 1536000 | 1536000 |
| 000111 | 24000 | 24000 | 010111 | 1921000 | 1921000 |
| 001000 | 26400 | 26400 | 011000-111110 | *Reserved* | *Reserved* |
| 001001 | 28000 | 28000 | | | |
| 001010 | 36000 | 36000 | 111111 | TLV follows | TLV follows |
| 001011 | 44000 | 44000 | | | |
| 001100 | 48000 | 48000 | | | |
| 001101 | 56000 | 56000 | | | |
| 001110 | 64000 | 64000 | | | |
| 001111 | 128000 | 128000 | | | |

**Traffic Indication Preference**

This parameter is a single bit indicator of an MS's preference for the reception of Traffic Indication messages during sleep mode. When set it indicates that the BS may present Traffic

Indication messages to the MS when data SDUs bound for the MS are present while the MS is in sleep mode.

**Maximum traffic burst**

The Maximum traffic burst parameter defines the maximum burst size that must be accommodated for the service. Since the physical speed of ingress/egress ports, any air interface, and the backhaul will in general be greater than the maximum sustained traffic rate parameter for a service, this parameter describes the maximum continuous burst the system should accommodate for the service assuming the service is not currently using any of its available resources. Maximum traffic burst set to zero shall mean no Maximum traffic burst reservation requirement.

**Minimum reserved traffic rate**

The Minimum reserved traffic rate parameter specifies the minimum rate, in bits per second, reserved for this service flow. The BS shall be able to satisfy bandwidth requests for a connection up to its minimum reserved traffic rate. If less bandwidth than its Minimum reserved traffic rate is requested for a connection, the BS may reallocate the excess reserved bandwidth for other purposes. The value of this parameter is calculated excluding MAC overhead. Minimum reserved traffic set to zero shall mean no minimum reserved traffic rate requirement.

**Maximum latency**

The value of this parameter specifies the maximum interval between the reception of a packet at CS of BS or SS and the arrival of the packet to the peer device. If defined, this parameter represents a service commitment and shall be guaranteed. A value of zero for Maximum latency shall be interpreted as no commitment.

**Table 124c—Maximum latency values**

| 6-bit Code (binary) | Value (ms) | 6-bit Code (binary) | Value (ms) | 6-bit Code (binary) | Value (ms) |
|---|---|---|---|---|---|
| 000000 | No requirement | 001000 | 50 | 010000 | 10000 |
| 000001 | 1 | 001001 | 100 | 010001 - 111110 | *Reserved* |
| 000010 | 2 | 001010 | 150 | | |
| 000011 | 5 | 001011 | 200 | 111111 | TLV follows |
| 000100 | 10 | 001100 | 500 | | |
| 000101 | 20 | 001101 | 1000 | | |
| 000110 | 30 | 001110 | 2000 | | |
| 000111 | 40 | 001111 | 5000 | | |

**SDU indicator**

The value of this parameter specifies whether the SDUs on the service flow are fixed-length or variable-length.

**Paging Preference**

This parameter is a single bit indicator of an MS's preference for the reception of paging advisory messages during idle mode. When set, it indicates that the BS may present paging advisory messages or other indicative messages to the MS when data SDUs bound for the MS are present while the MS is in Idle Mode.

### 6.3.14.7 Service Flow Creation

#### 6.3.14.7.1 Dynamic service flow creation

#### 6.3.14.7.1.1 Dynamic service flow creation—SS-initiated

***Change the third paragraph as indicated:***

A DSA-REQ from an SS contains a ~~service flow reference and~~ QoS Parameter set (marked either for admission-only or for admission and activation).

### 6.3.14.9 Service flow management

#### 6.3.14.9.2 Dynamic Service Flow state transitions

***Change the first paragraph as indicated:***

The Dynamic Service Flow state transition diagram (Figure 99) is the top-level state diagram and controls the general service flow state. As needed, it creates transactions, each represented by a Transaction state transition diagram, to provide the DSA, DSC, and DSD signaling. Each Transaction state transition diagram communicates only with the parent Dynamic Service Flow state transition diagram. The top-level state transition diagram filters DSx messages and passes them to the appropriate transaction based on SFID~~,~~ ~~service flow reference number,~~ and Transaction ID.

***Change Figure 101 on the transition line between "Holding Down" to "End" as indicated:***

(Timeout T~~8~~10 / DSA Ended)

(~~SF Change~~Delete-Remote / DSA Ended)

#### 6.3.14.9.3 DSA

#### 6.3.14.9.3.1 SS-initiated DSA

***Change the following text in Table 125:***

If ActiveQoSParamSet is non-null, Enable transmission ~~and/~~or reception of data on new service flow.

#### 6.3.14.9.3.3 DSA state transition diagrams

***In Figure 111, change the box of "[BS only] DSX-RVD" to a "send" symbol.***

#### 6.3.14.9.4 DSC

***Change the first paragraph as indicated:***

The DSC set of messages is used to modify the flow parameters associated with a service flow. Specifically, DSC can modify the service flow Specification. Implementation of dynamic service change initiated by BS is mandatory. Implementation of dynamic service change initiated by SS is optional.

***Change the eighth paragraph as indicated:***

Any service flow can be deactivated with a DSC command by sending a DSC-REQ message, referencing the SFID, and including a null ActiveQoSParamSet. ~~However, if a Basic, Primary Management, or~~

~~Secondary Management Connection of an SS is deactivated, that SS is deregistered and shall re-register. Therefore, care should be taken before deactivating such service flows.~~ If a service flow that was provisioned is deactivated, the provisioning information for that service flow shall be maintained until the service flow is reactivated.

***Change the eleventh paragraph as indicated:***

The following service flow parameters may not be changed, and shall not be present in the DSC-REQ or DSC-RSP messages:

- Service Flow Scheduling Type
- Request/Transmission Policy
- Convergence Sublayer Specification
- Fixed-Length versus Variable-Length SDU Indicator
- SDU Size
- ATM switching (ATM Services only)
- ARQ parameters, in accordance with individual TLV definitions
- FSN Size

#### 6.3.14.9.4.3 DSC state transition diagrams

***In Figure 120, change the box of "[BS only] DSX-RVD" to a "send" symbol.***

***In Figure 121, Change the fourth box from "SF Delete-Remote" to "SF Delete-Remote, SF Change-Local".***

***In Figure 122, Change first box from "SF Changed, SF Deleted, SF Delete-Remote" to "SF Changed, SF Deleted, SF Delete-Remote, SF Change-Local".***

***In Figure 123, Change first Box from "SF Deleted, SF Delete-Remote" to "SF Deleted, SF Delete-Remote, SF Change-Local".***

#### 6.3.14.9.5 Connection release

***Change the subclause as indicated:***

Any service flow can be deleted with the DSD messages. When a service flow is deleted, all resources associated with it are released. If a service flow for a provisioned service is deleted, the ability to re-establish the service flow for that service is network management dependent. Therefore, care should be taken before deleting such service flows. ~~However, the deletion of a provisioned service flow shall not cause an SS to reinitialize.~~ Implementation of dynamic Service deletion initiated by BS is mandatory. Implementation of dynamic service deletion initiated by SS is optional

### 6.3.15 ~~DFS for license-exempt operation~~ Procedures for shared frequency band usage

***Change the title of 6.3.15 and the subclauses 6.3.15.1 to 6.3.15.7 as indicated:***

#### 6.3.15.1 Introduction

Procedures are defined in this subclause that may be used when the IEEE 802.16 system is sharing a frequency band with another system or service, either for the reduction of interference to and from other systems, to facilitate coexistence of systems or for other reasons. These procedures generally involve mechanisms to facilitate the detection of other users, and the avoidance and prevention of harmful interference into other users. Included within these procedures for certain sharing scenarios, regulatory requirements specify that DFS (as defined by ITU-R in M.1652 [new reference B11]) shall be used to facilitate sharing with specific spectrum users identified by regulation. A specific spectrum user is a user from a service specifically identified in regulation as requiring protection from harmful interference. In the case DFS is mandated by regulatory requirements, then it shall be implemented according to this specification.

~~DFS is mandatory for license-exempt operation. Systems should detect and avoid primary users.~~ Further, the use of a channel selection algorithm~~s is~~ may be required, which results in uniform channel spreading across a minimum number of channels. This specification is intended to be compliant with ~~the~~ regulatory requirements ~~set forth in~~ such as ERC/DEC/(99)23 [B10]. The timing and threshold parameters used for DFS are specified by each regulatory administration.

The ~~DFS~~ procedures specified in this subclause provide for:

- Testing channels for ~~primary~~ other users including specific spectrum users (6.3.15.2)
- Discontinuing operations after detecting ~~primary~~ other users including specific spectrum users (6.3.15.3)
- Detecting ~~primary~~ other users including specific spectrum users (6.3.15.4)
- Scheduling for channel testing (6.3.15.5).
- Requesting and reporting of measurements (6.3.15.6)
- Selecting and advertising a new channel (6.3.15.7)

***Change the title of subclause 6.3.15.2 as indicated:***

### 6.3.15.2 Testing channels for ~~primary~~ other users (including specific spectrum users)

***Change the subclause as indicated:***

A BS or SS implementing these procedures shall not use a channel that it knows contains ~~primary~~ other users or has not been tested recently for the presence of ~~primary~~ other users. A BS shall test for the presence of ~~primary~~ other users based on timing parameters and values that may be set locally, or in the case of DFS and the detection of specific spectrum users, they may be defined in regulation. Timing parameters include: ~~for at least the following:~~

- **Startup Test Period** before operating in a new channel if the channel has not been tested for ~~primary~~ other users for at least **Startup Test Period** during the last **Startup Test Valid**.
- **Startup Test Period** before operating in a new channel if a channel was previously determined to contain ~~primary~~ other users during the last **Startup Test Valid**.
- **Operating Test Period** (where the period is only accumulated during testing) of each **Operating Test Cycle** ~~period~~ while operating in a channel. Testing may occur in quiet periods or during normal operation.

An SS may start operating in a new channel without following the above start-up testing procedures if:

- The SS moves to the channel as a result of the receipt of a Channel Switch Announcement from the BS.
- The SS is initializing with a BS that is not currently advertising, using the Channel Switch Announcement that it is about to move to a new channel.

A BS may start operating in a new channel without following the above start-up testing procedures if it has learned from another ~~BS~~ device by means outside the scope of this standard that it is usable.

***Change the title of subclause 6.3.15.3 as indicated:***

### 6.3.15.3 Discontinuing operations after detecting ~~primary~~ specific spectrum users

***Change the subclause as indicated:***

If a BS or an SS is operating in a channel and detects ~~primary~~ specific spectrum users, ~~which interference might be caused in the channel,~~ it shall discontinue any transmission of the following:

- MAC PDUs carrying data within **Max Data Operations Period**.
- MAC PDUs carrying MAC Management messages within **Management Operations Period**.

The values of the above parameters may be set locally, or in the case of DFS they may be defined in regulation.

***Change the title of subclause 6.3.15.4 as indicated:***

### 6.3.15.4 Detecting ~~primary~~ specific spectrum users

***Change the subclause as indicated:***

Each BS and SS shall use a method to detect ~~primary~~ specific spectrum users operating in a channel that satisfies the regulatory requirements, where applicable. The particular method used to perform ~~the primary user~~ detection is outside the scope of this ~~specification~~ standard.

### 6.3.15.5 Scheduling for channel testing

***Change the subclause as indicated:***

A BS may measure one or more channels itself and may request any SS to measure one or more channels on its behalf, either in a quiet period or during normal operation.

To request the SSs to measure one channel, the BS shall include in the DL-MAP a ~~Report~~ Channel Measurement IE as specified in 8.3.6.2.3. The BS that requests the SSs to perform a measurement shall not transmit MAC PDUs to any SS during the measurement interval. If the channel measured is the operational channel, the BS shall not schedule any uplink transmissions from SSs to take place during the measurement period.

Upon receiving a DL-MAP with the ~~DFS~~ Channel Measurement IE, an SS shall start to measure the indicated channel no later than **Max. Channel Switch Time** after the start of the measurement period. An SS may stop the measurement no sooner than **Max. Channel Switch Time** before the expected start of the next frame or the next scheduled uplink transmission (of any SS). If the channel to be measured is the operating channel, **Max. Channel Switch Time** shall be equal to the value of RTG, as specified in Table 358~~. **Max. Channel Switch Time** shall not exceed 2 ms~~, or in the case of DFS Max. Channel Switch Time may be defined in regulation.

### 6.3.15.6 Requesting and reporting of measurements

***Change the subclause as indicated:***

The SS shall, for each measured channel, keep track of the following information:

- Frame Number of the frame during which the first measurement was made
- Accumulated time measured

- Existence of a ~~Primary User~~ specific spectrum user on the channel
- Whether a WirelessHUMAN using the same PHY system was detected on the measured channel
- Whether unknown transmissions [such as radio local area network (RLAN) transmissions] were detected on the channel

The BS may request a measurement report by sending a REP-REQ message. This is typically done after the aggregated measurement time for one or more channels exceeds the regulatory required measurement time. Upon receiving a REP-REQ the SS shall reply with a REP-RSP message and reset its measurement counters for each channel on which it reported.

If the SS detects a ~~primary~~ specific spectrum user on the channel it is operating during a measurement interval or during normal operation it shall immediately cease to send any user data if so mandated by regulatory requirements and send at the earliest possible opportunity an unsolicited REP-RSP. The BS shall provide transmission opportunities for sending an unsolicited REP-RSP frequently enough to meet regulatory requirements, where applicable. The SS may also send, in an unsolicited fashion, a REP-RSP when ~~non-primary~~ other user interference is detected above a threshold value.

### 6.3.15.7 Selecting and advertising a new channel

***Change the second paragraph as indicated:***

A BS may use a variety of information, including information learned during SS initialization and information gathered from measurements undertaken by the BS and the SSs, to assist in the selection of the new channel. The algorithm to choose a new channel is not standardized but in the case of DFS shall satisfy any regulatory requirements, including uniform spreading rules and channel testing rules. If a BS would like to move to a new channel, a channel supported by all SSs in the sector should be selected.

***Change 6.3.17 as indicated:***

### 6.3.17 MAC support for ~~H-ARQ~~ HARQ

Hybrid automatic repeat request (~~H-ARQ~~HARQ) scheme is an optional part of the MAC ~~and can be enabled on a per-terminal basis~~. ~~H-ARQ~~HARQ may be supported only for the OFDMA PHY. ~~The per-terminal H-ARQ~~HARQ and associated parameters shall be specified and negotiated using SBC-REQ/RSP messages during ~~initialization~~ network entry or re-entry procedure. The utilization of HARQ is on a per-connection basis, that is, it can be enabled on a per CID basis by using the DSA/DSC messages. Two implementations of HARQ are supported: 1) per-terminal, that is, HARQ is enabled for all active CIDs for a terminal, and 2) per-connection, that is, it can be enabled on a per CID basis by using the DSA/DSC messages. The two implementation methods shall not be employed simultaneously on any terminal. If HARQ is supported, SS shall support per-terminal implementation. If HARQ is supported, MS shall support per-connection implementation. A burst cannot have a mixture of ~~H-ARQ~~HARQ and non-~~H-ARQ~~HARQ traffic.

One or more MAC PDUs can be concatenated and an ~~H-ARQ~~HARQ packet formed by adding a CRC to the PHY burst. Figure 130 shows how the ~~H-ARQ~~HARQ encoder packet is constructed.

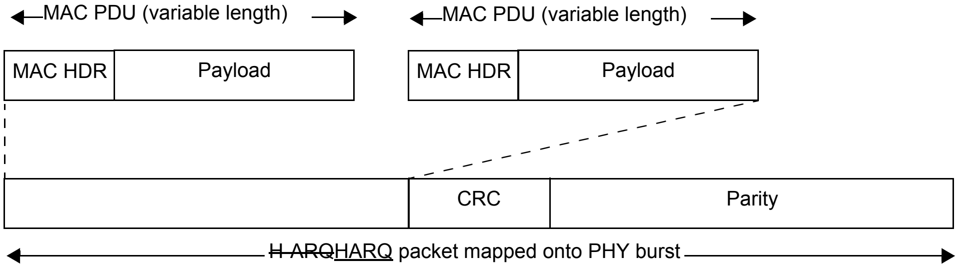

MAC PDU (variable length)
MAC PDU (variable length)
MAC HDR
Payload
MAC HDR
Payload
CRC
Parity
~~H-ARQ~~HARQ packet mapped onto PHY burst

Figure 130—Construction of HARQ encoder packet

~~Each H-ARQ packet is encoded according to the PHY specification, and four subpackets are generated from the encoded result. A subpacket identifier (SPID) is used to distinguish the four subpackets. In case of downlink communication, a BS can send one of the subpackets in a burst transmission. Because of the redundancy among the subpackets, SS can correctly decode the original encoder packet even before it receives all four subpackets. Whenever receiving the first subpacket, the SS attempts to decode the original encoder packet from it. If it succeeds, the SS sends an ACK to the BS, so that the BS stops sending additional subpackets of the encoder packet. Otherwise, the SS sends a NAK, which causes the BS to transmit one subpacket selected from the four. These procedures go on until the SS successfully decodes the encoder packet. When the SS receives more than one subpacket, it tries to decode the encoder packet from ever-received subpackets.~~

The rule of subpacket transmission is as follows,

1) At the first transmission, BS shall send the subpacket labeled '00'.
2) BS may send one among subpackets labeled '00', '01', '10', or '11' in any order.
3) BS can send more than one copy of any subpacket, and can omit any subpacket except the subpacket labeled '00'.

In order to specify the start of a new transmission, one-bit ~~H-ARQ~~ HARQ identifier sequence number (AI_SN) is toggled on every successful transmission of an encoder packet on the same ~~H-ARQ~~ HARQ channel. If the AI_SN changes, the receiver treats the corresponding subpacket as a subpacket belongs to a new encoder packet, and discards ever-received subpackets with the same ARQ identifier.

The ~~H-ARQ~~ HARQ scheme is basically a stop-and-wait protocol. The ACK is sent by the SS after a fixed delay (synchronous ACK) defined by ~~H-ARQ~~ HARQ DL ACK delay ~~offset~~ for DL burst, which is specified in ~~D~~UCD message. Timing of retransmission, however, is flexible and corresponds to the asynchronous part of the ~~H-ARQ~~ HARQ. The ACK/NAK is sent by the BS using the ~~H-ARQ~~ HARQ Bitmap IE, and sent by an SS using the fast feedback UL subchannel.

The ~~H-ARQ~~HARQ scheme supports multiple ~~H-ARQ~~HARQ channels per ~~a~~ connection, each of which may have an encoder packet transaction pending. The number of ~~H-ARQ~~HARQ channels in use per connection is determined through DSA-REQ/DSA-RSP handshake, or REG-REQ/REG-RSP handshake~~by BS~~. The total number of HARQ channels in use per terminal is determined through capability negotiation using SBC-REQ/SBC-RSP handshake. These HARQ channels are distinguished by an ~~H-ARQ~~HARQ channel identifier (ACID). The ACID for any subpackets can be uniquely identified by the control information carried in the MAPs.

~~H-ARQ~~HARQ can be used to mitigate the effect of channel and interference fluctuation. ~~H-ARQ~~HARQ renders performance improvement due to SNR gain and time diversity achieved by combining previously erroneously decoded packet and retransmitted packet.~~, and due to additional coding gain by IR (Incremental Redundancy).~~

HARQ is enabled on a CID basis.

To deal with ordering implication of HARQ, each connection may enable ARQ or PDU SN mechanisms on top of the enabled HARQ connection.

Time stamp of first HARQ burst transmission is used as the time relevance for all MAC specific Management messages and subheaders (such as BW requests, Fast feedback, ARQ feedbacks etc.) that have been transmitted in this burst.

***Change 6.3.17.1 as indicated:***

### 6.3.17.1 Subpacket generation

Two main variants of HARQ are supported—Chase Combining and Incremental Redundancy (IR). SS may support IR. MS may support either Chase Combining or IR. For IR, the PHY layer will encode the HARQ packet generating several versions of encoded subpackets. Each subpacket shall be uniquely identified using a subpacket identifier (SPID). For Chase Combining, the PHY layer shall encode the HARQ packet generating only one version of the encoded packet. As a result, no SPID is required for Chase Combining.

For downlink HARQ operation, the BS will send a version of the encoded HARQ packet. The SS will attempt to decode the encoded packet on this first HARQ attempt. If the decoding succeeds, the SS will send an ACK to the BS. If the decoding fails, the SS will send a NAK to the BS. In response, the BS will send another HARQ attempt. The BS may continue to send HARQ attempts until the SS successfully decodes the packet and sends an acknowledgement.

For IR, each HARQ attempt may have a uniquely encoded subpacket. The rule of subpacket transmission is as follows:

1) At the first transmission, ~~BS~~ the transmitting side shall send the subpacket labeled 0b00.
2) ~~BS~~ the transmitting side may send one among subpackets labeled 0b00, 0b01, 0b10, or 0b11 in any order.
3) ~~BS~~ the transmitting side can send more than one copy of any subpacket, and can omit any subpacket except the subpacket labeled 0b00.

In order to specify the start of a new transmission, one-bit ~~H-ARQ~~HARQ identifier sequence number (AI_SN) is toggled on every ~~successful transmission of an encoder packet~~HARQ retransmission attempt on the same ~~H-ARQ~~HARQ channel. If the AI_SN changes, the receiver treats the corresponding ~~subpacket as a subpacket belongs~~HARQ attempt as belonging to a new encoder packet, and discards ~~ever-received subpackets~~previous HARQ attempt with the same ARQ identifier.

The HARQ ~~H-ARQ~~ scheme is basically a stop-and-wait protocol where the retransmissions are only sent after receiving a NACK signal for the previous transmission or the ACK has not been received within the duration defined by H ARQ ACK Delay for UL burst (i.e., HARQ data sent by SS) or by H ARQ ACK delay for DL burst (i.e., HARQ data sent by BS). As acknowledgement of DL HARQ burst sent by the BS, ~~T~~the ACK is sent by the SS after a fixed delay (synchronous ACK) defined by ~~H-ARQ~~ HARQ_ACK_Delay_for DL Burst ~~DL ACK delay offset~~ which is specified in the ~~DCD~~ UCD message (see Table 353). As acknowledgement of UL HARQ burst sent by the SS, the ACK is sent by the BS after a fixed delay (synchronous ACK) defined by HARQ ACK delay for UL Burst which is specified in DCD message (see Table 358).Timing of retransmission is, however, flexible and corresponds to the asynchronous part of the HARQ ~~H-ARQ~~. The ACK/NAK is sent by the BS using the HARQ ~~H-ARQ~~ Bitmap IE, and sent by an SS using the fast feedback UL subchannel.

#### 6.3.17.2 DL/UL ACK/NAK signaling

***Change the subclause as indicated:***

For DL~~/UL~~ ~~H-ARQ~~ HARQ, fast ACK/NAK signaling is necessary. For the fast ACK/NAK signaling of DL ~~H-ARQ~~ HARQ channel, a dedicated PHY layer ACK/NAK channel is designed in UL. For the fast ACK/NAK signaling of UL fast feedback, ~~H-ARQ~~ HARQ ACK message is designed. The HARQ ACK/NAK message for UL HARQ may be omitted.

#### 6.3.17.3 ~~H-ARQ~~ HARQ parameter signaling

***Change the last paragraph as indicated:***

For the signaling of those parameters, ~~H-ARQ~~ HARQ ~~Allocation~~Control IE is defined and the IE is to be placed in a ~~DL-MAP or UL-MAP for~~ Compact MAP IE which allocates a data burst~~ where H-ARQ is used~~.

***Renumber subclause 6.3.17.4 as 6.3.18 and change the title of the subclause as indicated:***

### 6.3.18 DL CINR report operation

***Change the subclause as indicated:***

This subclause applies to OFDMA mode only. The SS transmits either a physical CINR metric or an effective CINR metric using the REP-RSP MAC message or fast-feedback (CQICH) channel.

The physical CINR is defined in 8.4.11.3. The effective CINR is a function of physical CINR, varying channel conditions and implementation margin. The exact measurement method used to derive the effective CINR is implementation specific. The reported effective CINR feedback shall correspond to the MCS in Table 298a with which the expected block error rate, assuming a specific block length, is closest to, but does not exceed, a specific target average error rate. The target average error rate and assumed block length are defined in profiles. When HARQ is employed, the computed block error rate shall only pertain to the first HARQ transmission.

The metric can be reported for either the preamble or a permutation zone. The manner in which the metric is derived for a permutation zone is in general implementation specific; however, the BS may explicitly instruct the SS to report the metric based on measurements from data or pilots.

The SS shall implement at least one measurement scheme and negotiate its capability.

#### 6.3.18.1 DL CINR report with REP-RSP MAC message

The REP-RSP message shall be sent by the SS in response to a REP-REQ message from the BS to report estimation of DL physical CINR or effective CINR.

REP-REQ shall indicate whether the reported metric shall apply to the preamble or to a specific permutation zone. For the report on the preamble, BS can request SS to report the CINR based on the measurement from the preamble for the different frequency reuse factors or band AMC configuration. For report on a specific permutation zone, the REP-REQ indicates the report type configuration, which includes the zone for which the CINR is to be estimated. The zone is identified by its permutation type (PUSC with ‘use all SC = 0’, PUSC with ‘use all SC = 1’, FUSC, Optional FUSC, AMC zone, Safety channel), and PRBS ID. Also, the same permutation and PRBS ID can be differentiated by the STC or AAS indication. The SS shall not perform a measurement in a frame in which the specified zone is not allocated, and shall retain the previous measurement. For PUSC permutation zones, the SS may be instructed to report CINR estimate for only a subset of the major groups. The SS may send a REP-RSP message in an unsolicited fashion.

In the case where the requested report configuration does not differ from the previous REP-REQ message in which CINR report was requested, the SS is required to send its response within three frames. A REP-REQ message shall not contain more than one TLV requesting any type of CINR report.

For the Band-AMC differential CINR reports, the effective CINR metric shall not be used.

If the BS instructs CINR reporting on an AAS zone, then the SS shall report the estimate of the physical or effective CINR measured from dedicated AAS preamble/pilot or data subcarriers that belong to slots allocated to it. For DL-PUSC in AAS mode, if major-group indication has been specified in the measurement configuration then the reported CINR shall be measured on all indicated major groups rather than on slots allocated to the SS.

***Change 6.3.18.2 as indicated:***

### 6.3.18.2 Periodic CINR report with fast-feedback (CQICH) channel

~~This subclause describes the operation scenarios and requirements of CQICH, which is designed for H-ARQ enabled SS.~~ After an SS turns on its power, the ~~only appropriate~~ subchannels that can be allocated to the ~~M~~SS are ~~normal subchannels~~all subchannels the SS can support except the band AMC subchannel. ~~To determine the M/C level of normal subchannels, the average CINR measurement is enough for the BS to determine the M/C levels of uplink and downlink.~~ As soon as the BS and the SS know the capabilities of both entities modulation and coding, the BS may allocate a CQICH subchannel using a ~~CQICH Control IE~~CQICH IE (CQICH allocation IE or CQICH Control IE) for periodic CINR reports (physical CINR or effective CINR). ~~Then, the MSS reports the average CINR of the BS preamble. From then on, the BS is able to determine the M/C level. A CINR measurement is quantized into 32 levels and encoded into 5~~four ~~information bits.~~

CQICH Allocation IE may indicate whether the reported metric shall apply to preamble or to a specific permutation zone. For the report on the preamble, BS can request SS to report the CINR based on the measurement from the preamble for the different frequency reuse factors. For the report on the specific permutation zones, the CQICH Allocation IE indicates the report type configuration, which includes the zone for which the CINR is to be estimated. The zone is identified by its permutation type (PUSC with ‘use all SC = 0’, PUSC with ‘use all SC = 1’, AMC AAS zone, FUSC, Optional FUSC, Safety channel), and PRBS ID. Also, the same permutation and PRBS ID can be differentiated by the STC or AAS indication. The SS shall not perform a measurement in a frame in which the specified zone is not allocated, and shall retain the previous measurement. For PUSC permutation zones, the SS may be instructed to report an estimate for only a subset of the major groups. The first CQICH Allocation IE sent to the SS shall indicate the report type configuration. Only a subsequent CQICH Allocation IE may update the report type configuration for CQI channel based reports. See 8.4.5.4.12 and 8.4.11.3. CQICH allocated through CQICH Control IE shall use the measurement configuration defined in the latest CQICH allocation IE. The quantization and encoding of physical CINR and effective CINR onto the Fast-Feedback channel is defined in 8.4.5.4.10.

A effective CINR reported on the CQI is interpreted as the SS’s recommendation that best meets the specified target error rate for the duration remaining until the next scheduled CQI report.

The SS may send an unsolicited REP-REQ message if it decides that the last effective CINR report is no longer appropriate for the duration remaining until the next periodic CQI transmission. The message is used to specify the new effective CINR for the CQI channel. The CQI channel is identified by its CQICH_ID or by the SS’s CID if the CQI channel is allocated without a CQICH_ID. The SS shall not send an unsolicited update to the effective CINR of a CQI channel if 'triggered update' is disabled in the CQICH Allocation IE that allocated the CQI channel.

An SS may support two concurrent CQI channels (not necessarily being scheduled in the same frame)—one for effective CINR reports and one for physical CINR reports—both of which refer to the same zone. In such a case, both reported values shall be derived from the same underlying set of measurements. The CQI channel is identified by the CQICH_ID field in the CQICH Allocation IE. Support for more than one concurrent CQI channel is optional and negotiated in 11.8.3.7.9.

For the BandAMC differential CINR reports, the effective CINR scheme shall not be used.

If the BS instructs CINR reporting on an AAS zone, then the SS shall report the estimate of the physical or effective CINR measured from dedicated AAS preamble/pilot or data subcarriers that belong to slots allocated to it. For DL-PUSC in AAS mode, if major-group indication has been specified in the measurement configuration, then the reported CINR shall be measured on all indicated major groups rather than on slots allocated to the SS.

The SS sends the REP-RSP message in an unsolicited fashion to BS to trigger Band AMC operation. The triggering conditions are given by TLV encodings in UCD messages. For SS, ~~T~~the REP-RSP (see 11.12 for the TLV encodings) includes the CINR measurements of ~~five~~ four best bands. For MS, the REP-RSP (see 11.12 for the TLV encodings) includes the CINR measurements of four or five selected best bands (see 8.4.6.3.2). Only when an SS reports its BS the CINR measurements of Band AMC channels, its logical definition is made differently, as follows. If the number of bands is 48 (2048 FFT in 20 MHz), the two contiguous bands are paired and renumbered the same as a 24 band system. Then, if the LSB of an SS MAC address is 1, it only uses the odd-numbered bands. If not, it only uses the even-numbered bands. Hence, for example, the LSB of an SS MAC address is 1, (4*m*+2, 4*m*+3) bands are paired and the paired band is the *m*-th band of the SS. Similarly, for an even-numbered SS, (4*m*, 4*m*+1) bands are paired and the paired band is the *m*-th band of the SS. If the number of bands is 24, the two contiguous bands are just paired and renumbered the same as a 12 band system. If the original number of band is equal to or less than 12, the logical definition is not necessary.

At any time, the BS may de-allocate the SS' CQICH by putting another CQICH ~~Control~~ IE with Duration d = 0000. Before the CQICH life timer (which is set at the receipt of the CQICH ~~Control~~ IE) expires~~)~~ sending another CQICH ~~Control~~ IE overwrites all the information related to the CQICH such as Allocation Index, Period, Frame offset, and Duration. Hence, unless the BS refreshes the timer, the SS should stop reporting as soon as the timer expires. However, in case of sending the MAP IE for re-allocation or deallocation, the BS should make sure if the previous CQICH is released before it is re-allocated to another SS.

The BS acknowledges the trigger from SS by ~~allocating Band AMC subchannels~~ sending a unicast MAC PDU to the SS using Band AMC subchannels. From the next frame when the SS sent the REP-RSP, the SS starts reporting the differential of CINR from preamble for ~~five~~four selected bands (increment: 1 and decrement: 0 with a step of 1 dB) on its CQICH. The CQICH shall then be used for differential Band-AMC reports, regardless of the report configuration specified in the CQICH IE that allocated the current CQI channel. If the BS does ~~not allocate the Band AMC subchannels~~ send a unicast MAC PDU to the SS using Band AMC subchannels or send REP-REQ to indicate reporting Band AMC CINR within the specified delay (CQICH Band AMC Transition Delay) in the UCD message, the SS ~~reports the updated average CINR of the preamble for normal subchannel allocations~~ shall resume to report CINR according to the report configuration specified in the latest CQICH Allocation IE. In addition, if the BS sends a unicast MAC PDU to the SS using non-Band AMC subchannels, or the CQICH allocation IE indicates to report CINR on a zone other than Band AMC zone, the SS shall resume to report CINR according to the report configuration specified in the latest CQICH Allocation IE.

When the BS wants to trigger the transition to Band AMC mode or update the CINR reports, it sends the REP-REQ message (see 11.11 for the TLV encodings). When the SS receives the message, it replies with REP-RSP. ~~When the BS receives the REP-RSP, it should synchronize the selection of bands reported and their CINR. Unless the BS allocates normal subchannels, the SS reports the differential increment compared~~

~~to the most up-to-date report from the next CQI reporting frame.~~ After BS receives the REP-RSP, the same procedure shall be used as in the triggering by the SS.

The transition of the CQICH reporting scheme from Band AMC to non-Band AMC mode can be made by SS and BS. At any time, SS can send REP-RSP of reporting CINR of the non-Band AMC mode to trigger a transition of the CQICH reporting scheme to the non-Band AMC mode. When BS receives the REP-RSP, BS may send CQICH allocation IE to the SS to direct the non-Band AMC reporting scheme. When BS does not send the CQICH allocation IE and/or SS does not receive the CQICH allocation IE, SS shall keep reporting the differential CINR through CQICH. At any time, BS can send CQICH allocation IE to trigger a transition of the CQICH reporting scheme to the non-Band AMC mode.

Conditions of transition triggering

a) Normal subchannel -> AMC transition
If the maximum of the standard deviations of the individual band's CINR measurements is lower than 'Band AMC Allocation Threshold' and the average CINR of the whole bandwidth is larger than 'Band AMC Entry Average CINR' for at least 'Band AMC Allocation Timer' frames, SS using normal subchannels sends an unsolicited REP_RSP to request mode transition. REP_RSP message contains band bitmap indicating the best four bands and their CINR measurements. The standard deviation of the individual band's CINR measurement shall be measured over time.
b) AMC -> Normal subchannel transition
If the maximum of the standard deviations of the individual band's CINR measurements for at least 'Band AMC Release Timer' frames is higher than 'Band AMC Release Threshold', SS in Band AMC mode may trigger mode transition from Band AMC to normal subchannel. The standard deviation of the individual band's CINR measurement shall be measured over time.
c) Band Change
If the CINR of any one band excluding the best four bands previously selected for band AMC allocations is greater than the average CINR of the AMC reporting bands for at least 'Band AMC Allocation Timer', SS sends an unsolicited REP_RSP that contains band bitmap indicating the best four bands and their CINR measurements.

***Insert new subclause 6.3.19:***

### 6.3.19 optional Band AMC operations using 6-bit CQICH encoding

***Insert new subclause 6.3.19.1:***

#### 6.3.19.1 Call flows for mode transitions between normal subchannel and band AMC

Three allocated CQICH codewords are allocated for indicating the transitions. Let the first codeword be C1 (the 62$^{nd}$ codeword in Table 296b: 0b111101), the second one C2 (the 63$^{rd}$ codeword: 0b111110), and the third one C3 (the 64$^{th}$ codeword: 0b111111).

a) Normal -> Band AMC
The MS transmits C1, and the BS that receives the codeword transmits REP-REQ. The MS replies with REP-RSP having the CINR measurements of the five best bands at the same frame or after transmitting C2. From the next frame after transmitting REP-RSP, the MS reports the Band AMC differential CQI of the selected bands.
b) Band AMC -> Normal
The MS transmits C3. The MS reports the regular CQI of the whole bandwidth. Until the BS allocates normal subchannels, the MS repeats this process. In other words, the MS transmits the C3 and the regular CQI alternately until the normal subchannel is allocated to it.
c) Band change
The MS and its BS follows the same procedure of the transition from normal subchannel to Band AMC.

d) Refreshing the CINR of the four best bands without band changes
The MS transmits an unsolicited REP-RSP at the same frame or after transmitting C2.

***Insert new subclause 6.3.19.2:***

### 6.3.19.2 Conditions of transition triggering

a) Normal subchannel -> AMC transition
If the maximum of the standard deviations of the individual band's CINR measurements is lower than 'Band AMC Allocation Threshold' and the average CINR of the whole bandwidth is larger than 'Band AMC Entry Average CINR' for at least 'Band AMC Allocation Timer' frames, MS using normal subchannels sends an unsolicited to request mode transition and transmits a special codeword on its CQICH to inform its BS of its request of mode transition. REP-RSP message contains band bitmap indicating the best five bands and their CINR measurements.
b) AMC -> Normal subchannel transition
If the maximum of the standard deviations of the individual band's CINR measurements for at least 'Band AMC Release Timer' frames is higher than 'Band AMC Release Threshold', MS in Band AMC mode may trigger mode transition from Band AMC to normal subchannel.
c) Band Change
If the CINR of any one band excluding the best five bands previously selected for band AMC allocations is greater than the average CINR of the AMC reporting bands for at least Band AMC Allocation Timer, the AMC allocation bands should be changed by following the procedure given above.

***Insert new subclause 6.3.20:***

### 6.3.20 Data delivery services for mobile network

Data delivery service is associated with certain predefined set of QoS-related service flow parameters. Note that definition of Data Delivery Service does not include assignment of specific values to the parameters.

***Insert new subclause 6.3.20.1:***

### 6.3.20.1 Types of data delivery services

Type of Data Delivery Service identifies specific set of QoS parameters—see Table 132a.

**Table 132a—Type of data delivery services**

| Type | Symbolic name of service type | Meaning |
|---|---|---|
| 0 | UGS | Unsolicited Grant Service<br>For UL connections should be supported by UGS Scheduling Service |
| 1 | RT-VR | Real-Time Variable Rate Service<br>For UL connections should be supported by rtPS Scheduling Service |
| 2 | NRT-VR | Non-Real-Time Variable Rate service<br>For UL connections should be supported by nrtPS Scheduling Service |
| 3 | BE | Best Efforts Service<br>For UL connections should be supported by BE Scheduling Service |
| 4 | ERT-VR | Extended Real-Time Variable Rate Service.<br>For UL connections should be supported by ertPS Scheduling Service. |

See the subclauses that follow for detailed definitions for the data delivery services of different types.

***Insert new subclause 6.3.20.1.1:***

### 6.3.20.1.1 Unsolicited grant service (UGS)

This type of service is to support real-time applications generating fixed-rate data. This data can be provided as either fixed or variable length PDUs. The following are the parameters of the service specified in Table 132b:

Table 132b—Unsolicited grant service parameters

| Parameter | Meaning |
|---|---|
| **Tolerated jitter** | According to 11.13.13 |
| if (Fixed length SDU){ | — |
| **SDU size** | According to 11.13.16 |
| } | — |
| **Minimum reserved traffic rate** | According to 11.13.8 |
| **Maximum Latency** | According to 11.13.14 |
| **Request/Transmission Policy** | According to 11.13.12 |
| **Unsolicited Grant Interval** | As in 11.13.20 |

***Insert new subclause 6.3.20.1.2:***

### 6.3.20.1.2 Real-Time Variable Rate (RT-VR) service

This service is to support real-time data applications with variable bit rates which require guaranteed data rate and delay. The following are the parameters of the service in Table 132c:

Table 132c—Real-Time Variable Rate service parameters

| Parameter | Meaning |
|---|---|
| Maximum Latency | As specified in 11.13.14 |
| Minimum Reserved Traffic Rate | As defined in 11.13.8 with averaging over time. |
| Maximum Sustained Traffic Rate | Optional, if absent defaulting to Minimum Reserved Traffic Rate. As specified in 11.13.8, with averaging over time. This value shall be bigger than Minimum Reserved Traffic Rate. |
| Traffic priority | According to 11.13.5 |
| Request/Transmission policy | According to 11.13.12 |
| Unsolicited Polling Interval | As in 11.13.21 |

**Description of the service**

Let $S$ denote the amount of data arrived to the transmitter's MAC SAP, during time interval $T$ = Time Base; and let $R$ = Minimum Reserved Traffic Rate. Then the BS is supposed, during each time interval of the length (Time Base), to allocate to the connection resources sufficient for transferring an amount of data according to the value of Minimum Reserved Traffic Rate (11.13.8) i.e., at least min $\{S, R * T\}$. Any SDU should be delivered within a time interval $D$ = Maximum Latency. In the case when the amount of data submitted to the transmitter's MAC SAP exceeds (Minimum Reserved Traffic Rate) * $T$, delivery of each specific SDU is not guaranteed.

***Insert new subclause 6.3.20.1.3:***

### 6.3.20.1.3 Non-Real-Time Variable Rate (NRT-VR) service

This QoS profile shall support applications that require a guaranteed data rate but are insensitive to delays. It is desirable in certain cases to limit the data rate of these services to some maximum rate. The QoS profile is defined by the parameters defined in Table 132d:

**Table 132d—Non Real-Time variable rate service parameters**

| Parameter | Meaning |
|---|---|
| Minimum Reserved Traffic Rate | As defined in 11.13.8 with averaging over time. |
| Maximum Sustained Traffic Rate | Optional, if absent defaulting to Minimum Reserved Traffic Rate. As specified in 11.13.8, with averaging over time. This value shall be bigger than Minimum Reserved Traffic Rate. |
| Traffic priority | According to 11.13.5. |
| Request/Transmission policy | According to 11.13.12. |

**Description of the service**

Let $S$ denote the amount of data arrived to the transmitter's MAC SAP, during time interval $T$ = Time Base; $R$ = Minimum Reserved Traffic Rate. Then the BS is supposed during each time interval of the length (Time Base) to allocate to the connection resources sufficient for transferring amount of data according to the value of Minimum Reserved Traffic Rate (11.13.8) i.e., at least min $\{S, R * T\}$. In the case when the amount of data submitted to the transmitter's MAC SAP exceeds (Maximum Sustained Traffic Rate) * $T$, delivery of each specific SDU is not guaranteed

***Insert new subclause 6.3.20.1.4:***

### 6.3.20.1.4 Best Effort (BE) service

This service is for applications with no rate or delay requirements. The parameters of the service are shown in Table 132e.

**Table 132e—Best Effort service parameters**

| Parameter | Meaning |
|---|---|
| Maximum Sustained Traffic Rate | As specified in 11.13.6 |
| Traffic priority | According to 11.13.5 |
| Request/Transmission policy | According to 11.13.12 |

***Insert new subclause 6.3.20.1.5:***

### 6.3.20.1.5 Extended Real-Time Variable Rate (ERT-VR) service

This service is to support real-time applications with variable data-rates, which require guaranteed data and delay, for example VoIP with silence suppression. The parameters required for this service are in Table 132f.

**Table 132f—Extended Real-Time Variable Rate service parameters**

| Parameter | Meaning |
|---|---|
| Maximum Latency | As specified in 11.13.14 |
| Tolerated Jitter | As specified in 11.13.13 |
| Minimum Reserved Traffic Rate | As specified in 11.13.8 |
| Maximum Sustained Traffic Rate | As specified in 11.13.6 |
| Traffic Priority | As specified in 11.13.5 |
| Request/Transmission Policy | As specified in 11.13.12 |
| Unsolicited Grant Interval | As specified in 11.13.20 |

***Insert new subclause 6.3.21:***

### 6.3.21 Sleep mode for mobility-supporting MS

***Insert new subclause 6.3.21.1:***

#### 6.3.21.1 Introduction

Sleep mode is a state in which an MS conducts pre-negotiated periods of absence from the Serving BS air interface. These periods are characterized by the unavailability of the MS, as observed from the Serving BS, to DL or UL traffic. Sleep mode is intended to minimize MS power usage and decrease usage of Serving BS air interface resources. Implementation of sleep mode is optional for the MS and mandatory for the BS.

For each involved MS, the BS keeps one or several contexts, each one related to certain Power Saving Class. Power Saving Class is a group of connections that have common demand properties. For example, all BE and NRT-VR connections may be marked as belonging to a single class while two UGS connections may belong to two different classes in case they have different intervals between consequent allocations. Power Saving class may be repeatedly activated and deactivated. Activation of certain Power Saving Class means starting sleep/listening windows sequence associated with this class. Algorithm of choosing Power Saving Class type for certain connections is outside of the scope of the standard.

There are three types of Power Saving Classes, which differ by their parameter sets, procedures of activation/deactivation, and policies of MS availability for data transmission.

Unavailability interval is a time interval that does not overlap with any listening window of any active Power Saving Class

Availability interval is a time interval that does not overlap with any Unavailability interval

During Unavailability interval the BS shall not transmit to the MS, so the MS may power down one or more physical operation components or perform other activities that do not require communication with the BS—scanning neighbor BSs, associating with neighbor BSs, etc. If there is a connection at the MS, which is not associated with any active Power Saving Class, the MS shall be considered available on permanent basis.

During Availability interval the MS is expected to receive all DL transmissions same way as in the state of normal operations (no sleep). In addition, the MS shall examine the DCD and UCD change counts and the frame number of the DL-MAP PHY Synchronization field to verify synchronization with the BS. Upon detecting a changed DCD and/or UCD count in the DL MAP, unless using the Broadcast Control Pointer IE for tracking and updating DCD and/or UCD changes, the MS shall continue reception until receiving the corresponding updated message.

- If the BS transmits the Broadcast Control Pointer IE, the MS shall read and react to this message according to the following:
    1) If the DCD_UCD Configuration Change Counter has changed since MS last decoding of this IE, even if scheduled to be in a sleep interval the MS shall awaken at DCD_UCD Transmission Frame in time to synchronize to the DL and decode the DCD and UCD message in the frame, if present. If the MS fails to decode one or both of DCD and UCD, or no DCD or UCD was transmitted by the BS, the MS shall continue decoding all subsequent frames until it has acquired both updated DCD and UCD. Upon successful completion of DCD and UCD decoding, the MS shall immediately return to regular sleep mode operation.
    2) If Skip Broadcast_System_Update is set to '0', even if scheduled to be in a sleep interval, the MS shall awaken at Broadcast_System_Update_Transmission_Frame in time to synchronize to the DL and decode and read the DL-MAP and any message, if present. Upon completion, the MS shall immediately return to regular sleep mode operation.

During Unavailability intervals for MS, the BS may buffer (or it may drop) MAC SDUs addressed to unicast connections bound to an MS. The BS may choose to delay transmission of SDUs addressed to multicast connections until the following Availability Interval, common for all MSs participating in the multicast connection.

An MS performing handover may include Power_Saving_Class_Parameters in RNG-REQ message to indicate its preference to enter sleep mode after the handover. In this case, the BS shall transmit unsolicited MOB_SLP-RSP message to the MS after handover.

In MOB_TRF-IND message with negative indication for the MS, the BS may include an updated SLPID for an MS by appending SLPID_Update TLV in the MOB_TRF-IND message. When the received MOB_TRF-IND message includes a SLPID_Update TLV, the MS shall decode the TLV and, if addressed, update its SLPID to the new one. The MS shall identify if the SLPID_Update TLV addresses it by searching through the SLPID_Update TLV and determining if the MS's current SLPID matches the Old_SLPID in the SLPID_Update TLV. If they match, then the MS shall set its SLPID to the New_SLPID provided in the SLPID_Update TLV. For an example of sleep mode operation, see Annex D.

MS in sleep mode may participate in periodic ranging. The procedure includes Serving BS allocation of UL transmission opportunity for periodic ranging in which the MS shall transmit RNG-REQ message. After transmittal of the RNG-REQ, the MS shall wait for the RNG-RSP message. Participation in the periodic ranging procedure does not change state of Power Saving Classes not associated with Ranging procedure.

MS in sleep mode may maintain triggers to perform event-based actions based on TLV encodings for CINR, RSSI, and RTD trigger (see Table 358.) received in DCD message or the TLV encodings for Neighbor BS CINR and Neighbor BS RSSI trigger (see Table 348e.) received in MOB_NBR-ADV message. For this purpose, MS may include Enabled-Action-Triggered TLV in RNG-REQ or MOB_SLP-REQ message requesting to associate specific actions with certain triggers. In response to the RNG-REQ or MOB_SLP-REQ message, BS shall transmit RNG-RSP or MOB_SLP-RSP message including Enabled-Action-Triggered TLV provided that it allows to activate the requested type of Power Saving Class. After receiving RNG-RSP or MOB_SLP-RSP message including the Enabled-Action-Triggered TLV, MS shall perform the action indicated in the Enabled-Action-Triggered TLV following function/action specified in DCD or MOB_NBR-ADV message. If MS does not include Enabled-Action-Triggered TLV in the RNG-REQ or MOB_SLP-REQ message, BS shall not include Enabled-Action-Triggered TLV in the RNG-RSP or MOB_SLP-RSP message. In this case, MS shall not perform and BS shall not expect the event-triggered action while the MS is in sleep mode. For the action indicated in the Enabled-Action-Triggered TLV, MS may transmit MOB_SCN-REPORT or MOB_SCN-REQ message and perform scanning and/or association without deactivating any Power Saving Class.

The Serving BS may verify MS exit from sleep mode by making a UL allocation for MS at any time subsequent to supposed wakening event (for example, positive indication in MOB_TRF-IND message) by transmitting at least BR message (if there is no data to transmit, BR field of the BR PDU shall be set to 0).

Figure 130a describes example of behavior of MS with two Power Saving Classes: Class A contains several connections of BE and NRT-VR type, Class B contains a single connection of UGS type. Then for Class A the BS allocates sequence of listening window of constant size and doubling sleep window. For Class B the BS allocates sequence of listening window of constant size and sleep window of constant size. The MS is considered unavailable (and may power down) within windows of unavailability, which are intersections of sleep windows of A and B.

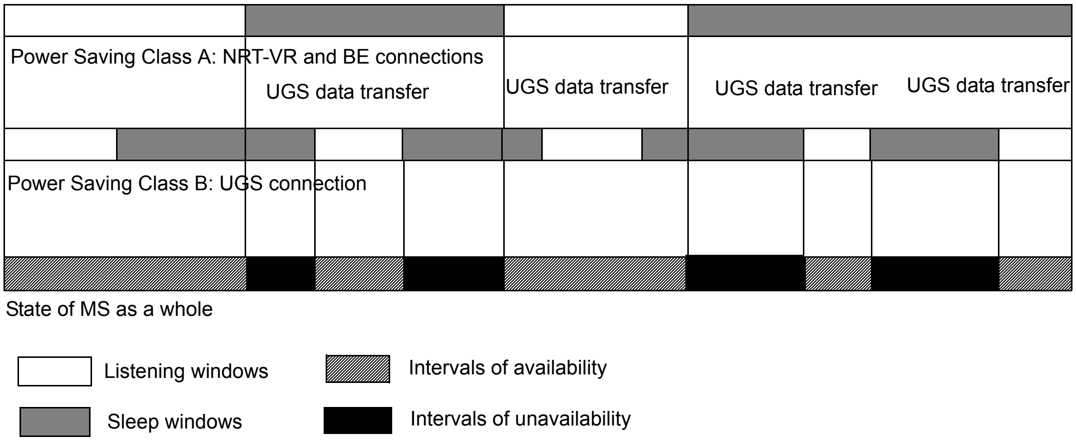

Power Saving Class A: NRT-VR and BE connections
UGS data transfer
UGS data transfer
UGS data transfer
UGS data transfer
Power Saving Class B: UGS connection
State of MS as a whole
Listening windows
Sleep windows
Intervals of availability
Intervals of unavailability

Figure 130a—Example of sleep mode operations with two power saving classes

*Insert new subclause 6.3.21.2:*

### 6.3.21.2 Power Saving Classes of type I

Power Saving Class of this type is recommended for connections of BE, NRT-VR type.

For definition and/or activation of one or several Power Saving Classes of type I the MS shall send MOB_SLP-REQ or Bandwidth request and uplink sleep control header (for activation only); the BS shall respond with an MOB_SLP-RSP message or DL Sleep control extended subheader. The MS may retransmit MOB_SLP-REQ message if it does not receive the MOB_SLP-RSP message within the T43 timer.

Alternatively Power Saving Class may be defined/activated/deactivated by TLVs transmitted in RNG-RSP message.

The following are relevant parameters:

- Initial-sleep window
- Final-sleep window base
- Listening window

- Final-sleep window exponent
- Start frame number for first sleep window
- Traffic triggered wakening flag

Power Saving Class becomes active at the frame specified as Start frame number for first sleep window. Each next sleep window is twice the size of the previous one, but not greater than specified final value.

*Sleep window = min (2*(Previous sleep window), Final-sleep window base * 2 ^ (Final-sleep window exponent))*

$$sleepWin = min(2 \cdot prevSleepWin, finalSleepWinBase \cdot 2^{finalSlpWinExp}),$$

where

*sleepWin* is the sleep window,
*prevSleepWin* is the previous sleep window,
*finalSleepWinBase* is the Final-sleep window base, and
*finalSlpWinExp* is the Final-sleep window exponent.

Sleep windows are interleaved with listening windows of fixed duration. The BS terminates active state of Power Saving Class by sending MOB_TRF-IND message. A traffic indication (MOB_TRF-IND) message shall be sent by the BS on broadcast CID or Sleep mode multicast CID during listening window to alert MS of appearance of DL traffic demand at the corresponding connections.

When an MS receives an UL allocation after receiving a positive MOB_TRF-IND message indication, the MS shall transmit at least BR message (if there is no data to transmit, BR field of the BR PDU shall be set to 0).

During active state of Power Saving Class of type I the MS is not expected to send or receive any MAC SDUs or their fragments or to send bandwidth requests at connections that belong to the Power Saving Class.

Power Saving Class is deactivated either by MOB_SLP-REQ/Bandwidth request and uplink sleep control header or MOB_SLP-RSP/DL Sleep control extended subheader messages or (if Traffic triggered wakening flag = 1) after one of following events:

- BS transmits (during availability window) a MAC SDU or fragment thereof over connection belonging to the Power Saving Class
- MS transmits a bandwidth request with respect to connection belonging to the Power Saving Class
- MS receives MOB_TRF-IND message indicating presence of buffered traffic addressed to the MS

Assuming TRF-IND_Required flag was set in MOB_SLP-REQ, Power Saving Class shall be deactivated if MS failed to receive MOB_TRF-IND message during availability window.

During listening windows the MS is expected to receive all DL transmissions same way as in the state of normal operations (no sleep).

***Insert new subclause 6.3.21.3:***

### 6.3.21.3 Power Saving Classes of type II

Power Saving Class of this type is recommended for connections of UGS, RT-VR type. The following are relevant parameters:

- Initial-sleep window

- Listening window
- Start frame number for first sleep window

Power Saving Class becomes active at the frame specified as “Start frame number for first sleep window”. All sleep windows are of the same size as initial window. Sleep windows are interleaved with listening windows of fixed duration. Power Saving Classes of this type are defined/activated/deactivated by MOB_SLP-REQ/MOB_SLP-RSP or Bandwidth request and uplink sleep control header/DL Sleep control extended subheader transaction. The MS may retransmit MOB_SLP-REQ message or Bandwidth request and uplink sleep control header if it does not receive the MOB_SLP-RSP message or DL Sleep control extended subheader within the T43 timer. The BS may send unsolicited MOB_SLP-RSP or DL Sleep control extended subheader to initiate activation of Power Saving Class. Once started, the active state continues until explicit termination by MOB_SLP-REQ/MOB_SLP-RSP messages or Bandwidth request and uplink sleep control header/DL Sleep control extended subheader. BS may send unsolicited MOB_SLP-RSP message or DL Sleep control extended subheader to deactivate Power Saving Class. Alternatively Power Saving Class of type II may be defined and/or activated /deactivated by TLVs transmitted in RNG-REQ and RNG-RSP message.

As opposite to Power Saving Class type I, during listening windows of Power Saving Class type II the MS may send or receive any MAC SDUs or their fragments at connections comprising the Power Saving Class as well as acknowledgements to them. The MS shall not receive or transmit MAC SDUs during sleep windows.

***Insert new subclause 6.3.21.4:***

#### 6.3.21.4 Power Saving Classes of type III

Power Saving Class of this type is recommended for multicast connections as well as for management operations, for example, Periodic Ranging, DSx operations, MOB_ NBR-ADV etc. Power Saving Classes of this type are defined/activated by MOB_SLP-REQ/MOB_SLP-RSP or Bandwidth request and uplink sleep control header/DL Sleep control extended subheader transaction. The MS may retransmit MOB_SLP-REQ message (or Bandwidth request and uplink sleep control header) if it does not receive the MOB_SLP-RSP message (or DL Sleep control extended subheader) within the T43 timer. The BS may send unsolicited MOB_SLP-RSP or DL Sleep control extended subheader to initiate activation of Power Saving Class. Deactivation of Power Saving Class occurs automatically after expiration of sleep window.

Alternatively Power Saving Class of type III may be defined/activated by TLV encodings in RNG-RSP message. For periodic ranging Next Periodic Ranging TLV encoding may be used. It activates special Power Saving Classes of type III associated with periodic ranging procedure. In this case the sleep window of the class starts in the next frame after RNG-RSP transmitted and ends in the previous frame, which Next Periodic Ranging TLV indicates.

If Next Periodic Ranging TLV encoding is included in MOB_SLP-RSP, this activates Power Saving Class of type III for periodic ranging and BS can continue to activate the Power Saving Class using Next Periodic Ranging TLV encoding in RNG-RSP message with ranging status set to success.

The following are relevant parameters:

- Final-sleep window base
- Final-sleep window exponent
- Start frame number for sleep window

Power Saving Class becomes active at the frame specified as “Start frame number for first sleep window”. Duration of sleep window is specified as base/exponent. After the expiration of the sleep window Power Saving Class automatically becomes inactive.

For multicast service Base Station may guess when the next portion of data will appear. Then the BS allocates sleep window for all time when it does not expect the multicast traffic to arrive. After expiration of the sleep window multicast data, if already available, may be transmitted to relevant MSs. After that the BS may decide to re-activate Power Saving Class.

As an example, Power Saving Class of type III may include Basic connection to serve needs of Periodic Ranging. In this case, duration (base/exponent) of sleep window shall be equal to time interval needed before next Periodic ranging transaction. Then the MS, after the specified time interval, shall be available to DL transmission and BS may either allocate an UL transmission opportunity for RNG-REQ or send unsolicited RNG-RSP. Re-activation of the Power Saving Class may be achieved using, for example, TLVs included into RNG-REQ/RSP.

Alternatively, Power Saving Class of type III may be activated /deactivated by TLVs transmitted in RNG-RSP messages.

***Insert new subclause 6.3.21.5:***

### 6.3.21.5 Periodic Ranging in sleep mode

For each MS in sleep mode, during its listening-window, BS may allocate an UL transmission opportunity for periodic ranging. Alternatively, BS may return the MS to Normal Operation by deactivation of at least one Power Saving Class to keep it in active state until assignment of a UL transmission opportunity for periodic ranging, or let the MS know when the periodic ranging opportunity shall occur with Next Periodic Ranging TLV in last successful RNG-RSP.

During periodic ranging or negotiation of sleep mode, after RNG-REQ (or MOB_SLP-REQ) reception, BS may send RNG-RSP (or MOB_SLP-RSP, respectively) including Next Periodic Ranging TLV so that MS shall know when to perform periodic ranging as described in more details in 6.3.19.4. In the frame specified by Next Periodic Ranging TLV, the MS shall decode all consequent UL-MAP messages waiting for a UL unicast transmission opportunity for periodic ranging. When such an opportunity occurs, the MS shall transmit a RNG-REQ message to the BS and then perform the regular procedure for periodic ranging. A successful periodic ranging procedure does not deactivate another Power Save Classes. In the case where periodic ranging procedure fails, the MS shall perform Initial Ranging procedure or handover to another BS.

When the periodic ranging operation between MS and BS successfully processes, the BS may inform the MS of the frame number in which the next periodic ranging operation is expected to start. For that, BS shall append a Next Periodic Ranging TLV encoding to the RNG-RSP message. BS also may inform MS of the existence of DL Traffic addressed to MS. For that, BS shall include the Next Periodic Ranging TLV with a value set to zero. This deactivates all Power Saving Classes at the MS. If an MS receives the RNG-RSP message with this indication from the BS, then the MS shall immediately resume Normal Operation with the BS.

The BS may include a SLPID_Update TLV item in a RNG-RSP message for an MS in sleep mode. If the serving BS receives a RNG-REQ message from an MS in sleep mode and there is any need to update SLPID assigned to the MS, the BS shall append a SLPID_Update TLV to the RNG-RSP message only for a RNG-RSP message with ranging status flag set to ‘success’. When the received RNG-RSP message with ranging status flag set to ‘success’ includes a SLPID_Update TLV, the MS shall decode the TLV and update its SLPID to the new one. The MS shall identify if the SLPID_Update TLV addresses it by searching through the SLPID_Update TLV and determining if the MS’s current SLPID matches the Old_SLPID in the SLPID_Update TLV. If they match, then the MS shall set its SLPID to the New_SLPID provided in the SLPID_Update TLV.

*Insert new subclause 6.3.21.6:*

#### 6.3.21.6 MDHO/FBSS Diversity Set Maintenance in sleep mode

An MS in Sleep mode shall maintain the Diversity set and Anchor BS if at least one active Power Saving Class has the Maintain Diversity Set and Anchor BSID set to 1 and the MDHO/FBSS duration as specified in the MOB_SLP-RSP message has not expired. Before the MDHO/FBSS duration expires, the MS shall continue to monitor the signal strength of neighbor BS and initiate deactivation of at least one Power Saving Class to keep in normal mode to perform Diversity Set update procedure (defined in 6.3.22.3.3) or Anchor BS update procedure (defined in 6.3.22.3.4).

*Insert new subclause 6.3.22:*

### 6.3.22 MAC layer handover procedures

This subclause contains the procedures performed during handover (HO).

An MS shall be capable of performing handover using the procedures defined in 6.3.22.2.

The handover process defined in this subclause may be used in a number of situations. Some examples are as follows:

- When the MS moves and (due to signal fading, interference levels, etc.) needs to change the BS to which it is connected in order to provide a higher signal quality;
- When the MS can be serviced with higher QoS at another BS.

The handover decision algorithm is beyond the scope of the standard.

*Insert new subclause 6.3.22.1:*

#### 6.3.22.1 Network topology acquisition

*Insert new subclause 6.3.22.1.1:*

#### 6.3.22.1.1 Network topology advertisement

A BS shall broadcast information about the network topology using the MOB_NBR-ADV message. The message provides channel information for neighboring base stations normally provided by each BS’s own DCD/UCD message transmissions. A BS may obtain that information over the backbone. Availability of this information facilitates MS synchronization with neighboring BS by removing the need to monitor transmission from the neighboring BS for DCD/UCD broadcasts.

*Insert new subclause 6.3.22.1.2:*

#### 6.3.22.1.2 MS scanning of neighbor BSs

A BS may allocate time intervals to MS for the purpose of MS seeking and monitoring suitability of neighbor BSs as targets for HO. The time during which the MS scans for available BS will be referred to as a scanning interval.

An MS may request an allocation of a group of scanning intervals with interleaving intervals of normal operation using the MOB_SCN-REQ message for the purpose of reducing the number of MOB_SCN-REQ and MOB_SCN-RSP messages required to create multiple scanning opportunities when frequent scanning is required. The MS indicates in this message the estimated duration of time it requires for the scan.

Scanning interval and interleaving interval repeat with the number of Scan iteration.

When the Trigger Action in the DCD message in encoded as 0x3, the MS shall send the MOB_SCN-REQ message to the BS to begin the neighbor BS scanning process when the trigger condition is met. In the MOB_SCN-REQ message the MS (the MOB_SCN-RSP message the BS) shall indicate group of neighbor BSs for which only Scanning or Scanning with Association are requested by MS (recommended by BS). Presence of those BSs for which Association is requested (recommended) is indicated by encoding of Scanning type> = 0b001. The BS may negotiate over the backbone with a BS Recommended for Association allocation unicast ranging opportunities. Then the MS will be informed on Rendezvous time to conduct Association ranging with the Recommended BS. When conducting initial ranging to a BS recommended for Association, MS shall use allocated unicast ranging opportunity, if available. Regardless of the presence of Recommended BS IDs, MS may determine and perform any scanning or Association activities during scanning interval at its own discretion. When the Report Mode is 0b10 in the MOB_SCN-RSP message, the MS shall scan all BSs within the Recommended BS list of the message and then report the scanning result with the MOB_SCN-REP message as conditioned by specified trigger event. Particularly if the Trigger Function in the most recently-received DCD channel encoding is 0x5 or 0x6, the MS shall include all recommended BSs of the MOB_SCN RSP within the MOB_SCN-REP. Otherwise, the MS shall add only the BSs that met the Trigger Function conditions within the MOB_SCN-REP message. The scanning duration performed by the MS on all neighbor BSs shall be no longer than the parameter Max_Dir_Scan_Time (as specified in 10.1) to limit the time before a report is sent to the BS. If the trigger type, trigger function and trigger action for a particular neighbor BS as defined in MOB_NBR-ADV are the same as the neighbor BS trigger type, trigger function and trigger action defined in the serving BS DCD, the trigger value and trigger averaging duration defined in the MOB_NBR-ADV shall take precedence.

Upon reception of the MOB_SCN-REQ message, the BS shall respond with a MOB_SCN-RSP message. The MS may retransmit the MOB_SCN-REQ message if it does not receive the MOB-SCN-RSP message-within the T44 timer. The MOB_SCN-RSP message shall either grant the requesting MS a scanning interval that is at least as long as requested by that MS, or deny the request. A value of zero for Scan duration in MOB_SCN-RSP shall indicate the request for an allocation of scanning interval is denied. The MOB_SCN-RSP message shall either grant the requesting MS a scanning interval that is at least as long as requested by that MS, or deny the request. A value of zero for Duration in MOB_SCN-RSP shall indicate the request for an allocation of scanning interval is denied. The serving BS may also send MOB_SCN-RSP message unsolicited. For unsolicited MOB_SCN-RSP message, a value of zero for Scan duration is used to trigger MS to report scanning result, without explicitly assigning scanning intervals to the MS. In this case, the MS shall only update Report Mode, Report Period and Report Metric based on the information received in MOB_SCN-RSP message.

Following reception of a MOB_SCN-RSP message granting the request, beginning at Start frame an MS may scan for one or more BS during the time interval allocated in the message. When a BS is identified through scanning, the MS may attempt to synchronize with its downlink transmissions, and estimate the quality of the PHY channel.

The serving BS may buffer incoming data addressed to the MS during the scanning interval and transmit that data after the scanning interval during any interleaving interval or after exit of the Scanning mode.

An MS may terminate scanning and return to Normal Operation anytime that may be indicated to the BS by sending a MAC PDU (for example, Bandwidth request) during any scanning interval. If a serving BS receives a MAC PDU message during any scanning interval from an MS that is supposed to be in Scanning Mode, the BS shall assume that the MS is no longer in Scanning Mode. The group of intervals is terminated at any time if the MS sends MOB_SCN-REQ message or serving BS sends MOB_SCN-RSP message during any interleaving interval with Scan Duration set to zero.

***Insert new subclause 6.3.22.1.3:***

### 6.3.22.1.3 Association procedure

Association is an optional initial ranging procedure occurring during scanning interval with respect to one of the neighbor BSs. The function of Association is to enable the MS to acquire and record ranging parameters and service availability information for the purpose of proper selection of HO target and/or expediting a potential future handover to a target BS. Recorded ranging parameters of an Associated BS may be further used for setting initial ranging values in future ranging events during actual handover.

There are three levels of association as follows:

- Association Level 0: Scan / Association without coordination
- Association Level 1: Association with coordination
- Association Level 2:Network assisted association reporting

Upon completion of a successful MS initial-ranging of a BS, if the RNG-RSP message contains a Service Level Prediction parameter set to 2, the MS may mark the BS as Associated in its MS local Association table of identities, recording elements of the RNG-RSP to the MS local Association table, and setting an appropriate aging timer (see Table 342). Association state in the MS local Association table shall be aged-out after ASC-AGING-TIMER timeout and the Association entry removed.

The BS may direct the MS to associate with recommended BSs by setting scanning type to 0b010 or 0b011 in MOB_SCN-RSP. If the MS supports directed association, it shall perform association as directed by the serving BS. If MS does not support directed association, it may ignore this message. The support of directed association shall be negotiated as part of SBC-REQ and SBC-RSP MAC management message dialog.

***Insert new subclause 6.3.22.1.3.1:***

### 6.3.22.1.3.1 Association Level 0—Scan / Association without coordination

When this association level is chosen by the network, the Serving BS and the MS negotiate about the association duration and intervals (via MOB_SCN-REQ with scanning type = 0b001 and MOB_SCN-RSP). The Serving BS allocates periodic intervals where the MS may range neighboring BSs; however, the Target BS has no knowledge of the MS and provides only contention-based ranging allocations. An MS chooses randomly a ranging code from the initial ranging domain of the Target BS and transmits it in the contention-based ranging interval of the Target BS.

After the BS successfully receives ranging code and sends RNG-RSP message with ranging status ‘success’, it will provide uplink allocation of adequate size for the MS to transmit RNG-REQ message with TLV parameters (Serving BS ID, MS MAC address) related to the association ranging.

***Insert new subclause 6.3.22.1.3.2:***

### 6.3.22.1.3.2 Association Level 1—Association with coordination

When this association level is chosen, the Serving BS provides association parameters to the MS and coordinates association between the MS and neighboring BSs.

The MS may request to perform association with coordination by sending the MOB_SCN-REQ message to the Serving BS with scanning type = 0b010. This message will include a list of neighboring BSs with which the MS wishes to perform association. The serving BS may also arrange for this type of association unilaterally by sending unsolicited MOB_SCN-RSP.

The Serving BS will then coordinate the association procedure with the requested neighboring BSs.

Each neighboring BS will provide a ranging region for association at a predefined “rendezvous time”, in terms of relative frame number. The neighboring BS will also assign:

- A unique code number (from within the initial ranging codeset)
- A transmission opportunity within the allocated region (in terms of offset from the start of the region)

The neighboring BS may assign the same code or transmission opportunity to more than one MS, but not both. In case all allocated transmission opportunities in current region are different, there is no potential for collision of transmissions from different MSs. In case the Serving BS allocates the same transmission opportunity to several MSs, there is some probability of collision and then neighbor BS may fail to identify transmitted codes.

The Serving BS (of the associating MS), will coordinate to assure that the neighboring BSs do not assign overlapping or too close in time to each other ranging regions.

The Serving BS will provide the pre-assigned association ranging info via the MOB_SCN-RSP message.

When the Dedicated ranging indicator is set to 1, the ranging region will be allocated via UIUC=12 in the UL-MAP.

When “Dedicated ranging indicator” is set to 1, then the ranging region and ranging method defined could be used for the purpose of ranging using dedicated CDMA code and transmit opportunity assigned in the MOB_PAG-ADV message (for location update in idle mode) or in the MOB_SCN-RSP message (for coordinated association).

MSs registered to this BS are prohibited from use of the named ranging region.

Upon receiving the MOB_SCN-RSP message, the MS should interpret the provided “rendezvous time”, dedicated code, and transmission opportunity as follows:

- “Rendezvous time” specifies the frame in which the neighbor BS will transmit a UL-MAP containing the definition of the dedicated ranging region where the MS can use the assigned CDMA ranging code. Rendezvous tim” is provided in units of frames, beginning at the frame where the MOB_SCN-RSP message is transmitted.
- The MS shall synchronize to the neighbor BS at the first frame immediately following the rendezvous time, read the UL-MAP transmitted at this frame, and extract the description of the dedicated ranging region (ranging region with “Dedicated ranging indicator” bit set to 1). The MS shall determine the specific region it should use for transmission of the dedicated CDMA code by applying the offset defined by the “transmission opportunity offset” field in MOB_SCN-RSP, which was received from the serving BS, to the dedicated ranging region definition in the UL-MAP of the neighbor BS. In case the neighbor BS decides to provide a regular (non-dedicated) ranging region with Dedicated ranging indicator set to 0, the MS may transmit the allocated CDMA code in the regular ranging region.
- If the MS could not obtain UL_MAP at the first frame immediately following the rendezvous time, it shall abort the Level 1 association process it’s attempting with the current BS. The MS may perform the Level 0 association with this BS as defined in 6.3.22.1.3.1 after it aborts the Level 1 association process.

***Insert new subclause 6.3.22.1.3.3:***

#### 6.3.22.1.3.3 Association Level 2—Network Assisted Association Reporting

The MS may request to perform association with network assisted association reporting by sending the MOB_SCN-REQ message to the Serving BS with scanning type = 0b011. This message will include a list of neighboring BSs with which the MS wishes to perform association. The serving BS may also request this type of association unilaterally by sending the MOB_SCN-RSP message.

The Serving BS will then coordinate the association procedure with the requested neighboring BSs in a fashion similar to association Level 1. However, when using this association type, the MS is required only to transmit the CDMA ranging code at the neighbor BS. Then the MS does not have to wait for RNG-RSP from the neighbor BS. Instead, the RNG-RSP information on PHY offsets will be sent by each neighbor BS to the Serving BS (over the backbone). The Serving BS may aggregate all ranging related information into a single MOB_ASC_REPORT message.

When receiving this message, the MS updates its association database (PHY offsets and CIDs) and timers for each associated BS.

If no ranging region exists with “Dedicated ranging indicator” set to 1 but a regular (non-dedicated) ranging region is allocated by the BS at the rendezvous time, then MS may use this allocation for the coordination process. In this case, the MS may transmit the allocated CDMA code in the region defined via UL-MAP_IE with UIUC=12 (i.e., the regular ranging region). The MS shall also in this case ignore the value of the “transmission opportunity offset” field of the MOB_SCN-RSP message it received from the serving BS during the association negotiation. The neighbor BS that decides to provide a regular (non-dedicated) ranging region instead of a ranging region with Dedicated ranging indicator set to 1, should expect to receive the allocated CDMA code in the regular (non-dedicated) ranging region. If the MS could not obtain UL_MAP at the first frame immediately following the rendezvous time, it shall abort the Level 2 association process its attempting with the current BS. The MS may perform the Level 0 association with this BS as defined in 6.3.22.1.3.1 after it aborts the Level 2 association process.

***Insert new subclause 6.3.22.2:***

#### 6.3.22.2 HO process

The subclause defines the HO process in which an MS migrates from the air-interface provided by one BS to the air-interface provided by another BS. The HO process consists of the following stages:

- Cell reselection—MS may use Neighbor BS information acquired from a decoded MOB_NBR-ADV message, or may make a request to schedule scanning intervals or sleep-intervals to scan, and possibly range, Neighbor BS for the purpose of evaluating MS interest in handover to potential target BS. The cell reselection process need not occur in conjunction with any specific, contemplated HO Decision.
- HO Decision and Initiation—A handover begins with a decision for an MS to handover from a serving BS to a target BS. The decision may originate either at the MS or the serving BS. The HO Decision consummates with a notification of MS intent to handover through MOB_MSHO-REQ or MOB_BSHO-REQ message.
- Synchronization to Target BS downlink—MS shall synchronize to downlink transmissions of Target BS and obtain DL and UL transmission parameters. If MS had previously received a MOB_NBR-ADV message including target BSID, Physical Frequency, DCD and UCD, this process may be shortened. If the target BS had previously received HO notification from serving BS over the backbone, then target BS may allocate a non-contention-based Initial Ranging opportunities.

- Ranging—MS and target BS shall conduct Initial Ranging per 6.3.9.5 or Handover Ranging per 6.3.10.3.3. If MS RNG-REQ includes serving BSID, then target BS may make a request to serving BS for information on the MS over the backbone network and serving BS may respond. Regardless of having received MS information from serving BS, target BS may request MS information from the backbone network. Network re-entry proceeds per 6.3.9.5 except as may be shortened by target BS possession of MS information obtained from serving BS over the backbone network. Depending on the amount of that information Target BS may decide to skip one or several of the following Network Entry steps:
    1) Negotiate basic capabilities (Bit #0 in HO Process Optimization TLV in RNG-RSP is set)
    2) PKM Authentication phase (Bit #1 in HO Process Optimization TLV is set)
    3) TEK establishment phase (Bit #2 in HO Process Optimization TLV is set)
    4) Send REG-REQ (Bit #9 in HO Process Optimization TLV is set)
    5) BS may send unsolicited REG-RSP message with updated capabilities information or skip REG-RSP message when no TLV information to be updated (Bit #10 in HO Process Optimization TLV is set)

  In case Bit #6 in HO Process Optimization TLV is set, full service and operational state transfer or sharing between Serving BS and Target BS is assumed (ARQ state, all timers, counters, MAC state machines, CIDs, Service Flows information and other connection information), so BS and MS do not exchange network re-entry messages after ranging before resuming normal operations.

  A full list of optimization capabilities is provided in definition of HO Process Optimization TLV (Table 367).

  In case Network Re-entry includes Key Request/Reply handshake, the BS shall provide sufficient time to the MS to process received TEK information before moving to next step as specified by HO TEK processing time TLV.

  If TLVs for re-establishment of connections (11.7.9) appear in RNG-RSP (REG-RSP), DSA-REQ/RSP procedure shall not be used for this purpose. In this case, re-establishment of connections starts immediately after RNG-RSP (REG-RSP); the BS shall provide sufficient time to the MS to process connections information as specified by MS HO connections parameters processing time TLV.
  In case Key Request/Key Reply handshake is not omitted, BS shall send REG-RSP, solicited or not. If REG-RSP is not omitted, network re-entry process completes with REG-RSP message.

- Termination of MS Context—The final step in handover. Termination of MS Context is defined as serving BS termination of context of all connections belonging to the MS and the context associated with them (i.e., information in queues, ARQ state-machine, counters, timers, header suppression information, etc. is discarded).

- HO Cancellation—An MS may cancel HO at any time prior to expiration of Resource_Retain_Time interval after transmission of MOB_HO-IND message.

The HO process, and its similarity to the initial network entry process, is depicted in Figure 130b.

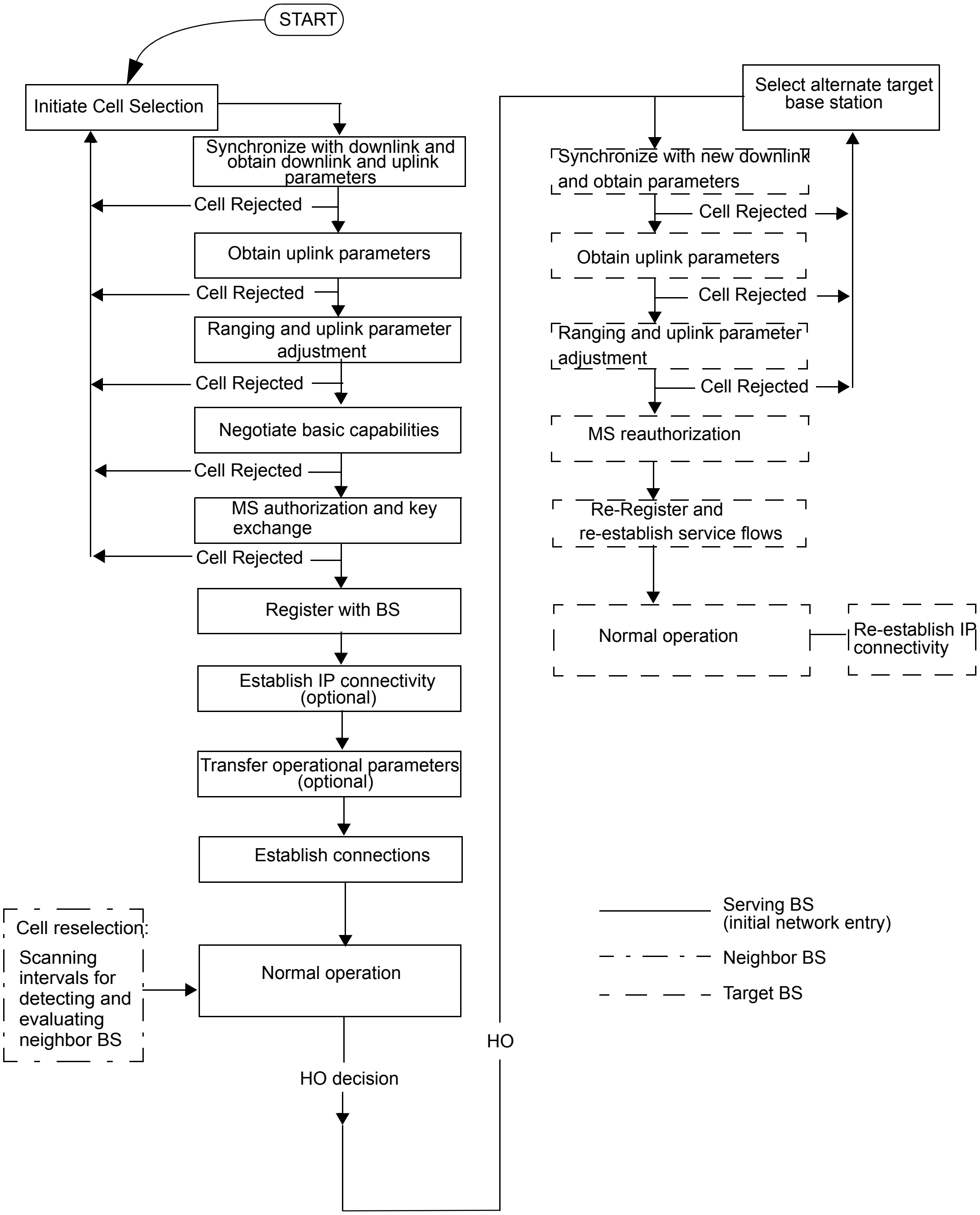

START
Initiate Cell Selection
Synchronize with downlink and obtain downlink and uplink parameters
Cell Rejected
Obtain uplink parameters
Cell Rejected
Ranging and uplink parameter adjustment
Cell Rejected
Negotiate basic capabilities
Cell Rejected
MS authorization and key exchange
Cell Rejected
Register with BS
Establish IP connectivity (optional)
Transfer operational parameters (optional)
Establish connections
Cell reselection:
Scanning intervals for detecting and evaluating neighbor BS
Normal operation
HO decision
HO
Select alternate target base station
Synchronize with new downlink and obtain parameters
Cell Rejected
Obtain uplink parameters
Cell Rejected
Ranging and uplink parameter adjustment
Cell Rejected
MS reauthorization
Re-Register and re-establish service flows
Normal operation
Re-establish IP connectivity
Serving BS (initial network entry)
Neighbor BS
Target BS

Figure 130b—HO and initial network entry

*Insert new subclause 6.3.22.2.1:*

### 6.3.22.2.1 Cell reselection

Cell reselection refers to the process of an MS Scanning and/or Association with one or more BS in order to determine their suitability, along with other performance considerations as a handover target. The MS may incorporate information acquired from a MOB_NBR-ADV message to give insight into available Neighbor BSs for cell reselection consideration. Serving BS may schedule scanning intervals or sleep-intervals to conduct cell reselection activity. Such a procedure does not involve termination of existing connection to a serving BS.(See Figure 130c.)

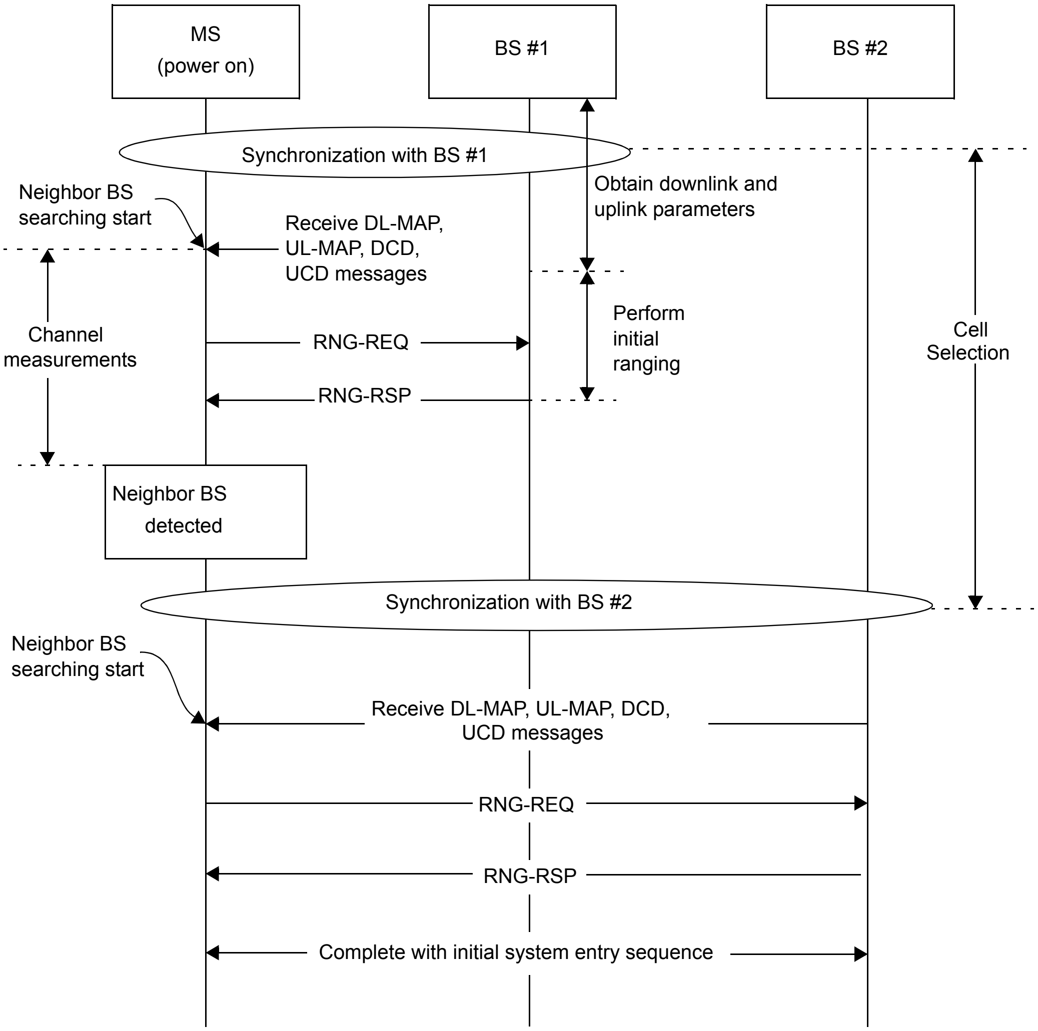

MS
(power on)
BS #1
BS #2
Synchronization with BS #1
Neighbor BS searching start
Obtain downlink and uplink parameters
Receive DL-MAP, UL-MAP, DCD, UCD messages
Channel measurements
RNG-REQ
Perform initial ranging
Cell Selection
RNG-RSP
Neighbor BS detected
Synchronization with BS #2
Neighbor BS searching start
Receive DL-MAP, UL-MAP, DCD, UCD messages
RNG-REQ
RNG-RSP
Complete with initial system entry sequence

Figure 130c—Example of cell selection with ranging

*Insert new subclause 6.3.22.2.2:*

### 6.3.22.2.2 HO decision and initiation

A handover begins with a decision for an MS to handover from a serving BS to a target BS. The decision may originate either at the MS, the serving BS, or on the network. The HO may proceed with a notification through either MOB_MSHO-REQ or MOB_BSHO-REQ messages. The HO notification is recommended, but not required. Acknowledgement of MOB_MSHO-REQ with MOB_BSHO-RSP is required. After MS transmits MOB_MSHO-REQ, MS shall not transmit any MOB_MSHO-REQ prior to expiration of timer MS_handover_retransmission_timer. MS shall deactivate timer MS handover retransmission timer on MS transmit of MOB_HO-IND or MS receipt of MOB_BSHO-RSP.

If an MS that transmitted a MOB_MSHO-REQ message detects an incoming MOB_BSHO-REQ message, it shall ignore that MOB_BSHO-REQ message. A BS that transmitted a MOB_BSHO-REQ message and detects an incoming MOB_MSHO-REQ message from the same MS shall ignore its MOB_BSHO-REQ. A BS that transmitted a MOB_BSHO-REQ message and detects an incoming MOB_HO-IND message from the same MS shall ignore its own previous request.

When MOB_MSHO-REQ is sent by an MS, the MS may indicate one or more possible target BS. When MOB_BSHO-REQ is sent by a BS, the BS may indicate one or more possible target BSs. MS may evaluate possible target BS(s) through previously performed scanning and Association activity.

Serving BS criteria for recommendation of target BS may include factors such as expected MS performance at potential target BS and MS QoS requirements. Serving BS may obtain expected MS performance at potential target BS through the exchange of backbone messages with that BS. Serving BS may negotiate location of common time interval where dedicated initial ranging transmission opportunity for the MS will be provided by all potential target BSs. This information may be included into MOB_BSHO-RSP message.

Dedicated allocation for transmission of RNG-REQ means that channel parameters learned by the MS during Association of that BS are considered valid during sufficient time and can be reused for actual Network Re-entry without preceding CDMA Ranging. Information such as indicators of link quality in the UL direction learned by the MS during Association may be provided to the Serving BS over the backbone.

If Network Assisted HO supported flag is set to “1” in MOB_BSHO-REQ message, MS may perform a handover to any BS among the recommended BSs in MOB_BSHO-REQ without notifying the serving BS of a selected target BS. As an acknowledgement to the MOB_BSHO-REQ message, the MS may send a MOB_HO-IND message with its target BSID set to “0x00000000”.

When the serving BS, transmitted MOB_BSHO-REQ with Network Assisted HO supported flag = “1”, receive MOB_HO-IND with target BS ID = “0x00000000”, it may neglect target BS ID included in MOB_HO-IND message.

MS actual pursuit of handover to one of BSs specified in MOB_BSHO-RSP is recommended, but not required. MS may decide to attempt handover to a different BS that may or may not have been included in MOB_BSHO-RSP. If the MS signals rejection of serving BS instruction to HO through HO_IND_type field in the MOB_HO-IND set value of 0b10 (HO reject option), the BS may reconfigure the neighbor BS list and retransmit MOB_BSHO-RSP message including a new neighbor BS list.

In some instances, the BS may need to force the MS to conduct handover. The BS shall include a value of HO operation mode = 1 in either the MOB_BSHO-REQ or MOB_BSHO-RSP to signal to the MS that the MS must conduct handover. Upon receiving a message with HO operation mode = 1, the MS should treat the handover request as required and shall respond with a HO-IND. MS should send HO-IND with option HO_IND_type = 0b00 indicating commitment to HO unless MS is unable to handover to any of the recommended BSs in the message, in which case MS may respond with HO-IND with option HO_IND_type=0b10 indicating HO reject. An MS required to conduct handover is not restricted to conducting handover to those BS included in the notifying message. In other words, the MS may attempt handover to a different BS that may or may not have been included in either the MOB_BSHO-REQ or MOB_BSHO-RSP.

Serving BS may notify one or more potential target BS over the backbone network of MS intent to handover. Serving BS may also send MS information to potential target BS over the backbone to expedite handover.

The MS that sent MOB_HO-IND with option HO_IND_type = 0b00 indicating commitment to HO and intent to release the serving BS, shall not be expected to monitor serving BS DL traffic after expiration of Resource retain timer.

***Insert new subclause 6.3.22.2.3:***

#### 6.3.22.2.3 HO cancellation

After an MS or BS has initiated an HO using either MOB_MSHO-REQ or MOB_BSHO_REQ message, the MS may cancel HO at any time.

The cancellation shall be made through transmission of a MOB_HO-IND messages the HO cancel option (HO_IND_type=0b01).

When MS transmits and serving BS receives MOB_HO-IND message with the HO cancel option (HO_IND_type=0b01) during Resource Retain Time (when Resource Retain Flag=1), regardless of MS attempt at HO, the MS and serving BS shall resume Normal Operation communication.

***Insert new subclause 6.3.22.2.4:***

#### 6.3.22.2.4 Use of scanning and association results

MS may scan target neighbor BSs and optionally try association. If the target BS had previously received HO notification from serving BS over the backbone, then target BS may place a Fast_Ranging_IE() (see 8.2.1.9.3.6, 8.3.6.3.9, and 8.4.5.4.21. Fast ranging Information Element) in the UL-MAP to allocate a non-contention-based Initial Ranging opportunity. MS shall scan target BS for UL-MAP that includes either a contention- or non-contention-based MS Initial Ranging opportunity.

***Insert new subclause 6.3.22.2.5:***

#### 6.3.22.2.5 Termination with the Serving BS

After the handover request/response handshake has completed, the MS may begin the actual HO. At some stage during the HO process, the MS terminates service with the serving BS. This is accomplished by sending a MOB_HO-IND message with the HO_IND_type value indicating serving BS release.

If the HO_IND_type field specifies serving BS release, the BS shall start the Resource retain timer from value Resource_Retain_Time provided by BS in REG-RSP, BSHO-REQ, or BSHO-RSP messages. The serving BS shall retain the connections, MAC state machine, and PDUs associated with the MS for service continuation until the expiration of Resource retain timer. Regardless of Resource retain timer, the serving BS shall remove MAC context and MAC PDUs associated with the MS upon reception of a backbone message from the target BS indicating MS Network Attachment at target BS.

If the serving BS determines to retain the connection information of an MS that has sent MOB_HO-IND with HO_IND_type=0b00 and begun the actual HO, this connection information may be used by the MS in order to perform an expedited re-entry operation with target BS or the serving BS. The serving BS shall notify the MS of retention of MS connection information through Resource Retain Flag in MOB_BSHO-RSP message or MOB_BSHO-REQ message during handover request/response handshake operation. If Resource Retain Flag = 1 and Resource Retain Time is not included as a TLV item in the message, then the serving BS and MS shall use the System Resource Retain Time timer.

*Insert new subclause 6.3.22.2.6:*

#### 6.3.22.2.6 Drops during HO

A drop is defined as the situation where an MS has stopped communication with its serving BS (either in the downlink or in the uplink) before the normal HO sequence outlined in Cell Selection and Termination with the serving BS has been completed.

An MS can detect a drop by its failure to demodulate the downlink, or by exceeding the RNG-REQ retries limit allowed for the periodic ranging mechanism. A BS can detect a drop when the Number of retries limit allowed on inviting Ranging Requests for the periodic ranging mechanism is exceeded.

When the MS has detected a drop during network re-entry with a target BS, it may attempt network re-entry with its preferred target BS as through Cell Reselection (see 6.3.22.2.1), and may include resuming communication with the Serving BS by sending MOB_HO-IND message with HO_IND type = 0b01 (HO cancel). If the MS fails network re-entry with its preferred Target BS, the MS shall perform initial entry procedure.

MS shall perform CDMA ranging with Target BS using codes from HO codes domain.

Upon Target BS sending RNG-RSP with ‘ranging status’ = success, Target BS shall provide CDMA_ALLOC_IE with appropriate UL allocation for RNG-REQ from MS. MS shall send RNG-REQ with MAC address and HMAC/CMAC. Target BS may now identify that HO attempt by MS was not coordinated with Serving BS and may request all relevant MS context from Serving BS. Using this info Target BS shall now send RNG-RSP with ‘HO process optimization’ bitmap and network re-entry may continue as in the typical, non-drop case.

When the serving BS has detected a drop, it shall react as if a MOB_HO-IND message has been received with HO_IND_type indicating serving BS release.

*Insert new subclause 6.3.22.2.7:*

#### 6.3.22.2.7 Network entry/re-entry

Unless otherwise indicated in this subclause, MS mobile network entry/re-entry is processed according to 6.3.9.

An MS and a target BS shall conduct Ranging per 6.3.9.5 except when dedicated Ranging opportunity is available, in which case, the procedure described in 6.3.22.2.4 shall be employed. For identification of the MS, RNG-REQ message may include MS MAC Address or HO_ID (if assigned in MOB_BSHO-REQ or MOB_BSHO-RSP). The target BS shall assign to the MS Basic CID and Primary CID in the RNG-RSP management message.

The MS shall signal the target BS of a current HO attempt by including a serving BSID TLV and Ranging Purpose Indication TLV with Bit #0 set to 1 in the RNG-REQ management message. The MS shall not include a Ranging Purpose Indication TLV in the RNG-REQ management message unless actually in the process of conducting an HO, location update, or Network Re-entry from Idle Mode attempt.

If an MS RNG-REQ includes a serving BSID and Ranging Purpose Indication TLV with Bit #0 set to 1, and the target BS had not previously received MS information over the backbone, then the target BS may make an MS information request of the serving BS over the backbone network and the serving BS may respond. Regardless of having received MS information from the serving BS, the target BS may request MS information from another network entity via the backbone network.

Network re-entry proceeds per 6.3.9, except as may be shortened by the target BS's possession of MS information obtained from the serving BS over the backbone network, and except 6.3.9.10 to 6.3.9.12, which may be postponed until after the MS re-enters the network.

To notify an MS seeking HO of possible omission of re-entry process management messages during the current HO attempt (due to the availability of MS service and operational context information obtained over the backbone network), the target BS shall place in RNG-RSP an HO Process Optimization TLV indicating which re-entry management messages may be omitted. The MS shall complete the processing of all indicated messages before entering Normal Operation with target BS.

As indicated in the HO Process Optimization TLV settings, the target BS may elect to use MS service and operational information obtained over the backbone network to build and send unsolicited SBC-RSP and/or REG-RSP management messages to update MS operational information, or to include this information into TLV items in the RNG-RSP. If the target BS sends an unsolicited SBC-RSP or unsolicited REG-RSP message and the MS sends the corresponding SBC-REQ (REG-REQ) message, the BS may ignore only the first corresponding REQ management message received. The MS is not required to send the complimentary REQ management message if it receives an unsolicited SBC-RSP or unsolicited REG-RSP management message prior to MS attempt to send the corresponding REQ management message. Target BS re-entry unsolicited response management messages may be grouped into the same DL frame transmission with the RNG-RSP. However, unsolicited SBC-RSP and unsolicited REG-RSP may not be grouped together into the same DL frame transmission when the PKM-REQ/RSP management message process is required. For a security keying process that has not been determined to be omitted in the HO Process Optimization TLV settings, if MS RNG-REQ includes an serving BSID and Ranging Purpose Indication TLV with Bit #0 set to 1, and target BS has received a backbone message containing MS information, MS and target BS shall use the embedded TLV PKM-REQ information and the reauthorization process as defined in 7.2.

If the MS finishes the re-entry registration procedure by successfully receiving either an unsolicited REG-RSP message or a RNG-RSP message including REG-RSP specific TLV items, the MS shall send a Bandwidth Request header with zero BR field when Bit #12 of the HO Process Optimization TLV in the RNG-RSP message is set to one. If the BS receives a Bandwidth Request header with zero BR after sending either the unsolicited REG-RSP message or the RNG-RSP message including REG-RSP specific TLV items, the BS regards the Bandwidth Request header as a notification of MS's successful re-entry registration.

When, during capabilities negotiation, MS specifies that it supports IEEE 802.16 security, if the normal PKM initial network entry process as defined in 7.2 is to be abridged or omitted, then the MS shall include the HMAC/CMAC Tuple as the last message item in the RNG-REQ management message using the Authorization Key and Key Sequence Number derived for use on the target BS. If the required HMAC/CMAC Tuple is invalid or omitted in the RNG-REQ management message, then the full PKM REQ/RSP sequence must be completed and cannot be omitted. The target BS shall include a valid HMAC/CMAC Tuple as the last message item in the RNG-RSP if it instructs the MS, through the HO Process Optimization TLV, that the PKM-REQ/RSP sequence may be omitted.

If MS RNG-REQ includes a serving BSID and Ranging Purpose Indication TLV with Bit #0 set to 1, and target BS has received a backbone message containing MS information, the target BS may use MS service and operational information obtained over the backbone network to build and send a REG-RSP management message that includes service flow remapping information in SFID, New_CID and Connection_Info TLVs.

During HO, the target BS may notify the MS, through the Bit #7 MS DL data pending element of the HO Process Optimization TLV item in RNG-RSP, of post-HO re-entry MS DL data pending. Upon MS successful re-entry at the target BS, now the new serving BS, the new serving BS can transmit forwarded data (called "pre-HO pending MS DL data") to the MS. After completing reception of any HO pending MS DL data retained and forwarded, the MS may re-establish IP connectivity and the new serving BS may send a backbone message to request the old serving BS or other network entity to stop forwarding pre-HO pending MS DL data.

Network entry/re-entry process completes with establishment /re-establishment of provisioned connections.

When the target BS has detected a failed HO entry/re-entry attempt, it may inform the serving BS of HO failure through a backbone message indicating Handover Failure.

***Insert new subclause 6.3.22.2.8:***

### 6.3.22.2.8 MS-Assisted coordination of DL transmission at Target BS for HO

If both the Serving BS and the Target BS involved in the HO process can support continuity of ARQ or SDU_SN enabled connections, the BSs and the MS may perform MS-Assisted coordination of DL transmission during HO as described in this subclause. Target BS may signal to the MS on the intention to apply this procedure using Bit #11 of 'HO Process Optimization' flag in the RNG-RSP message.

Once the MS has successfully completed handover to the Target BS (now new Serving BS), to maintain continuity of transmission to the MS between the old and new Serving BSs, the last successfully received information unit needs to be identified to the new Serving BS. Depending on whether the connection is ARQ enabled or ARQ disabled, the identity of the next information unit can be given by the ARQ block sequence number or the MAC SDU sequence number respectively.

MS can optionally support the feedback of the ARQ block sequence number or the virtual MAC SDU sequence number after the MS has successfully completed handover to the Target BS. The capability and the support for each connection are defined in the REG-REQ/RSP and DSA-REQ/RSP TLVs respectively.

- For ARQ enabled, the ARQ block sequence number is already available at the MS.
- For ARQ disabled, the following procedures shall be performed by the BS and the MS: the old Serving BS shall include a SDU SN extended subheader at least once every $2^p$ MAC PDUs, where $p$ is specified in the SN Feedback support TLV (11.7.8.9). Upon transmitting MOB_BSHO-RSP (in response to receiving MOB_MSHO-REQ, in case of MS initiated HO) or upon transmitting MOB_BSHO-REQ (in case of BS initiated HO), if the old serving BS continues transmission of data to the MS, it shall include SDU SN extended subheader in MAC PDU at least once before "Estimated HO time" (the first time that MS is expected to communicate with the Target BS). The MS shall maintain MAC SDU sequence number based on the information received from the BS. When the MS receives a MAC PDU without SDU SN extended subheader, the MS shall increment the MAC SDU sequence number by one for every SDU received. When the MS receives MAC SDU sequence number from the BS, it shall reset the MAC SDU sequence number to the value included in SDU SN extended subheader.

Upon completion of network re-entry, the Target BS (now new Serving BS) should provide UL allocation for the MS sufficient for transmission of SN Report MAC header with LSBs of the sequence number(s) of ARQ block or virtual MAC SDU number. After reception of SN Report MAC header, the BS shall resume transmission of the data of the corresponding DL Service Flow starting from MAC SDUs pointed by the sequence number. At the completion of network re-entry, the MS shall send SN Report MAC headers (as described in 6.3.2.1.2.1.7) that include the next ARQ Block (or virtual MAC SDU) sequence number that it is expecting for each of its connections that have SN feedback enabled. The MS shall send the sequence number in numerical ascending order of the values of the SFIDs values. The new Serving BS may send the SN request extended subheader to explicitly request an MS to send additional SN report header. After receiving the SN request extended subheader, the MS shall send the requested SN report header. The new Serving BS provides allocation through UL-MAP_IE for the MS to send the additional SN report header.

***Insert new subclause 6.3.22.2.9:***

#### 6.3.22.2.9 HO process

Figure 130d shows the process of an MS initiating handover with the BS.

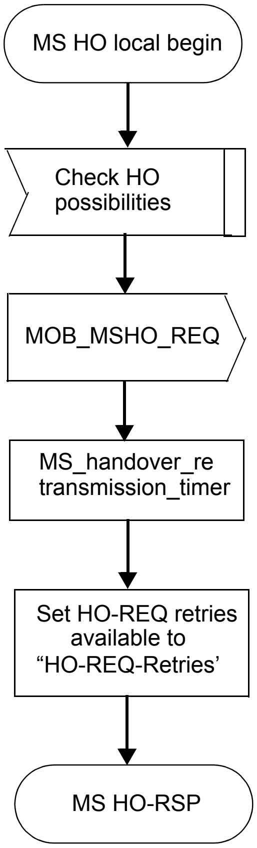

MS HO local begin
Check HO possibilities
MOB_MSHO_REQ
MS_handover_retransmission_timer
Set HO-REQ retries available to "HO-REQ-Retries'
MS HO-RSP

Figure 130d—MS initiating handover with the BS

Figure 130e shows the process of an MS waiting for a response from the BS; in addition, it presents the case in which the MS has decided to stop the handover in the middle of the process.

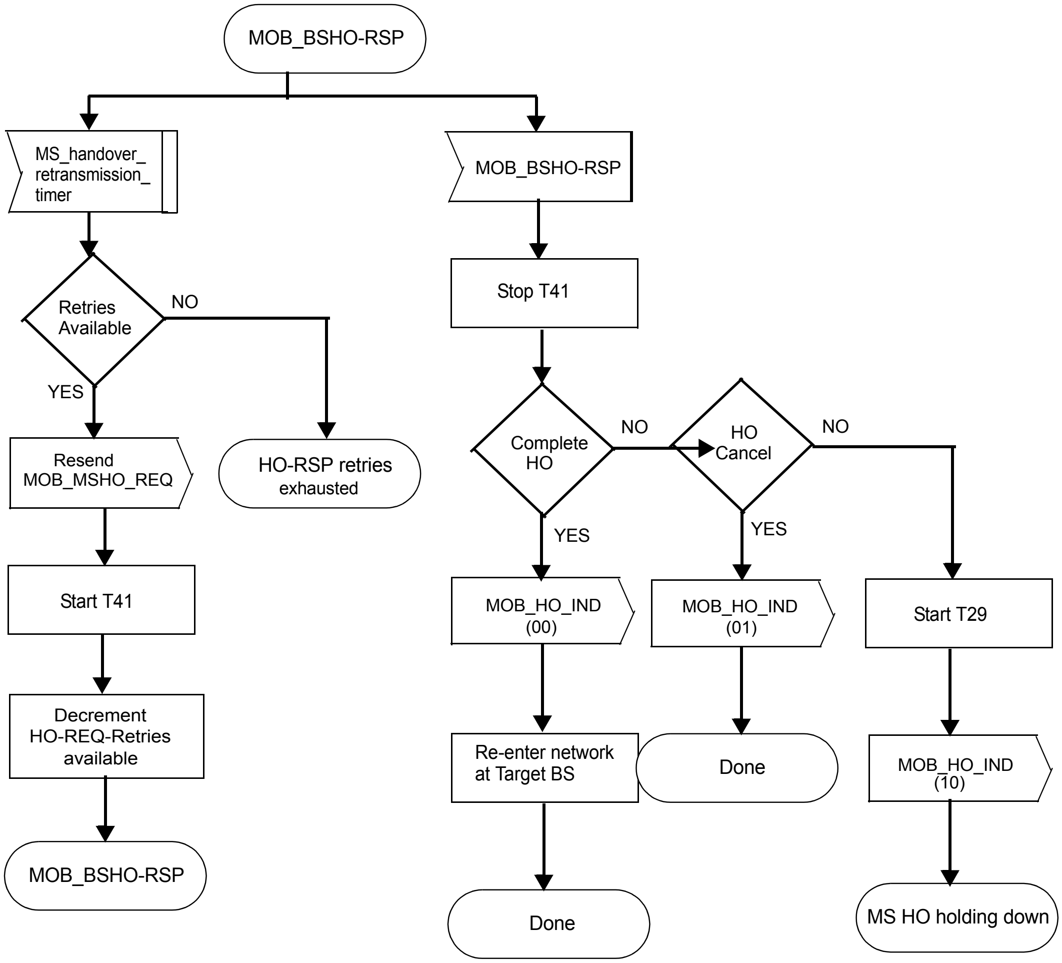

MOB_BSHO-RSP
MS_handover_ retransmission_ timer
MOB_BSHO-RSP
Stop T41
Retries Available
NO
YES
Resend MOB_MSHO_REQ
HO-RSP retries exhausted
Start T41
Decrement HO-REQ-Retries available
MOB_BSHO-RSP
Complete HO
NO
HO Cancel
NO
YES
YES
MOB_HO_IND (00)
MOB_HO_IND (01)
Start T29
Re-enter network at Target BS
Done
MOB_HO_IND (10)
Done
MS HO holding down

Figure 130e—locally initiated transaction MOB_BSHO-RSP pending state flow diagram

Figure 130f shows the process of an MS following a canceling of the handover and ensuring that the MOB_HO-IND message was received by the BS (by expiration of T42 timeout). While waiting, if new handover process is required, the MS shall stop T42 timer without waiting.

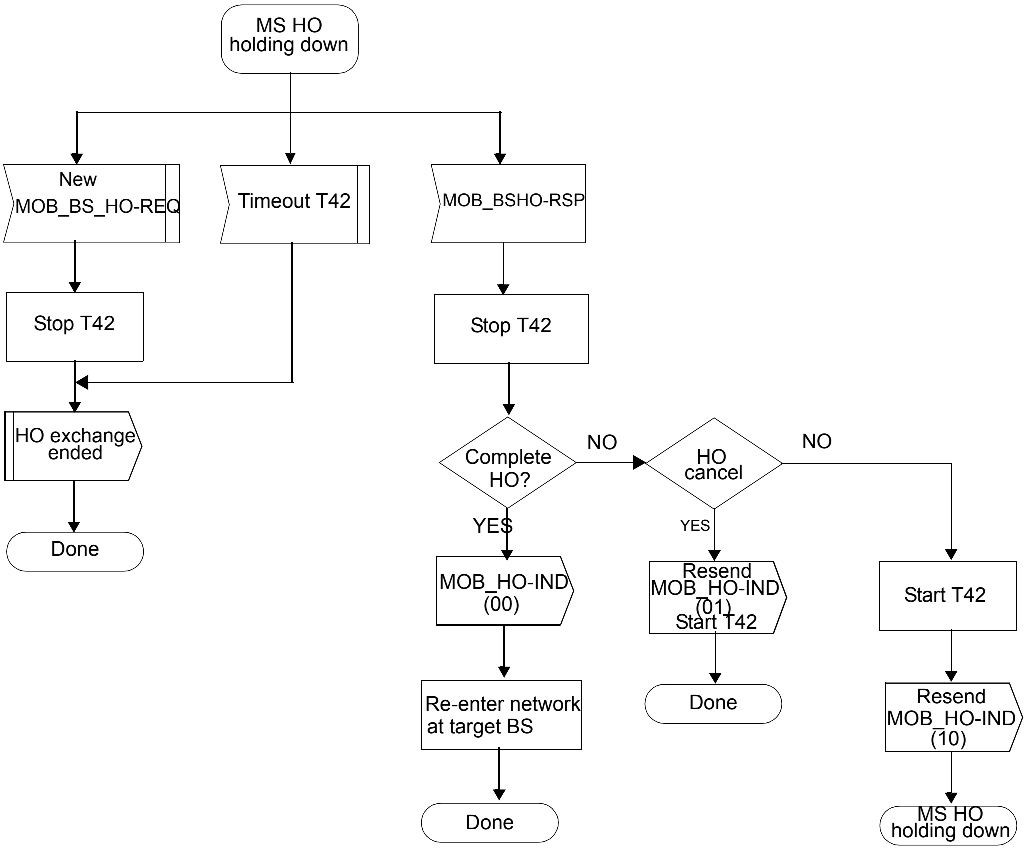

MS HO holding down
New MOB_BS_HO-REQ
Timeout T42
MOB_BSHO-RSP
Stop T42
Stop T42
HO exchange ended
Done
Complete HO?
NO
HO cancel
NO
YES
YES
MOB_HO-IND (00)
Resend MOB_HO-IND (01) Start T42
Start T42
Re-enter network at target BS
Done
Resend MOB_HO-IND (10)
Done
MS HO holding down

**Figure 130f—Typical MS listening state flow diagram**

Figure 130g shows the process of an MS receiving a MOB_BSHO-REQ message from the BS; in addition, it presents the case in which the MS has decided to stop the handover in the middle of the process.

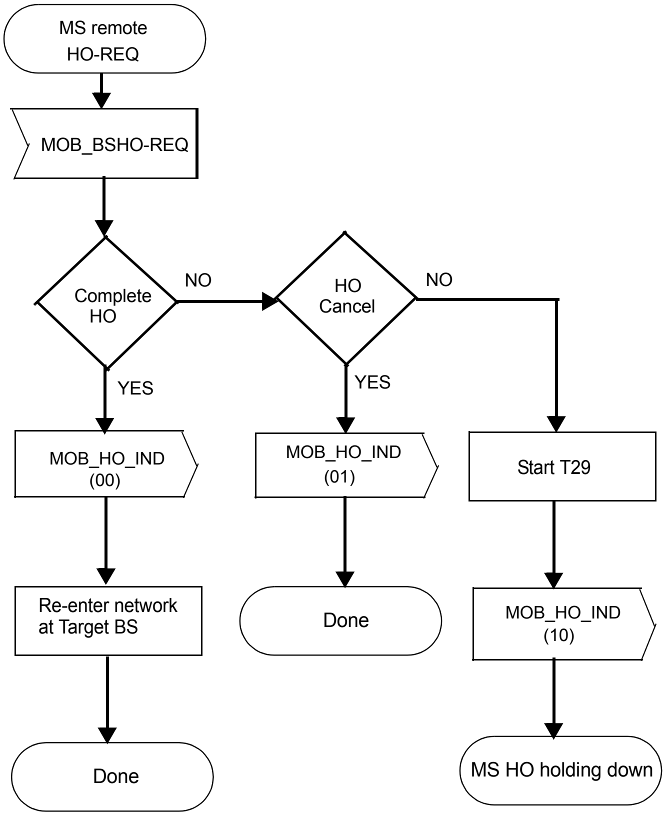

MS remote
HO-REQ
MOB_BSHO-REQ
Complete
HO
NO
HO
Cancel
NO
YES
YES
MOB_HO_IND
(00)
MOB_HO_IND
(01)
Start T29
Re-enter network
at Target BS
Done
MOB_HO_IND
(10)
Done
MS HO holding down

**Figure 130g—locally initiated transaction MOB_BSHO-RSP pending state flow diagram**

***Insert new subclause 6.3.22.3:***

### 6.3.22.3 Macro diversity handover and fast BS switching

In addition to the HO procedures previously discussed, there are two optional HO modes, MDHO and FBSS. The MDHO or FBSS capability can be enabled or disabled in the REG-REQ/RSP message exchange. With MDHO or FBSS enabled, the MS shall perform the following stages:

- MDHO Decision: A MDHO begins with a decision for an MS to transmit to and receive from multiple BSs at the same time. A MDHO can start with either MOB_MSHO-REQ or MOB_BSHO-REQ messages.
- FBSS HO Decision: A FBSS handover begins with a decision for an MS to receive/transmit data from/to the Anchor BS that may change within the Diversity Set. A FBSS handover can be triggered by either MOB_MSHO-REQ or MOB_BSHO-REQ messages.

- Diversity Set Selection/Update: An MS may scan the neighbor BS and select BSs that are suitable to be included in the diversity set. The MS shall report the selected BSs and the diversity set update procedure shall be performed by the BS and the MS.
- Anchor BS Selection/Update: An MS is required to continuously monitor the signal strength of the BSs that are included in the diversity set. The MS shall select one BS from its current Diversity Set to be the Anchor BS and reports the selected Anchor BS on CQICH or MOB_MSHO-REQ message.

If MOB_BSHO-RSP specifies another HO type value than requested by MOB_MSHO-REQ (for example, the MS requested HO and the BS prescribes MDHO/FBSS), then the MS should perform the procedure specified by the BS.

The MS should perform the procedure specified by the BS in HO Type field of MOB_BSHO-REQ.

When a Diversity Set and an Anchor BS are maintained at the MS and the BS, the BS can decide to put the MS MDHO or FBSS on a per burst allocation basis, based on factors such as QoS of a particular service flow being transmitted.

***Insert new subclause 6.3.22.3.1:***

#### 6.3.22.3.1 MDHO decision and initiation

Support of MDHO or FBSS is optional for both the MS and the BS.

For an MS and a BS that support MDHO, the MS and the BS shall maintain a list of BSs that are involved in MDHO with the MS. The list is called the Diversity Set. Among the BSs in the Diversity Set, an Anchor BS is defined. Regular operation when MS is registered at a single BS is a particular case of MDHO with Diversity Set consisting of single BS, which in this case shall be the Anchor BS. When operating in MDHO, the MS communicates with all BSs in the Diversity Set for UL and DL unicast messages and traffic.

There are two methods for the MS to monitor DL control information (i.e., DL-MAP, UL-MAP, and FCH) and DL broadcast messages. The first method is the MS monitors only the Anchor BS for DL control information and DL broadcast messages. In this case, the DL-MAP and UL-MAP of the Anchor BS may contain burst allocation information for the non-Anchor Active BS. The second method is the MS monitors all the BSs in the Diversity Set for DL control information and DL broadcast messages. In this case, the DL-MAP and UL-MAP of any Active BS may contain burst allocation information for the other Active BSs. The method to be used by MS is defined during the REG-REQ and REG-RSP handshake.

A MDHO begins with a decision for an MS to transmit/receive unicast messages and traffic from multiple BSs at the same time interval. For DL MDHO, two or more BSs provide synchronized transmission of MS downlink data such that diversity combining can be performed by the MS. For UL MDHO, the transmission from an MS is received by multiple BSs such that selection diversity of the information received by multiple BSs can be performed.

The BS supporting MDHO or FBSS shall broadcast the DCD message that includes the H_Add Threshold and H_Delete Threshold. These thresholds are used by the FBSS/MDHO capable MS to determine if MOB_MSHO-REQ should be sent. When long-term CINR of a serving BS is less than H_Delete Threshold, the MS shall send MOB_MSHO-REQ to requires dropping this serving BS from the diversity set; when long-term CINR of a neighbor BS is higher than H_Add Threshold, the MS shall send MOB_MSHO-REQ to require adding this neighbor BS to the diversity set.

The decision to update the Diversity Set begins with a notification by the MS through the MOB_MSHO-REQ message or by the BS through the MOB_BSHO-REQ management message. The process of Anchor BS update may begin with MOB_MSHO-REQ from MS or MOB_BSHO-REQ from the Anchor BS.

Acknowledgement with MOB_BSHO-RSP of a notification is required. After MS transmits MOB_MSHO-REQ, MS shall not transmit any MOB_MSHO-REQ prior to expiration of timer MS_handover_retransimssion_timer. MS shall deactivate timer MS_handover_retransmission_timer on MS transmit of MOB_HO-IND or MS receipt of MOB_BSHO-RSP. Process of Anchor BS update may also begin with Anchor switching indication via fast-feedback channel.

If an MS that transmitted a MOB_MSHO-REQ message detects an incoming MOB_BSHO-REQ message, it shall ignore that MOB_BSHO-REQ message. A BS that transmitted a MOB_BSHO-REQ message and detects an incoming MOB_MSHO-REQ or MOB_HO-IND message from the same MS shall ignore its own previous request.

The BSs involving in MDHO with an MS shall use the same set of CIDs for the connections that are established with the MS. The BS may assign a new set of CIDs to the MS during Diversity Set update through MOB_BSHO-REQ message and MOB_BSHO-RSP message.

There are several conditions that are required to enable macro diversity handover and or Fast BS Switching handover between MS and a group of BSs. These conditions are listed below:

- The BSs involving in MDHO are synchronized based on a common time source.
- The frames sent by the BSs involving in MDHO at a given frame time arrive at the MS within the prefix interval.
- BSs involving in MDHO have synchronized frame structure.
- BSs involving in MDHO have the same frequency assignment.
- BSs involving in MDHO shall use the same set of CIDs for the connections that are established with the MS.
- The same MAC/PHY PDUs shall be sent by all the BSs involving in MDHO to the MS.
- BSs involved in MDHO are also required to share or transfer MAC context. Such context includes all information the MS and BS normally exchange during Network Entry, particularly authentication state, so that an MS authenticated/registered with one of BSs from diversity set BSs is automatically authenticated/registered with other BSs from the same diversity set. The context also includes a set of Service Flows and corresponding mapping to connections associated with MS, current authentication, and encryption keys associated with the connections.

***Insert new subclause 6.3.22.3.2:***

#### 6.3.22.3.2 FBSS decision and initiation

Support of FBSS is optional for both MS and BS.

For MS and BS that support FBSS, the MS and the BS shall maintain a list of BSs that are involved in FBSS with the MS. The list is called the Diversity Set. Among the BSs in the Diversity Set, an Anchor BS is defined. Regular operation when MS is registered at a single BS is a particular case of FBSS with Diversity Set consisting of single BS, which in this case shall be the Anchor BS. When operating in FBSS, the MS only communicates with the Anchor BS for UL and DL messages including management and traffic connections. Transition from one Anchor BS to another ("switching") is performed without invocation of HO procedure described in 6.3.22.2. Anchor update procedure is defined in 6.3.22.3.4.

The BS supporting FBSS shall broadcast the DCD message that includes the H_Add Threshold and H_Delete Threshold. These thresholds may be used by the FBSS capable MS to determine if MOB_MSHO-REQ should be sent to request switching to another Anchor BS or changing Diversity Set. When mean CINR of a BS is less than H_Delete Threshold, the MS may send MOB_MSHO-REQ to request dropping this BS from the diversity set; when mean CINR of a neighbor BS is higher than H_Add Threshold, the MS may send MOB_MSHO-REQ to request adding this neighbor BS to the diversity set. In each case, Anchor BS responds with MOB_BSHO-RSP with updated Diversity Set.

The process of Anchor BS update may begin with MOB_MSHO-REQ from MS or MOB_BSHOREQ from the Anchor BS. Acknowledgement of MOB_MSHO-REQ with MOB_BSHO-RSP is required. After MS transmits MOB_MSHO-REQ, MS shall not transmit any MOB_MSHO-REQ prior to expiration of timer MS_handover_retransmssion_timer. The MS shall deactivate the timer MS handover retransmission timer upon MS transmit of MOB_HO-IND or upon MS receipt of MOB_BSHO-RSP. The process of Anchor BS update may also begin with Anchor switching indication via fast-feedback channel.

If an MS that transmitted a MOB_MSHO-REQ message detects an incoming MOB_BSHO-REQ message, it shall ignore that MOB_BSHO-REQ message. A BS that transmitted a MOB_BSHO-REQ message and detects an incoming MOB_MSHO-REQ or MOB_HO-IND message from the same MS shall ignore its own previous request.

There are several conditions that are required to enable Fast BS Switching handover between MS and a group of BSs. These conditions are listed below:

- BSs involving in FBSS are synchronized based on a common time source
- The frames sent by the BSs from Diversity Set arrive at the MS within the prefix interval
- BSs involving in FBSS have synchronized frames
- BSs involving in FBSS operate at same frequency channel
- BSs involving in FBSS are also required to share or transfer MAC context. Such context includes all information MS and BS normally exchange during Network Entry, particularly authentication state, so that an MS authenticated/registered with one of BSs from diversity set BSs is automatically authenticated/registered with other BSs from the same diversity set. The context also includes a set of Service Flows and corresponding mapping to connections associated with MS, current authentication, and encryption keys associated with the connections.

***Insert new subclause 6.3.22.3.3:***

### 6.3.22.3.3 Diversity Set update for MDHO/FBSS

When MOB_MSHO-REQ is sent by an MS, the MS may provide a possible list of BSs to be included in the MS' Diversity Set. The MS may evaluate the possible list of BSs through the received MOB_NBR-ADV message, and previously performed signal strength measurement, propagation delay measurement, scanning, ranging, and association activity. When MOB_BSHO-RSP is sent by the Anchor BS or BSs in the MS' current Diversity Set, the BSs may provide a list of BSs recommended for incorporation into the MS' Diversity Set.

When MOB_BSHO-REQ is sent by the Anchor BS or BSs in the MS' current Diversity Set, the BSs may provide a recommended list of BSs to be included in the MS' Diversity Set. The criteria for the recommendation may be based on expected QoS performance to MS requirements and list of BSs that can be involved in MDHO/FBSS as broadcast in MOB_NBR-ADV.

MS actual update of Diversity Set is recommended, but not required. However, the actual Diversity Set chosen by the MS shall be a subset of those listed in MOB_BSHO-RSP or in MOB_BSHO-REQ and shall be indicated in MOB_HO-IND, with MDHOFBSS_IND_type field in MOB_HO-IND set to 0b00 (confirm Diversity Set update). The MS may reject the Diversity Set recommended by the Anchor BS by setting the MDHOFBSS_IND_type field in MOB_HO-IND to 0b10 (Diversity Set update reject). The BS may reconfigure the Diversity Set list and retransmit MOB_BSHO-RSP message to the MS.

After an MS or BS has initiated an Diversity Set update using MOB_MSHO/BSHO-REQ, the MS may cancel the Diversity Set update at any time. The cancellation shall be made through transmission of a MOB_HO-IND with MDHOFBSS_IND_type field set to 0b01.

If the MS is operating in FBSS, when adding a new BS to the MS' Diversity Set, the MS may initiate ranging with newly added BS.

***Insert new subclause 6.3.22.3.4:***

#### 6.3.22.3.4 Anchor BS update for MDHO/FBSS

There are two mechanisms for the MS and BS to perform Anchor BS update. The first mechanism is by using the HO messages. The second mechanism is by using the fast Anchor BS selection feedback. The preferred Anchor BSs shall be within the current Diversity Set of the MS. The MS may select the preferred Anchor BS through the previously performed signal strength measurement. The BS decides the target Anchor BS based on the MS report. MS and BS supporting MDHO or FBSS shall implement one of the two mechanisms to perform Anchor BS update.

***Insert new subclause 6.3.22.3.4.1:***

#### 6.3.22.3.4.1 HO MAC management message method

For the method using MAC management message, the MS reports the preferred Anchor BS by using the MOB_MSHO-REQ message. The BS informs the MS of the Anchor BS update through MOB_BSHO-REQ or MOB_BSHO-RSP message with the estimated switching time. The MS shall update its Anchor BS based on the information received in MOB_BSHO-REQ or MOB_BSHO-RSP. The MS also shall indicate its acceptance of the new anchor BS through MOB_HO-IND, with MDHOFBSS_IND_type field set to 0b00. The MS may reject the Anchor BS update instruction by the BS, by setting the MDHOFBSS_IND_type field in MOB_HO-IND to 0b10 (Anchor BS update reject). The BS may reconfigure the Anchor BS list and retransmit MOB_BSHO-RSP or MOB_BSHO-REQ message to the MS. After an MS or BS has initiated an Anchor BS update using MOB_MSHO/BSHO-REQ, the MS may cancel Anchor BS update at any time. The cancellation shall be made through transmission of a MOB_HO-IND with MDHOFBSS_IND_type field set to 0b01.

When switching to a new Anchor BS within the MS' Diversity Set, the network entry procedures, as depicted in Figure 130b, are not required and shall not be performed by the MS.

***Insert new subclause 6.3.22.3.4.2:***

#### 6.3.22.3.4.2 Fast Anchor BS selection feedback mechanism

For MS and BS using the Fast-feedback method to update Diversity Set, when the MS has more than one BS in its Diversity Set, the MS shall transmit fast Anchor BS selection information to the current Anchor BS using Fast-feedback channel. If the MS needs to transmit Anchor BS selection information, it transmits the codeword corresponding to the selected Anchor BS via its Fast-feedback channel. The codeword is identified by TEMP_BSID assigned to the BSs in an diversity set.

Fast-feedback channel shall be allocated by one of the following three methods:

a) Pre-allocated by MOB_BSHO-RSP or MOB_BSHO-REQ when a BS is added to the diversity set.
b) Allocated through Anchor_Switch_IE during anchor switching operation.
c) Allocated by UL-MAP of the new anchor BS after the switching period.

For FBSS operation, the time axis is slotted by an ASR (Anchor Switch Reporting) slot that is M frame long. If the current frame number is N, then the ASR slot number shall be the integer quotient of N divided by M. The ASR slot shall start at the frame where frame number modulus M equals to zero. M shall be configured by the DCD. A switching period is introduced whose duration is equals to L ASR slots. L shall be configured by the DCD to be long enough such that certain process (e.g., HARQ transmission, backhaul context transfer) can be completed at the current anchor BS before the MS switches to the new anchor BS.

The switching operation for L = 2 is illustrated in Figure 130h. In the first ASR slot, the MS detects the signal strength from a BS in the diversity set (e.g., BS B) is better than that of the current anchor BS (e.g., BS A) such that a switch to the new anchor BS is desired. The MS transmits the anchor BS switch indicator at the beginning of the next ASR slot. At the start of the second ASR slot, the MS shall start a switching timer with value equals to the switching period. Starting from the second ASR slot and for the subsequent ASR slots prior to the expiry of the switching timer, the MS shall transmit the anchor switch indicator through CQICH allocated by the current Anchor BS (e.g., BS A).

The current anchor BS may send the Anchor_Switch_IE prior to the expiry of the switching timer to do one of the following: 1) acknowledge the MS's switch indication and/or assign a CQICH at the new Anchor BS (BS B), and/or specify a new action time when the switch shall occur, and/or specify a new anchor BS to switch to; 2) cancel the MS switching event. If the MS does not receive an Anchor_BS_switch_IE prior to the expiry of the switching timer, the MS shall switch to the new Anchor BS after the expiry of the switching timer. If the MS receives an Anchor_BS_Switch_IE prior to the expiry of the switching timer with no cancellation and no new action time specified, the MS shall switch to the new Anchor BS after the expiry of the switching timer. If the MS receives an Anchor_BS_Switch_IE prior to the expiry of the switching timer with new action time specified, the MS shall switch to the new Anchor BS at the action time specified. If the MS receives an Anchor_BS_Switch_IE with cancellation prior to the expiry of the switching timer, the MS shall cancel the switching operation. If the MS successfully decodes an Anchor_BS_Switch_IE, the MS shall acknowledge the reception of the IE using the allocated codeword over the CQICH.

Prior to the expiry of the switching timer, the MS shall report CQI of the current anchor BS (e.g., BS A) and anchor switch indication on alternate frames. If the MS started the switching operation by indicating a BS within the diversity set (e.g., BS B) as the new anchor BS, the MS shall not indicate another new anchor BS prior to the expiry of the switching timer. Prior to the expiry of the switching timer, if the MS has intention to cancel the switching due to factors such as the signal strength of the new anchor BS (e.g., BS B) is no longer higher than that of the current anchor BS (e.g., BS A) by a certain threshold, the MS shall continue to indicate BS B in the CQICH during the switching period. However, the MS can initiate the cancellation of the anchor BS switch if, and only if, no Anchor_BS Switch_IE with cancellation flag disabled is received prior to the expiry of the switching timer. In such case, after the expiry of the switching timer, the MS shall stay with BS A and shall transmit the CQI on the same CQICH allocated by BS A in the same fashion as prior to the switch operation starts. On the BS side, after the expiry of the switching timer, the BS A shall continue to monitor the same CQICH allocated to the MS for an implementation dependent duration. If CQI transmission is detected, the BS A shall assume that the MS has cancelled the switch. The MS shall not initiate cancellation of the switch if Anchor_BS_Switch_IE with cancellation flag disabled is received prior to the expiry of the switching timer.

If no cancellation occurs, after the expiry of the switching timer, the MS shall switch to the new anchor BS (e.g., BS B) and monitor the downlink of BS B. If the BS B has already pre-allocated a CQICH to the MS (this can be done using MOB-_BSHO-RSP or Anchor_Switch_IE), the MS reports the CQI using the allocated CQICH and may begin the normal communication with the new anchor BS (e.g., BS B) starting from the first frame after the expiry of the switching timer. If CQICH is not pre-allocated to the MS prior to the switch, the MS shall monitor the MAP from the new anchor BS (e.g., BS B) and wait for the CQICH allocation after the switch. If after the switch, the MS does not receive a CQICH allocation within duration equals to the switching period, the MS requests the new anchor BS (e.g., BS B) to allocate CQICH channel by transmitting CQICH allocation request header. If the new anchor BS (e.g., BS B) receives CQICH allocation request header, the BS shall allocate a CQICH for the MS.

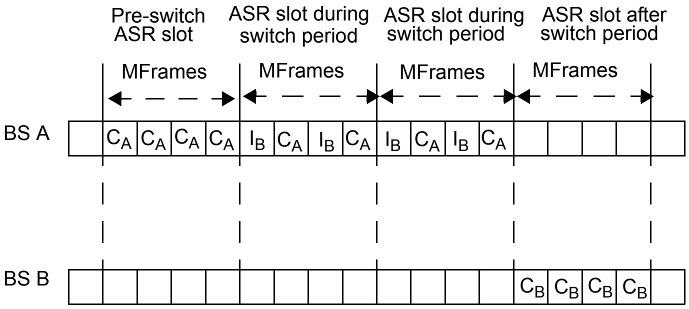

Pre-switch ASR slot
ASR slot during switch period
ASR slot during switch period
ASR slot after switch period
MFrames
MFrames
MFrames
MFrames
BS A
C_A C_A C_A C_A I_B C_A I_B C_A I_B C_A I_B C_A
BS B
C_B C_B C_B C_B

Figure 130h—Fast anchor BS selection mechanism

If MDHO support is negotiated, the BS may assign UL resource to the MS to send combined CQI of active BSs using the Feedback header. The BS may also assign fast-feedback channel or Enhanced fast-feedback channel for CQI feedback. When such a channel is assigned, the MS shall report the CQI of the Anchor BS on the channel.

***Insert new subclause 6.3.22.3.5:***

### 6.3.22.3.5 MS-Assisted coordination of DL transmission at new Anchor BS

The following procedure shall only be supported for FBSS.

Once the MS has successfully switched to the new anchor BS, to maintain continuity of transmission to the MS between the old and new anchor BSs, the last successfully received information unit needs to be identified to the new anchor BS. Depending on whether the connection is ARQ enabled or ARQ disabled, the identity of the next information unit can be given by the ARQ block sequence number or the MAC SDU sequence number respectively.

MS can optionally support the feedback of ARQ block sequence number or the virtual MAC SDU sequence number after the MS has successfully switched to the new anchor BS. The capability and the support for each connection are defined in the REG-REQ/RSP and DSA-REQ/RSP TLVs respectively.

For the connections that have SN Feedback enabled, the following procedures shall be performed by the BS and the MS:

- For ARQ disabled with SN feedback enabled, the BS shall include a SDU SN extended subheader at least once every $2^{\wedge p}$ MAC PDUs, where p is specified in the MAC header and extended subheader support TLV (11.7.25). Upon receiving anchor BS switching request from the MS, the old anchor BS shall include SDU SN extended subheader in MAC PDU at least once before the expiration of the switching timer. The MS shall maintain MAC SDU sequence number based on the information received from the BS. When the MS receives a MAC PDU without SDU SN extended subheader, the MS shall increment the MAC SDU sequence number by one for every SDU received. When the MS receives MAC SDU sequence number from the BS, it shall reset the MAC SDU sequence number based on the value included in SDU SN extended subheader.
- At the expiration of the Anchor switch timer, the new anchor BS should assign UL resource through UL-MAP_IE for the MS to transmit the LSB of the sequence number(s) of ARQ block or virtual MAC SDU on the SN Report MAC header (6.3.2.1.6). At the expiration of the Anchor switch timer,

the MS shall send up to two SN Report MAC headers (with Last = 0 and Last = 1 as described in 6.3.2.1.2.1.7) that include the next ARQ Block (or virtual MAC SDU) sequence number that it is expecting for each of its connections that have SN feedback enabled. The MS shall send the sequence number in numerical ascending order of the values of the SFIDs values. The new anchor BS may send the SN request extended subheader to explicitly request an MS to send additional SN report header. After receiving the SN request extended subheader, the MS shall send the requested SN report header. The new anchor BS may assign UL resource through UL-MAP_IE for the MS to send the additional SN report header.

— Once the handover to the new anchor BS has been completed, acknowledgement and/or retransmission of any outstanding ARQ blocks is handled per the ARQ mechanism defined in 6.3.4.

***Insert new subclause 6.3.23:***

### 6.3.23 Multicast and broadcast services (MBS)

Some globally defined service flows may carry broadcast or multicast information that should be delivered to a plurality of SS or MS. Such service flows have certain QoS parameters and may require encryption performed using a globally defined sequence of TEKs. Since a multicast or broadcast transport connection is associated with a service flow, it is associated with the QoS and traffic parameters for that service flow. Some MS are registered to certain BS while some are in Idle mode and not currently served by any specific BS.

Two types of access to multicast and broadcast services (MBS) may be supported: single-BS access and multi-BS access. Single-BS access is implemented over multicast and broadcast transport connections within one BS, while multi-BS access is implemented by transmitting data from Service Flow(s) over multiple BS. MS may support both Single-BS and Multi-BS access. ARQ is not applicable to either single-BS-MBS or multi-BS-MBS. Initiation of MBS with respect to specific MS is always performed in registered state by creation of multicast connection carrying MBS data. During such initiation the MS learns the Service Flow ID that identifies the service. For multi-BS-MBS, each BS capable of providing MBS belongs to a certain MBS Zone, which is a set of BSs where the same CID and same SA is used for transmitting content of certain Service Flow(s). MBS Zone is identified by a unique MBS_ZONE identifier.

***Insert new subclause 6.3.23.1:***

#### 6.3.23.1 Single-BS Access

The BS may provide the MS with single-BS access by creating a multicast traffic connection with each MS to be associated with the service or a broadcast transport connection. Any available traffic CID value may be used for the single-BS-MBS service. The CID used for the service is the same for all MS on the same channel that participate in the connection. The data transmitted on the connection with the given CID shall be received and processed by the MAC of each involved MS. Thus, each multicast MAC SDU is transmitted only once per BS channel.

If a downlink multicast connection is to be encrypted, each MS participating in the connection shall have an additional security association (SA), allowing that connection to be encrypted using certain keys that are independent of those used for other encrypted transmissions between the MS and BS.

***Insert new subclause 6.3.23.2:***

#### 6.3.23.2 Multi-BS Access

Multi-BS-MBS is defined as a kind of service that all MSs successfully registered to the specific Multi-BS-MBS connection (each MS needs register to MBS service at the network level simultaneously) can receive on the cell the encrypted MAC PDUs of the multicast and broadcast content that multiple BSs transmit anywhere under the given time period. It requires the multiple BS participating in same Multi-BS-MBS service to be synchronized in the transmissions of common multicast/broadcast data. To ensure proper multicast operation on networks of BS employing synchronized transmissions of common multicast data, the CID used for a multi-BS-MBS connection shall be the same for all BS and MSs on the same channel that participate in the connection.

Multicast service synchronized across multiple BS enables an MS to receive the multicast or broadcast transmission from multiple BS, and thereby improve the reliability of reception. In contrast to Single-BS access, Multi-BS access does not require that the MS be registered to the BS from which it receives the transmission, or to any other BS. In this case, transmitted MAC PDUs shall use the same CID, and transport the same data synchronized across the group of BS across the group of BS. A multicast and broadcast zone identifier (MBS_ZONE) is used to indicate the group of BS through which a CID and SA for a broadcast and multicast service flow are valid.

During a Dynamic Service Addition procedure, an MBS connection for multiple MBS contents can be established by using an MBS Contents Identifier TLV encoding in DSA-REQ or DSA-RSP message sent by the BS as described in 11.13.36. In other words, when the MS sends DSA-REQ message with the MBS service request as described in 11.13.23, the BS may respond to it with DSA-RSP message including an MBS Contents Identifier TLV encoding. The BS may also send the MS a DSA-REQ message including an MBS Contents Identifier TLV encoding in order to make an establishment of an MBS connection. Logical Channel ID, which pairs with Multicast CID in MBS_DATA_IE, is allocated to each MBS Contents IDs in the order that it is included in TLV value. As a result, an MS can receive multiple MBS messages for an MBS connection with different MBS contents distinguished by Logical Channel ID belonging to a Multicast CID. BS shall allocate MBS PDUs in the order that the combination of Multicast CID and Logical Channel ID is defined in Extended_MBS_DATA_IE.

***Insert new subclause 6.3.23.2.1:***

#### 6.3.23.2.1 Establishment and maintenance of multicast and broadcast services

Establishment of MBS with respect to certain Service Flow is always performed when MS is registered to certain BS. Such establishment is specified in 6.3.23.1.

Multicast and broadcast services are associated with multicast and broadcast service flows. Multicast and broadcast service flows are not dedicated to the specific MS and are maintained even though the MS is either in awake/sleep mode or in the idle mode. When an MS is registered at a BS for receiving multicast and broadcast service, multicast and broadcast service flows shall be instantiated as multicast connections. Data of multicast and broadcast service flows may be transmitted from BS and received at MS also regardless of what mode the MS is currently in. The BS may establish a downlink multicast and broadcast service by creating a multicast and broadcast service flows when the service commences.

Mapping of multicast and broadcast service flow IDs to CIDs shall be known to all BSs belong to the same multicast and broadcast service zone.

When the MS is being registered at BS for receiving multicast and broadcast services, it shall initiate DSA procedure with respect to multicast and broadcast connections to inform the BS that the MS is a consumer of certain multicast/broadcast services. Such knowledge may be used to initiate bi-directional upper layers communication between the MS and the network for the purpose of configuration of multicast/broadcast service. After the successful configuration, the MS may reuse the same configuration when it moves to another BS without re-configuration.

During communication to the BS the MS may learn MBS_ZONE identifier. If MS acquired MBS_ZONE and goes to Idle Mode, then the MS may continue receiving MBS content from any BS that advertises the same MBS_ZONE. By doing this, the MS uses the same CID and SA that were used in registered state. In case MS, still in Idle state, migrates to BS advertising another MBS_ZONE, it is expected to register at that BS and to acquire a new CID and SA for further reception of MBS content.

Multicast and broadcast service flows are encrypted at the application layer or MAC layer or both. Upper layer encryption may be employed to prevent non-authorized access to multicast and broadcast content. Multicast and broadcast service may provide access control against theft of service by enforcing data encryption based on AES-CTR defined in NIST Special Publication 800-38A, FIPS 197. Details of MBS Security is defined in 7.8.3.

***Insert new subclause 6.3.23.2.2:***

#### 6.3.23.2.2 Performance enhancement with macro diversity

To increase the receiving performance, MBS transmission in a group of BS should be synchronized. In such case, each BS shall transmit the same PDUs, using the same transmission mechanism (symbol, subchannel, modulation, and etc.) at the same time. The way that multiple BSs accomplish the synchronized transmission (which implies performing functions like classification, fragmentation, scheduling at a centralized point called the MBS Server) is outside the scope of the standard. In order to indicate the allocation of MBS data, MBS MAP shall denote corresponding bursts with multicast CIDs associated with certain Service Flows within given MBS Zone.

***Insert new subclause 6.3.23.2.3:***

#### 6.3.23.2.3 Power saving operation

To facilitate power efficient reception of MBS data, an MBS_MAP_IE may be placed in the DL-MAP to points to the location of a dedicated MBS allocation in the DL subframe. The purpose of this IE is to do the initial direction of the MS to the MBS allocation, and to redirect MS that lost synchronization with MBS allocations back to the next MBS allocation.

***Insert new subclause 6.3.23.2.4:***

#### 6.3.23.2.4 Multicast and broadcast zone (MBS_Zone)

Different CIDs or different SAs may be used in different regions for the same multicast and broadcast service flow. A multicast and broadcast zone identifier (MBS_ZONE) is used to indicate a region through which a CID and SA for a broadcast and multicast service flow are valid. BS may advertise MBS_ZONE in DCD message. In case BS sends DSA for establishment of connection for MBS, MBS_ZONE shall be encoded in the DSA message. If an MS in Idle mode moves into BSs in the same MBS zone, the MS does not have to re-enter the network and to re-establish a connection or a connection defined by MBS Contents Identifier to monitor the multicast and broadcast service flow. However, if an MS moves into a different MBS zone, the MS may need to re-establish a connection or a virtual connection for the multicast and broadcast service flow.

One BS may have multiple MBS zone identifiers.

***Insert new subclause 6.3.24:***

### 6.3.24 MS Idle Mode (optional)

Idle Mode is intended as a mechanism to allow the MS to become periodically available for DL broadcast traffic messaging without registration at a specific BS as the MS traverses an air link environment populated by multiple BSs, typically over a large geographic area. Idle Mode benefits MS by removing the active requirement for HO, and all Normal Operation requirements. By restricting MS activity to scanning at discrete intervals, Idle Mode allows the MS to conserve power and operational resources.

Idle Mode benefits the network and BS by providing a simple and timely method for alerting the MS to pending DL traffic directed toward the MS, and by eliminating air interface and network HO traffic from essentially inactive MS.

The BSs are divided into logical groups called paging groups. The purpose of these groups is to offer a contiguous coverage region in which the MS does not need to transmit in the UL, yet can be paged in the DL if there is traffic targeted at it. The paging groups should be large enough so that most MSs will remain within the same paging group most of the time, and small enough such that the paging overhead is reasonable. Figure 130i shows an example of four paging groups defined over multiple BS arranged in a hexagonal grid. A BS may be a member of one or more Paging Groups.

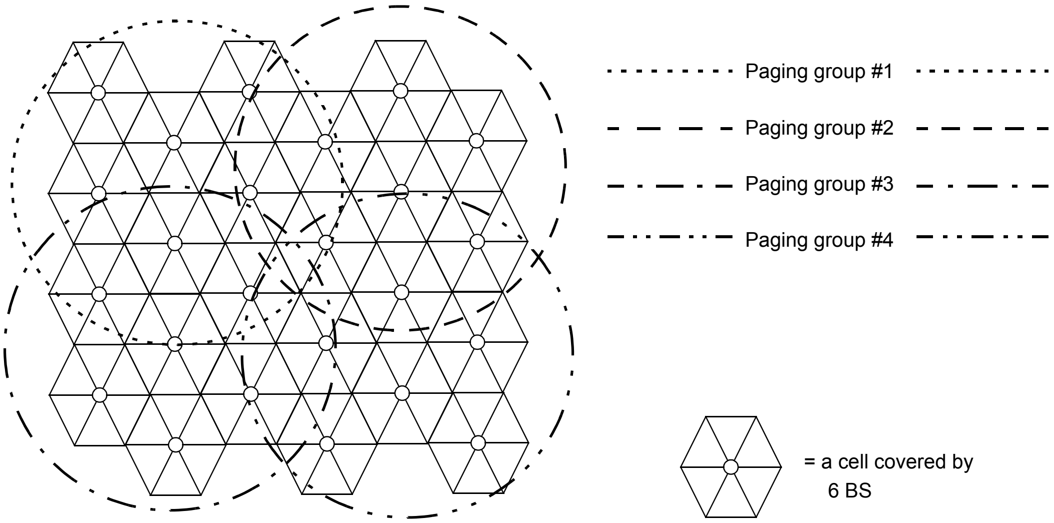


Figure 130i—Paging-groups example

The paging-groups are defined in the management system. One possible method of definition is by using the paging-group-action backbone message. Another backbone message, paging-announce, is used to manage the list of MS in idle mode and initiate paging of the MS on all BS belonging to the paging group.

Idle is comprised of the following activities/stages:

- MS Idle Mode Initiation
- Cell Selection
- MS Broadcast Paging Message time synchronization
- MS Paging Unavailable Interval
- MS Paging Listening Interval
- BS Paging Interval
- BS Broadcast Paging message
- Paging Availability Mode Termination

***Insert new subclause 6.3.24.1:***

### 6.3.24.1 MS Idle Mode Initiation

Idle Mode Initiation may begin after MS De-Registration. During Normal Operation with its serving BS, an MS may signal intent to begin Idle Mode by sending a DREG-REQ with a De-Registration_Request_Code = 0x01; request for MS De-Registration from serving BS and initiation of MS Idle Mode. If the MS does not receive the DREG-CMD message within T45 timer expiry after it sends the DREG-REQ message to the BS, the MS shall retransmit the DREG-REQ message as long as DREG Request Retry Count has not been exhausted. Otherwise, the MS shall re-initialize MAC. Also, the BS shall start Management_Resource_Holding_Timer to maintain connection information with the MS as soon as it sends the DREG-CMD message to the MS. If Management_Resource_Holding_Timer has been expired, the BS shall release connection information with the MS. Similarly, a serving BS may signal for an MS to begin Idle Mode by sending a DREG-CMD with an Action Code = 0x05 in unsolicited manner. In this case of BS initiated Idle Mode, the serving BS shall start T46 timer as well as Management_Resource_Holding_Timer at the same time. If the BS does not receive the DREG-REQ message with De-Registration_Request_Code = 0x02 from the MS in response to the unsolicited DREG-CMD with Action Code = 0x05 within T46 timer expiry, the BS shall retransmit the DREG-CMD message with Action Code = 0x05 in unsolicited manner as long as DREG Command Retry Count has not been exhausted. MS shall enter Idle Mode after it sends DREG-REQ message with De-Registration_Request Code = 0x02 in response to the unsolicited DREG-CMD with Action Code = 0x05.

As another case of BS initiated Idle Mode, the serving BS may also include a REQ-duration TLV with an Action Code = 0x05 in the DREG-CMD, signaling for an MS to initiate an Idle Mode request through a DREG-REQ with Action Code = 0x01, request for MS De-Registration from serving BS and initiation of MS Idle Mode, at REQ-duration expiration. In this case, BS shall not start T46 timer. MS may include Idle Mode Retain Information TLV with in DREG-REQ message with Action Code=0x01 transmitted at the REQ-duration expiration. In this case, BS shall transmit another DREG-CMD message with Action Code=0x05 including Idle Mode Retain Information TLV.

At the expiration of T46 timer due to no reception of DREG-REQ. BS shall retransmit the unsolicited DREG-CMD message, reset Management Resource Holding Timer, and increment DREG Command Retry Count. These operations may go on until BS receives the DREG-REQ message from MS. If DREG Command Retry Count is exhausted, BS shall does not retransmit DREG-CMD message any more. On the contrary, if BS receives DREG-REQ message De-Registation_Request_Code = 0x02 as long as DREG Command Retry Count is not exhausted, BS regards MS as entering Idle Mode normally and deletes the MS's connection information at expiration of Management Resource Holding Timer.

For MS terminating Normal Operation with the serving BS and entering Idle Mode, the Paging Controller—the serving BS or other network entity administering Idle Mode activity for the MS—may retain certain MS service and operational information useful for expediting a future MS network re-entry from Idle Mode. The MS may request Paging Controller retention of specific MS service and operational information for Idle Mode management purposes through inclusion of the Idle Mode Retain Information element in the DREG-REQ management message. The serving BS shall report the likely effect on expedited future MS network re-entry due to Paging Controller retention of MS service and operational context by reporting the indicative Idle Mode Retain Information in DREG-CMD. Similarly, the BS may also include Idle Mode Retain Information element in the unsolicited DREG-CMD message.

The MS shall maintain an Idle Mode Timer and Paging Controller shall maintain an Idle Mode System Timer to provide an interval timer to prompt MS Idle Mode Location Update activity and demonstrate MS continued network presence to re-validate Paging Controller retention of MS service and operational information. Idle Mode Timer and Idle Mode System Timer shall start on serving BS transmission of DREG-CMD directing MS transition to Idle Mode. Idle Mode Timer and Idle Mode System Timer shall recycle on any successful MS network Idle Mode Location Update. On expiration of Idle Mode System Timer or on

MS network entry/reentry and resumption of Normal Operation, the Paging Controller shall discard all MS service and operational information retained for Idle Mode management purposes. On expiration of Idle Mode Timer, the MS shall consider that Paging Controller has discarded all MS service and operational information retained for Idle Mode management purposes. If the MS intends to retain the MS service and operational information, the MS should avoid Idle Mode Timer and Idle Mode System Timer expiration, by performing location update operation sufficiently ahead of the time expiration of the Idle Mode Timer and Idle Mode System Timer.

When MS enters idle mode, ARQ state information and parameters between MS and BS are removed and ARQ is reset when connection is setup during network re-entry after idle mode.

The MS may request BS inclusion of MS MAC Address Hash in MOB_PAG-ADV message at regular intervals, regardless of need for notification, by including 'MAC Hash Skip Threshold' in DREG-REQ with Action Code=0x01. The value of MAC Hash Skip Threshold specifies the maximum number of successive MOB_PAG-ADV messages that may be sent from a BS without individual notification for an MS, including MAC Address Hash of an MS for which Action Code is 00, 'No Action Required'. Provided the BS approves the MS deregistration with initiation of Idle Mode and elects MAC Hash Skip Threshold function, the BS shall respond by sending DREG-CMD message with Action Code=0x05 and including the MAC Hash Skip Threshold TLV.

***Insert new subclause 6.3.24.2:***

#### 6.3.24.2 Cell selection

At MS Idle Mode Initiation, an MS may engage in cell selection to obtain a new Preferred BS. A Preferred BS is a Neighbor BS that the MS evaluates and selects as the BS with the best air interface DL properties. The Preferred BS may be the MS's previous Serving BS. In all other respects, cell selection is similar to 6.3.22.2.1.

***Insert new subclause 6.3.24.3:***

#### 6.3.24.3 MS Broadcast Paging Message time synchronization

At evaluation and selection of the Preferred BS, the MS shall synchronize and decode the DCD and DL-MAP for the Preferred BS, extracting the frame size and frame number. The MS shall evaluate the frame size and frame number and use them to determine time until next regular BS Paging Interval for the Preferred BS. The calculated time until the next regular BS Paging Interval, less any MS DL scanning, decoding, and synchronization time requirements, shall be the MS Paging Unavailable Interval.

***Insert new subclause 6.3.24.4:***

#### 6.3.24.4 MS Paging Unavailable Interval

During MS Paging Unavailable Interval, the MS may power down, scan Neighbor BSs, re-select a Preferred BS, conduct ranging, or perform other activities for which the MS will not guarantee availability to any BS for DL traffic. Should the MS re-select a Preferred BS during the MS Paging Unavailable Interval, then the MS shall return to the MS Broadcast Paging Message time synchronization stage.

***Insert new subclause 6.3.24.5:***

#### 6.3.24.5 MS Paging Listening Interval

The MS shall scan, decode the DCD and DL-MAP, and synchronize on the DL for the Preferred BS in time for the MS to begin decoding any BS Broadcast Paging message during the entire BS Paging Interval. At the end of MS Paging Listening Interval, providing that the MS does not elect to terminate the MS Idle Mode, the MS may return to MS Paging Unavailable Interval.

If the BS transmits the Broadcast Control Pointer IE, the MS shall read and react to this message as follows:

a) If the DCD_UCD Configuration Change Counter has changed since MS last decoding of this IE, even if scheduled to be in a paging unavailable interval the MS shall awaken at DCD_UCD Transmission Frame in time to synchronize to the DL and decode the DCD and UCD message in the frame, if present. If the MS fails to decode one or both of DCD and UCD, or no DCD or UCD was transmitted by the BS, the MS shall continue decoding all subsequent frames until it has acquired both updated DCD and UCD. Upon successful completion of DCD and UCD decoding, the MS shall immediately return to regular Idle Mode operation.
b) If Skip Broadcast_System_Update is set to ‘0’, even if scheduled to be in a paging unavailable interval, the MS shall awaken at Broadcast_System_Update_Transmission_Frame in time to synchronize to the DL and decode the DL-MAP and any message, if present. Upon completion, the MS shall immediately return to regular Idle Mode operation.

A BS Paging Interval shall occur during the N frames beginning with the frame whose frame number, $N_{frame}$, meets the condition

$$N_{frame} \text{ modulo PAGING\_CYCLE} == \text{PAGING\_OFFSET}$$

on each BS, where N is Paging Interval Length. The BS receives notification of active PAGING_CYCLEs through backbone messages. A BS may broadcast one or more BS Broadcast Paging messages during the MS Paging Listening Interval. Different BSs may synchronize their MS Paging Listening Intervals.

***Insert new subclause 6.3.24.6:***

### 6.3.24.6 BS Broadcast Paging message

A BS Broadcast Paging message is an MS notification message indicating either the presence of DL traffic pending, through the BS or some network entity, for the specified MS or to poll the MS and request a location update without requiring a full network entry. The BS Broadcast Paging message shall be sent on the Broadcast CID or Idle Mode Multicast CID (defined in Table 345 of 10.4) during the BS Paging Interval if there is some MSs that need paging. If there is no MS that needs paging to corresponding frame, the BS may not broadcast BS Broadcast Paging message. A paging message shall be transmitted during the MS Paging Listening Interval if there is any MS that need paging.

The BS Broadcast Paging message shall include one or more Paging Group IDs identifying the logical affiliations of the transmitting BS.

MSs are identified in the BS Broadcast Paging message by their MS MAC Address hash. A single BS Broadcast Paging message may include multiple MAC Addresses. For a given BS Broadcast Paging message in a specific BS Paging Interval, the BS shall include only those MS MAC Address hash particular to the PAGING_CYCLE.

The BS Broadcast Paging message shall also include an Action Code directing each MS notified via the inclusion of its MS MAC Address hash to either:

0b00: no action required
0b01: perform Ranging to establish location and acknowledge message
0b10: perform initial network entry
0b11: Reserved

When MAC Hash Skip Threshold set to 0xFF is included in DREG-CMD message at MS Idle Mode Initiation, MAC Address Hash of an MS shall be omitted in every MOB_PAG-ADV message for which the MS need not be paged, and as would result in MOB_PAG-ADV notification of the MS with Action Code=0b00, No Action Required. MS shall maintain an MS MAC Hash Skip Counter and BS shall independently maintain a BS MAC Hash Skip Counter for count of successive MOB_PAG-ADV messages that omit individual MS MAC Address Hash and any Action Code. BS shall maintain one such respective BS MAC Hash Skip Counter for each MS Idle Mode Initiation and for which BS is currently serving as Preferred BS. MS and BS shall reset their respective MAC Hash Skip Counter when BS transmits MOB_PAG-ADV including MS MAC Address Hash and Action Code.

After transmitting the Broadcast Paging message with Action Code ‘Perform Ranging’ or ‘Enter Network’, if the BS does not receive RNG-REQ from the MS paged until the next MS Paging Listening Interval, the BS shall retransmit the Broadcast Paging message. Every time the BS retransmits the Broadcast Paging message, it decreases the predefined ‘’Paging Retry Count’ by one. If the BS does not receive RNG-REQ from the MS until the ‘Paging Retry Count’ decreases to zero, the BS determines that the MS is unavailable, and shall send a backbone message to indicate that the list of MSs in Idle Mode shall be updated in all BSs that belong to the same paging group.

For a BS Broadcast Paging message to be transmitted to indicate the presence of DL traffic pending, there shall be at least a packet in the DL traffic whose Paging Preference indicates paging generation.

***Insert new subclause 6.3.24.7:***

### 6.3.24.7 Paging Availability Mode termination

Idle Mode may only be terminated through:

- MS re-entry to the network
- Paging Controller detection of MS unavailability through repeated, unanswered paging messages
- Expiration of the Idle Mode System Timer

***Insert new subclause 6.3.24.7.1:***

#### 6.3.24.7.1 MS side

An MS may terminate MS Idle Mode at any time.

An MS shall terminate Idle Mode and re-enter the network if it decodes a BS Broadcast Paging message that contains the MS own MS MAC Address hash and an Action Code of 0b10, enter network. In the event that an MS decodes a BS Broadcast Paging message that contains the MS own MS MAC Address hash and an Action Code of 0b01, Perform Ranging, the MS shall conduct and complete Idle Mode Location Update to establish location to the network and acknowledge message decoding. In both cases for the OFDMA PHY, if a PHY specific ranging code and transmission opportunity is assigned to the MS in the MOB_PAG-ADV message, the MS shall perform network re-entry or Idle Mode Location Update by transmitting the code at the transmission opportunity assigned in the MOB_PAG-ADV message on the dedicated ranging region assigned in the UL-MAP-IE (UIUC = 12 and dedicated ranging indicator bit set to 1).

The procedure for PHY specific ranging code operation is described as follows:

- After receiving the MOB_PAG-ADV and within the Page-Response window, the MS shall transmit the assigned ranging code at the transmission opportunity in the frames where dedicated ranging regions are assigned in the UL-MAP_IE (UIUC = 12 and dedicated ranging indicator bit set to 1). The assigned ranging code transmission can be terminated early if the MS receives a RNG-RSP message with ‘success’ status before the end of the Page-Response window.

- In the case where RNG-RSP message with 'continue' status is received and within the Page-Response window, the MS shall transmit the assigned ranging code at the transmission opportunity in the next frame where the dedicated ranging region is assigned.
- In the case where RNG-RSP message with 'success' status is not received within the Page-Response window, the MS shall continue with the normal initial ranging procedure for Network Re-entry from Idle (6.3.22.10) or Idle Mode Location Update (6.3.24.8.2).
- In the case where no RNG-RSP message is received or no dedicated ranging region is assigned within the Page-Response window to the MS, the MS shall continue with the normal initial ranging procedure for Network Re-entry from Idle (6.3.24.9) or Idle Mode Location Update (6.3.24.8.2).
- In all other cases, the MS shall use normal network re-entry or Idle Mode Location Update procedure, as described in 6.3.24.8.2

To prevent collisions from multiple MSs trying to wake from Idle mode at the same time, the MS shall use the Initial_ranging_backoff_start and Initial_ranging_backoff_end described in Table 349.

***Insert new subclause 6.3.24.7.2:***

### 6.3.24.7.2 BS side

The BS at which the MS re-entered the network shall inform the appropriate element in the network of the re-entry of the MS. The means by which the BS accomplishes this is outside the scope of this standard.

***Insert new subclause 6.3.24.8:***

### 6.3.24.8 Location Update

Location Update is comprised of condition evaluation and update processing.

***Insert new subclause 6.3.24.8.1:***

### 6.3.24.8.1 Location Update conditions

An MS in Idle mode shall perform a Location Update process operation if any Location Update condition is met. There are four location update evaluation conditions: Paging Group Update, Timer Update, Power Down Update, and MAC Hash Skip Threshold Update. MS may also perform Location Update process at will.

***Insert new subclause 6.3.24.8.1.1:***

### 6.3.24.8.1.1 Paging Group update

The MS shall perform Location Update process when the MS detects a change in paging group. The MS shall detect the change of paging group by monitoring the paging group identifier, PG_ID, which is transmitted by the Preferred BS in the DCD message or MOB_PAG-ADV broadcast message during the MS Paging Listening Interval. If the PG_ID detected does not match the Paging Group to which the MS belongs, the MS shall determine that paging group has changed.

***Insert new subclause 6.3.24.8.1.2:***

### 6.3.24.8.1.2 Timer update

The MS shall periodically perform Location Update process prior to the expiration of the Idle Mode Timer.

***Insert new subclause 6.3.24.8.1.3:***

### 6.3.24.8.1.3 Power Down update

The MS shall attempt to complete a Location Update once as part of its orderly power-down procedure. This mechanism enables the Paging Controller to update the MS's exact status and to delete all information for the MS and discontinue Idle Mode Paging Control for the MS at the time of power down. At the time of successful Power Down Location Update, the Paging Controller shall release all Idle Mode retaining information related to the MS. In case of 'Failure of Power Down Information Update', the Paging Controller shall perform availability check using Location Update polling. Unavailability of MS shall be determined and the Paging Controller shall delete all Idle Mode retaining information if the MS does not answer for the BS's Location Update polling up to 'Paging Retry Count'.

***Insert new subclause 6.3.24.8.1.4:***

### 6.3.24.8.1.4 MAC Hash Skip Threshold update

The MS shall perform Location Update process when the MS MAC Hash Skip Counter exceeds MAC Hash Skip Threshold successively. After successful Location Update, the BS and MS shall re-initialize their respective MAC Hash Skip Counters.

***Insert new subclause 6.3.24.8.2:***

### 6.3.24.8.2 Location Update Process

If an MS in Idle Mode determines or elects to update its location, depending on the security association the MS shares with the target BS, the MS shall use one of two processes: Secure Location Update Process or Unsecure Location Update Process. For purposes of Location Update Process, the target BS shall be the Preferred BS.

***Insert new subclause 6.3.24.8.2.1:***

### 6.3.24.8.2.1 Secure Location Update process

If the MS shares a valid security context with the target BS such that the MS may include a valid HMAC/CMAC Tuple in the RNG-REQ, then the MS shall conduct initial ranging with the target BS by sending a RNG-REQ including Ranging Purpose Indication TLV with Bit #1 set to 1, Location Update Request and Paging Controller ID TLVs and HMAC/CMAC Tuple. If the target BS evaluates the HMAC/CMAC Tuple as valid and can supply a corresponding authenticating HMAC/CMAC Tuple, then the target BS shall reply with a RNG-RSP including the Location Update Response TLV and HMAC/CMAC Tuple completing the Location Update process. If Paging Group ID has changed, then target BS shall include Paging Group ID TLV in the RNG-RSP. If the target BS responds with a successful Location Update Response=0x01, Success of Location Update, the target BS shall notify the Paging Controller via the backbone of the MS new location information, the MS shall assume the Paging Group ID of the target BS, and the Paging Controller may send a backbone message to inform the BS at which the MS entered Idle Mode that the MS has transitioned to a different Paging Group. If the target BS evaluates the HMAC/CMAC Tuple as invalid, cannot supply a corresponding authenticating HMAC/CMAC Tuple, or otherwise elects to direct the MS to use Unsecure Location Update, then the target BS shall instruct the MS to continue network re-entry using the Unsecure Location Update process by inclusion of Location Update Response TLV in RNG-RSP with a value of 0x00= Failure of Location Update.

***Insert new subclause 6.3.24.8.2.2:***

#### 6.3.24.8.2.2 Unsecure Location Update process

For an MS and target BS that do not share current, valid security context, they shall process Location Update using the Network Re-Entry from Idle Mode method.

***Insert new subclause 6.3.24.9:***

### 6.3.24.9 Network Re-Entry from Idle Mode

For the Network Re-Entry from Idle Mode method, the MS shall initiate network re-entry with the target BS by sending a RNG-REQ including Ranging Purpose Indication TLV with Bit #0 set to 1 and Paging Controller ID TLVs.

If the MS shares a valid security context with the target BS such that the MS may include a valid HMAC/CMAC Tuple in the RNG-REQ, then the MS shall conduct initial ranging with the target BS by sending a RNG-REQ including HMAC/CMAC Tuple.

If MS RNG-REQ includes an Ranging Purpose Indication TLV with Bit #0 set to 1 and Paging Controller ID TLVs, and target BS had not previously received MS information over the backbone, then target BS may make an MS information request of Paging Controller over the backbone network and Paging Controller may respond. Regardless of having received MS information from Paging Controller, target BS may request MS information from another network management entity via the backbone network.

Network re-entry proceeds per 6.3.9.5 except as may be shortened by target BS possession of MS information obtained from Paging Controller or other network entity over the backbone network.

For the target BS to notify an MS seeking Network Re-entry from Idle Mode of re-entry process management messages that may be omitted during the current re-entry attempt due to the availability of MS service and operational context information obtained over the backbone network, the target BS shall place an HO Process Optimization TLV in the RNG-RSP indicating which re-entry management messages may be omitted. The target BS shall not direct the omission of any re-entry process management messages that would compromise the security or integrity of Normal Operation of the communications as established through an unabridged Initial Entry.

If the target BS evaluates a HMAC/CMAC Tuple included in the RNG-REQ as valid and can supply a corresponding authenticating HMAC/CMAC Tuple, then the target BS may reply with a RNG-RSP including the valid HMAC/CMAC Tuple. The target BS shall not indicate through the HO Process Optimization TLV that the PKM-REQ/RSP management messages may be omitted in the current re-entry attempt without inclusion of a valid HMAC/CMAC Tuple. If an MS detects an invalid HMAC/CMAC Tuple included as part of a RNG-RSP during Network Re-entry from Idle Mode, the MS shall continue with network re-entry but shall process full PKM security re-keying regardless of HO Process Optimization TLV settings.

Regardless of the HO Process Optimization TLV settings, the target BS may elect to use MS service and operational information obtained over the backbone network to build and send unsolicited SBC-RSP and/or REG-RSP management messages to update MS operational information, or to include 11.7 REG-RSP specific or 11.8 SBC-RSP specific message items as TLV items in the RNG-RSP. Target BS may ignore only the first corresponding REQ management message received if it sends an unsolicited SBC-RSP or unsolicited REG-RSP message. MS is not required to send the complimentary REQ management message if it receives an unsolicited SBC-RSP or unsolicited REG-RSP management message prior to MS attempt to send the corresponding REQ management message. Target BS re-entry unsolicited response management messages may be grouped into the same DL frame transmission and may be grouped into the same DL frame transmission with the RNG-RSP. However, unsolicited SBC-RSP and unsolicited REG-RSP may not be grouped together into the same DL frame transmission when the PKM-REQ/RSP management message process is required.

For a security keying process that has not been determined to be omitted in the HO Process Optimization TLV settings, if MS RNG-REQ includes Ranging Purpose Indication TLV with Bit #0 set to 1 and Paging Controller ID TLVs, and target BS has keying material for the MS, the MS and target BS shall use the RNG-RSP SA Challenge Tuple information to initiate the 3-way handshake reauthorization process as defined in 7.8.1.

If MS RNG-REQ includes Ranging Purpose Indication TLV with Bit #0 set to 1 and Paging Controller ID TLVs, and target BS has received a backbone message containing MS information, the target BS may use MS service and operational information obtained over the backbone network to build and send a REG-RSP management message that includes service flow remapping information in SFID, New_CID, and Connection_Info TLVs.

During network re-entry, the target BS may notify the MS, through the Bit #7 MS DL data pending element of the HO Process Optimization TLV item in RNG-RSP, of post- network reentry MS DL data pending. Upon MS successful re-entry at target BS, now new serving BS, and new serving BS completing reception of any network re-entry pending MS DL data retained and forwarded, MS may re-establish IP connectivity and the new serving BS may send a backbone message to request the old serving BS or other network entity to stop forwarding pre-HO pending MS DL data.

Network entry/re-entry process completes with establishment of Normal Operations.

The target BS shall notify the Paging Controller via the backbone of MS successful network re-entry and the Paging Controller may send a backbone message to inform the BS at which the MS entered Idle Mode that the MS has resumed Normal Operations at the new serving BS.

# 7. Security sublayer

***Change Clause 7 as indicated:***

The ~~S~~security sublayer provides subscribers with privacy, authentication, or confidentiality[6] across the ~~fixed~~ broadband wireless network. It does this by applying cryptographic transforms to MPDUs carried across ~~between~~ connections between SS and BS.

In addition, the security sublayer provides operators with strong protection from theft of service. The BS protects against unauthorized access to these data transport services by securing ~~enforcing encryption of~~ the associated service flows across the network. The s~~S~~ecurity sublayer employs an authenticated client/server key management protocol in which the BS, the server, controls distribution of keying material to client SS. Additionally, the basic security ~~transport connection security~~ mechanisms are strengthened by adding digital-certificate-based SS device-authentication to ~~its~~the key management protocol.

***Change 7.1 as indicated:***

## 7.1 Architecture

Security has two component protocols as follows:

a) An encapsulation protocol for securing~~encrypting~~ packet data across the ~~fixed~~ BWA network. This protocol defines (1) a set of supported *cryptographic suites*, i.e., pairings of data encryption and authentication algorithms, and (2) the rules for applying those algorithms to a MAC PDU payload.
b) A key management protocol (PKM) providing the secure distribution of keying data from the BS to the SS. Through this key management protocol, SS and BS synchronize keying data; in addition, the BS uses the protocol to enforce conditional access to network services.

The protocol stack for the security components of the system are shown in Figure 130j.

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[6] In security parlance, confidentiality = privacy + authenticity.

***Insert new figure:***

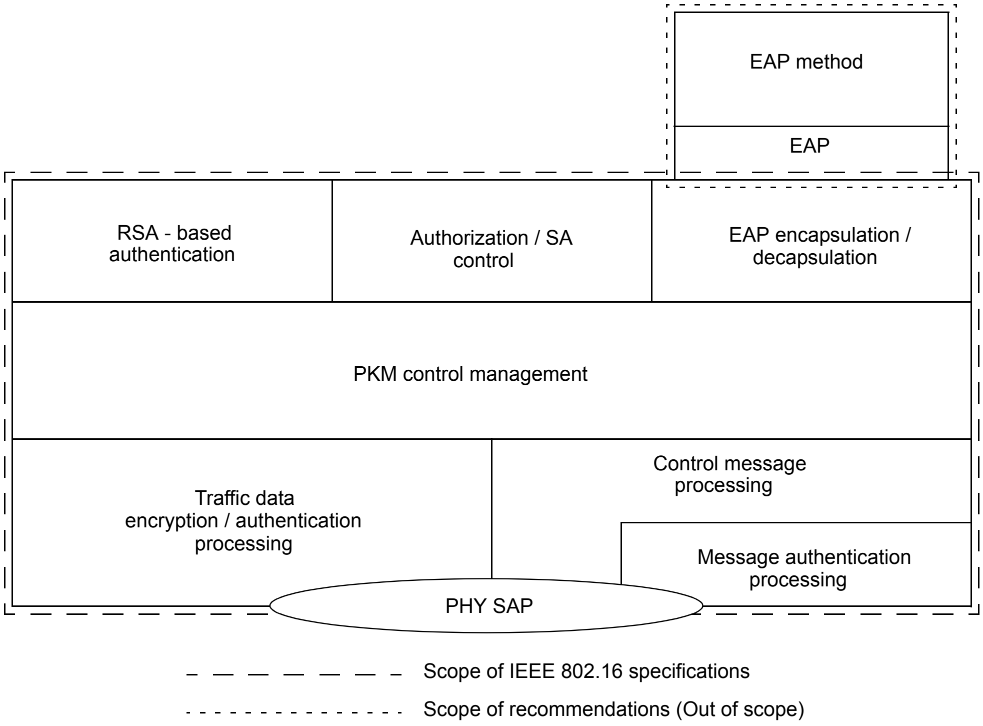
EAP method
EAP
RSA - based authentication
Authorization / SA control
EAP encapsulation / decapsulation
PKM control management
Traffic data encryption / authentication processing
Control message processing
Message authentication processing
PHY SAP
Scope of IEEE 802.16 specifications
Scope of recommendations (Out of scope)

**Figure 130j—Security sublayer**

***Change 7.1.1 as indicated:***

### 7.1.1 ~~Packet~~ ~~data encryption~~ Secure encapsulation of MPDUs

Encryption services are defined as a set of capabilities within the MAC Security Sublayer. MAC Header information specific to encryption is allocated in the generic MAC header format.

Encryption is applied to the MAC PDU payload when required by the selected ciphersuite; the generic MAC header is not encrypted. All MAC management messages ~~described n subclause 6.4.2.3~~ shall be sent in the clear to facilitate registration, ranging, and normal operation of the MAC.

***Replace 7.1.2 with the following:***

### 7.1.2 Key management protocol

The PKM protocol allows for both mutual authentication and unilateral authentication (e.g., where the BS authenticates SS, but not vice versa). It also supports periodic reauthentication/reauthorization and key refresh. The key management protocol uses either EAP [IETF RFC 3748], or X.509 digital certificates [IETF RFC 3280] together with RSA public-key encryption algorithm [PKCS #1] or a sequence starting with RSA authentication and followed by EAP authentication. It uses strong encryption algorithms to perform key exchanges between an SS and BS.

The PKM's authentication protocol establishes a shared secret (called an Authorization Key (AK)) between the SS and the BS. The shared secret is then used to secure subsequent PKM exchanges of TEKs. This two-tiered mechanism for key distribution permits refreshing of TEKs without incurring the overhead of computation-intensive operations.

A BS authenticates a client SS during the initial authorization exchange. Each SS presents its credentials, which will be a unique X.509 digital certificate issued by the SS's manufacturer (in the case of RSA authentication) or a operator-specified credential (in the case of EAP-based authentication).

The BS associates an SS's authenticated identity to a paying subscriber, and hence to the data services that subscriber is authorized to access. Thus, with the AK exchange, the BS determines the authenticated identity of a client SS and the services (i.e., specific TEKs) the SS is authorized to access.

Since the BS authenticates the SS, it may protect against an attacker employing a cloned SS, masquerading as a legitimate subscriber's SS.

The traffic-key management portion of the PKM protocol adheres to a client/server model, where the SS (a PKM "client") requests keying material, and the BS (a PKM "server") responds to those requests, ensuring that individual SS clients receive only keying material for which they are authorized.

The PKM protocol uses MAC management messaging, i.e., PKM-REQ and PKM-RSP messages defined in 6.3.2.3. The PKM protocol is defined in detail in 7.2.

***Replace 7.1.3 with the following:***

### 7.1.3 Authentication protocol

An SS uses the PKM protocol to obtain authorization and traffic keying material from the BS, and to support periodic reauthorization and key refresh.

PKM supports two distinct authentication protocol mechanisms:

- RSA protocol [PKCS #1 v2.1 with SHA-1(FIPS 186-2)] (support is mandatory in PKMv1, support is optional in PKMv2)
- Extensible Authentication Protocol (optional unless specifically required)

***Insert new subclause 7.1.3.1:***

#### 7.1.3.1 PKM RSA authentication

The PKM RSA authentication protocol uses X.509 digital certificates [IETF RFC 3280], the RSA public-key encryption algorithm [PKCS #1] that binds public RSA encryption keys to MAC addresses of SSs.

A BS authenticates a client SS during the initial authorization exchange. Each SS carries a unique X.509 digital certificate issued by the SS's manufacturer. The digital certificate contains the SS's Public Key and SS MAC address. When requesting an AK, an SS presents its digital certificate to the BS. The BS verifies the digital certificate, and then uses the verified Public Key to encrypt an AK, which the BS then sends back to the requesting SS.

All SSs using RSA authentication shall have factory-installed RSA private/public key pairs or provide an internal algorithm to generate such key pairs dynamically. If an SS relies on an internal algorithm to generate its RSA key pair, the SS shall generate the key pair prior to its first AK exchange, described in 7.2.1. All SSs with factory-installed RSA key pairs shall also have factory-installed X.509 certificates. All SSs that rely on internal algorithms to generate an RSA key pair shall support a mechanism for installing a manufacturer-issued X.509 certificate following key generation.

***Insert new subclause 7.1.3.2:***

#### 7.1.3.2 PKM EAP authentication

PKM EAP Authentication uses Extensible Authentication Protocol [IETF RFC 3748] in conjunction with an operator-selected EAP Method (e.g. EAP-TLS [IETF RFC 2716]). The EAP method will use a particular kind of credential – such as an X.509 certificate in the case of EAP-TLS, or a Subscriber Identity Module in the case of EAP-SIM.

The particular credentials and EAP methods that are to be used are outside of the scope of this specification. However, the EAP method selected should fulfill the “mandatory criteria” listed in section 2.2 of RFC 4017. Use of an EAP method not meeting these criteria may lead to security vulnerabilities.

During re-authentication, the EAP transfer messages are protected with an HMAC/CMAC tuple. The BS and SS must discard unprotected EAP transfer messages, or EAP transfer messages with invalid HMAC/CMAC digests during re-authentication.

***Replace 7.2 and all its subclauses with a new 7.2 and the following subclauses as indicated:***

## 7.2 PKM protocol

There are two Privacy Key Management Protocols supported in IEEE Std 802.16e. PKM version 1 and PKMv2 with more enhanced features such as new key hierarchy, AES-CMAC, AES-key-wraps, and MBS.

### 7.2.1 PKM Version 1

#### 7.2.1.1 Security Associations

A *Security Association* (SA) is the set of security information a BS and one or more of its client SSs share in order to support secure communications across the IEEE 802.16 network. Three types of SAs are defined: *Primary, Static, and Dynamic*. Each SS establishes a primary security association during the SS initialization process. Static SAs are provisioned within the BS. Dynamic SAs are established and eliminated, on the fly, in response to the initiation and termination of specific service flows. Both Static and Dynamic SAs may be shared by multiple SSs.

An SA’s shared information shall include the Cryptographic Suite employed within the SA. The shared information may include TEKs and Initialization Vectors. The exact content of the SA is dependent on the SA’s Cryptographic Suite.

SAs are identified using SAIDs.

Each SS shall establish an exclusive Primary SA with its BS. The SAID of any SS’s Primary SA shall be equal to the Basic CID of that SS.

Using the PKM protocol, an SS requests from its BS an SA’s keying material. The BS shall ensure that each client SS only has access to the SAs it is authorized to access.

An SA’s keying material [e.g., Data Encryption Standard (DES) key and CBC Initialization Vector] has a limited lifetime. When the BS delivers SA keying material to an SS, it also provides the SS with that material’s remaining lifetime. It is the responsibility of the SS to request new keying material from the BS before the set of keying material that the SS currently holds expires at the BS. Should the current keying material expire before a new set of keying material is received, the SS shall perform network entry as described in 6.3.9.

In certain Cryptographic Suites, key lifetime may be limited by the exhaustion rate of a number space [e.g., the PN (Packet Number) in AES-CCM mode]. In this case, the key ends either at the expiry of the key lifetime or the exhaustion of the number space, which ever is earliest. Note that in this case, security is not determined by the key lifetime.

### 7.2.1.3 SS authorization and AK exchange overview

SS authorization, controlled by the Authorization state machine, is the process of the BS authenticating a client SS's identity:

a) The BS and SS establishing a shared AK by RSA, from which a key encryption key (KEK) and message authentication keys are derived.
b) The BS providing the authenticated SS with the identities (i.e., the SAIDs) and properties of primary and static SAs the SS is authorized to obtain keying information for.

After achieving initial authorization, an SS periodically reauthorizes with the BS; reauthorization is also managed by the SS's Authorization state machine. TEK state machines manage the refreshing of TEKs.

#### 7.2.1.3.1 Authorization via RSA authentication protocol

An SS begins authorization by sending an Authentication Information message to its BS. The Authentication Information message contains the SS manufacturer's X.509 certificate, issued by the manufacturer itself or by an external authority. The Authentication Information message is strictly informative; i.e., the BS may choose to ignore it. However, it does provide a mechanism for a BS to learn the manufacturer certificates of its client SS.

The SS sends an Authorization Request message to its BS immediately after sending the Authentication Information message. This is a request for an AK, as well as for the SAIDs identifying any Static Security SAs the SS is authorized to participate in. The Authorization Request includes:

a) A manufacturer-issued X.509 certificate.
b) A description of the cryptographic algorithms the requesting SS supports; an SS's cryptographic capabilities are presented to the BS as a list of cryptographic suite identifiers, each indicating a particular pairing of packet data encryption and packet data authentication algorithms the SS supports.
c) The SS's Basic CID. The Basic CID is the first static CID the BS assigns to an SS during initial ranging—the primary SAID is equal to the Basic CID.

In response to an Authorization Request message, a BS validates the requesting SS's identity, determines the encryption algorithm and protocol support it shares with the SS, activates an AK for the SS, encrypts it with the SS's public key, and sends it back to the SS in an Authorization Reply message. The authorization reply includes:

- An AK encrypted with the SS's public key.
- A 4-bit key sequence number, used to distinguish between successive generations of AKs.
- A key lifetime.
- The identities (i.e., the SAIDs) and properties of the single primary and zero or more static SAs the SS is authorized to obtain keying information for.

While the Authorization Reply shall identify Static SAs in addition to the Primary SA whose SAID matches the requesting SS's Basic CID, the Authorization Reply shall not identify any Dynamic SAs.

The BS, in responding to an SS's Authorization Request, shall determine whether the requesting SS, whose identity can be verified via the X.509 digital certificate, is authorized for basic unicast services, and what additional statically provisioned services (i.e., Static SAIDs) the SS's user has subscribed for. Note that the protected services a BS makes available to a client SS can depend upon the particular cryptographic suites SS and BS share support for.

An SS shall periodically refresh its AK by reissuing an Authorization Request to the BS. Reauthorization is identical to authorization with the exception that the SS does not send Authentication Information messages during reauthorization cycles. The description of the authorization state machine in 7.2.1.6 clearly indicates when Authentication Information messages are sent.

To avoid service interruptions during reauthorization, successive generations of the SS's AKs have overlapping lifetimes. Both the SS and BS shall be able to support up to two simultaneously active AKs during these transition periods. The operation of the Authorization state machine's Authorization Request scheduling algorithm, combined with the BS's regimen for updating and using a client SS's AKs (see 7.3), ensures that the SS can refresh.

#### 7.2.1.4 TEK exchange overview

***Relocate text of 7.2.2 to here and renumber subclause 7.2.1.4.***

##### 7.2.1.4.1 TEK exchange overview for PMP topology

***Relocate text of 7.2.2.1 to here and renumber subclause 7.2.1.4.1.***

##### 7.2.1.4.2 TEK exchange overview for Mesh mode

***Relocate text of 7.2.2.2 to here and renumber subclause 7.2.1.4.2.***

#### 7.2.1.5 Security capabilities selection

***Relocate text of 7.2.3 to here and renumber subclause 7.2.1.5.***

#### 7.2.1.6 Authorization state machine

***Relocate text of 7.2.4 to here and renumber subclause 7.2.1.6.***

##### 7.2.1.6.1 States

***Relocate text of 7.2.4.1 to here and renumber subclause 7.2.1.6.1.***

##### 7.2.1.6.2 Messages

***Relocate text of 7.2.4.2 to here and renumber as subclause 7.2.1.6.2.***

##### 7.2.1.6.3 Events

***Relocate text of 7.2.4.3 to here and renumber as subclause 7.2.1.6.3.***

##### 7.2.1.6.4 Parameters

***Relocate text of 7.2.4.4 to here and renumber as subclause 7.2.1.6.4.***

#### 7.2.1.6.5 Actions

***Relocate text of 7.2.4.5 to here and renumber as subclause 7.2.1.6.5.***

### 7.2.1.7 TEK state machine

***Relocate text of 7.2.5 here and renumber as subclause 7.2.1.7.***

#### 7.2.1.7.1 States

***Relocate text of 7.2.5.1 here and renumber as subclause 7.2.1.7.1.***

#### 7.2.1.7.2 Messages

***Relocate text of 7.2.5.2 here and renumber as subclause 7.2.1.7.2.***

#### 7.2.1.7.3 Events

***Relocate text of 7.2.5.3 here and renumber as subclause 7.2.1.7.3.***

#### 7.2.1.7.4 Parameters

***Relocate text of 7.2.5.4 here and renumber as subclause 7.2.1.7.4.***

#### 7.2.1.7.5 Actions

***Relocate text of 7.2.5.5 here and renumber as subclause 7.2.1.7.5.***

## 7.2.2 PKM Version 2

### 7.2.2.1 TEK exchange overview for PMP topology

If the SS and BS decide “No authorization” as their authorization policy, the SS and BS shall perform neither SA-TEK handshake nor Key Request/Key Reply handshake. In this case, target SAID value, which may be included in DSA-REQ/RSP messages, shall be Null SAID.

Upon achieving authorization, an SS starts a separate TEK state machine for each of the SAIDs identified in the Authorization Reply or PKMv2 SA-TEK-RSP message, if data traffic encryption is provisioned for one or more service flows. Each TEK state machine operating within the SS is responsible for managing the keying material associated with its respective SAID. TEK state machines periodically send Key Request messages to the BS, requesting a refresh of keying material for their respective SAIDs.

The BS responds to a Key Request with a Key Reply message, containing the BS’s active keying material for a specific SAID.

TEKs and KEKs may be either 64 bits or 128 bits long. SAs employing any ciphersuite with a basic block size of 128 bits shall use 128-bit TEKs and KEKs. Otherwise 64-bit TEKs and KEKs shall be used. The name TEK-64 is used to denote a 64-bit TEK and TEK-128 is used to denote a 128-bit TEK. Similarly, KEK-64 is used to denote a 64-bit KEK and KEK-128 is used to denote a 128-bit KEK.

For SAs using a ciphersuite employing DES-CBC, the TEK in the Key Reply is triple DES (3-DES) (encrypt-decrypt-encrypt or EDE mode) encrypted, using a two-key, 3-DES KEK derived from the AK.

For SAs using a ciphersuite employing 128 bits keys, such as AES-CCM mode, the TEK in the key Reply is AES encrypted using a 128-bit key derived from the AK and a 128-bit block size.

Note that at all times the BS maintains two diversity sets of keying material per SAID. The lifetimes of the two generations overlap such that each generation becomes active halfway through the life of it predecessor and expires halfway through the life of its successor. A BS includes in its Key Replies both of an SAID's active generations of keying material.

For SAs using a ciphersuite employing CBC mode encryption the Key Reply provides the requesting SS, in addition to the TEK and CBC initialization vector, the remaining lifetime of each of the two sets of keying material. For SAs using a ciphersuite employing AES-CCM mode, the Key Reply provides the requesting SS, in addition to the TEK, the remaining lifetime of each of the two sets of keying material. The receiving SS uses these remaining lifetimes to estimate when the BS will invalidate a particular TEK, and therefore when to schedule future Key Requests such that the SS requests and receives new keying material before the BS expires the keying material the SS currently holds. For AES-CCM mode, when more than half the available PN numbers in the 31-bit PN number space are exhausted, the SS shall schedule a future Key Request in the same fashion as if the key lifetime was approaching expiry. The operation of the TEK state machine's Key Request scheduling algorithm, combined with the BS's regimen for updating and using an SAID's keying material (see 7.3), ensures that the SS will be able to continually exchange encrypted traffic with the BS.

A TEK state machine remains active as long as

a) The SS is authorized to operate in the BS's security domain, i.e., it has a valid AK, and
b) The SS is authorized to participate in that particular SA, i.e., the BS continues to provide fresh keying material during rekey cycles.

MAC PDUs sent on connections that belong to an SA that includes data encryption, shall be encrypted. A MAC PDU received on such connections, with the EC bit not set, shall be discarded.

### 7.2.2.2 Key derivation

The PKMv2 key hierarchy defines what keys are present in the system and how the keys are generated.

Since there are two authentication schemes, one based on RSA and one based on EAP, there are two primary sources of keying material.

The keys used to protect management message integrity and transport the traffic encryption keys are derived from source key material generated by the authentication and authorization processes. The RSA-based authorization process yields the pre-Primary AK (pre-PAK) and the EAP based authentication process yields the MSK. Keys used to protect MBS traffic are derived from the MBSAK, which is supplied by means outside the scope of this specification. These keys form the roots of the key hierarchy.

All PKMv2 key derivations are based on the Dot16KDF algorithm as defined in 7.5.4.6.1.

The MSK is the shared "master key" that is derived by the two sides in the course of executing the EAP inner method. The authentication part of the authorization flow (and the involvement of the generic EAP layer) is now complete.

#### 7.2.2.2.1 RSA-based authorization

When the RSA-based authorization is negotiated as authorization policy, the PKMv2 RSA-Request, the PKMv2 RSA-Reply, the PKMv2 RSA-Reject, and the PKMv2 RSA-Acknowledgement messages are used to share the pre-PAK (Primary Authorization Key).

The pre-PAK is sent by the BS to the SS encrypted with the public key of the SS certificate. Pre-PAK is mainly used to generate the PAK. The optional EIK for transmitting authenticated EAP payload (see 7.2.2.2.2) are also generated from pre-PAK:

EIK | PAK = Dot16KDF(pre-PAK, SS MAC Address | BSID | “EIK+PAK”, 320)

PAK will be used to generate the AK (see 7.2.2.2.3) if RSA authorization was used. PAK is 160 bits long.

#### 7.2.2.2.2 EAP authentication

If a RSA mutual authorization took place before the EAP exchange or if the first EAP took place during EAP-in-EAP mode, the EAP messages may be protected using EIK-EAP Integrity Key derived from pre-PAK (see 7.2.2.2.1). EIK is 160 bits long.

The product of the EAP exchange that is transferred to IEEE 802.16 layer is the Master Session Key (MSK), which is 512 bits in length. This key is derived [or may be equivalent to the 512-bits Master Session Key (MSK)]. This key is known to the AAA server, to the Authenticator (transferred from AAA server) and to the SS. The SS and the authenticator derive a PMK (Pairwise Master Key) and optional EIK by truncating the MSK to 320 bits.

The PMK derivation from the MSK is as follows:

The PMK and EIK derivation from the MSK during first EAP method is as follows:

EIK | PMK $\Leftarrow$ truncate (MSK, 320)

The PMK2 derivation from the MSK2 during second EAP method is as follows:

PMK2 $\Leftarrow$ truncate(MSK2, 160)

If more keying material is needed for future link ciphers, the key length of the PMK may be increased.

After successful EAP based authorization, if the SS or BS negotiates authorization policy as “Authenticated EAP after EAP” mode, the authenticated EAP messages shall carry second EAP message. It shall cryptographically bind previous EAP authentication and following EAP authentication session, while protecting second EAP messages. In order to prevent “man-in-the-middle attack”, the first and second EAP method should fulfill the “mandatory criteria” listed in section 2.2 of RFC 4017 such as EAP-PSK, EAP-AKA.

If SS and BS negotiate double EAP mode (a.k.a. Authenticated EAP after EAP), SS and BS perform two rounds of EAP as follows:

1) In order to initiate first round EAP of double EAP, SS may send PKMv2 EAP Start message with no attribute.
2) SS and BS shall perform first round EAP conversation with PKMv2 EAP Transfer message without HMAC/CMAC Digest.
3) During first EAP conversation, if BS has to send EAP-Success, BS shall send EAP payload to SS with PKMv2 EAP Complete message signed by newly generated EIK BS shall re-send the PKMv2 _EAP_Complete message by Second_EAP_Timeout. Total number of sending PKMv2_EAP_Complete message is EAP_Complete_Resend. After SS receives the PKMv2 EAP_Complete message which includes EAP-Success payload, SS can possess EIK and PMK. In this case, SS can validate the message. Otherwise, if SS receives EAP-Failure or cannot validate the message, SS fails in authentication. After BS transfers the PKMv2 EAP Complete message to SS, BS activates the Second_EAP_Timeout in order to wait PKMv2 Authenticated EAP Start message. When the timer expires, BS shall regard the authentication as failure.

4) After the successful first round EAP, SS shall send PKMv2 EAP Start message signed by EIK to initiates second round EAP conversation. If BS validates the PKMv2 EAP Start message by EIK, BS shall initiate second EAP by sending PKMv2 Authenticated EAP message including EAP-Identity/Request to SS. If BS cannot validate the PKMv2 Authenticated EAP Start message, BS shall regard the authentication as failure.
5) SS and BS shall perform second EAP conversation with PKMv2 Authenticated EAP message signed by EIK.
6) If second round EAP succeeds, both SS and authenticator generate AK from PMK and PMK2. SS and BS shall perform SA-TEK 3-way handshake.

After the successful initial authentication, SS and BS shall perform reauthentication by PMK/PMK2 lifetime. In performing reauthentication, SS and BS perform double EAP just like initial authentication. Otherwise, SS and BS can perform EAP once.

When SS and BS perform reauthentication with double EAP also, the following procedure shall be performed as follows:

- In order to initiate reauthentication, SS may send PKMv2 EAP Start message signed by H/CMAC_KEY_U derived from AK.
- SS and BS shall use PKMv2 EAP Transfer message to carry first round EAP conversation.
- BS shall carry EAP-Success or EAP-Failure message with PKMv2 EAP Complete message signed by AK generated from the previous double EAP.
- After successful first round EAP, SS shall initiate second round EAP by sending PKMv2 EAP Start message signed by H/CMAC_KEY_U generated from AK (previous double EAP generated this key).
- SS and BS shall perform second round EAP conversation with PKMv2 EAP Transfer message signed by AK which is generated by previous double EAP.
- SS and BS shall perform SA-TEK 3-way handshake.

When SS and BS perform reauthentication with double EAP, SS and BS can perform EAP once as follows:

- In order to initiate reauthentication, SS may send PKMv2 EAP Start message signed by H/CMAC_KEY_U derive d from AK.
- SS and BS shall use PKMv2 EAP Transfer message to carry first round EAP conversation.
- BS shall carry EAP-Success or EAP-Failure message with PKMv2 EAP Transfer instead of sending PKMv2 EAP Complete signed by AK. It means that BS does not want to run second round EAP.

### 7.2.2.2.3 Authorization Key (AK) derivation

The AK will be derived by the BS and the SS from the PMK (from EAP-based authorization procedure) and/or the PAK (from RSA-based authorization procedure). Note that PAK and/or PMK can be used according to the value of Authorization Policy Support field included in the SBC-REQ/RSP messages.

The exclusive-or (XOR: $\oplus$ ) value of PAK and PMK is mainly used to generate the AK.

If (PAK and PMK)

$$AK \Leftarrow \text{Dot16KDF}(PAK \oplus PMK, \text{SS MAC Address} \mid BSID \mid PAK \mid \text{“AK”}, 160)$$

Else If (PMK and PMK2)

$$AK \Leftarrow \text{Dot16KDF}(PMK \oplus PMK2, \text{SS MAC Address} \mid BSID \mid \text{“AK”}, 160)$$

Else

```
    If (PAK)
        AK ⇐ Dot16KDF (PAK, SS MAC Address | BSID | PAK | “AK”, 160)
    Else                    // PMK only
        AK ⇐ Dot16KDF(PMK, SS MAC Address | BSID |  “AK”, 160);
    Endif
Endif
```

#### 7.2.2.2.4 Key Encryption Key (KEK) derivation

The Key Encryption Key or KEK is derived directly from the AK. The KEK is defined in 7.2.2.2.9 with the HMAC/CMAC definition. It is used to encrypt the TEKs, GKEK and all other keys sent by the BS to SS in unicast message.

#### 7.2.2.2.5 Group Key Encryption Key (GKEK) derivation

GKEK is randomly generated at the BS and transmitted to the SS encrypted with the KEK. There is one GKEK per Group Security Association. GKEK is used to encrypt the GTEKs sent in multicast messages by the BS to the SSs in the same multicast group.

#### 7.2.2.2.6 Traffic Encryption Key (TEK)

The TEK is generated as a random number in the BS and is encrypted using the corresponding TEK encryption algorithm (e.g., AES_KEY_WRAP for SAs with TEK encryption algorithm identifier in the cryptographic suite is equal to 0x04), keyed with the KEK and transferred between BS and SS in the TEK exchange.

#### 7.2.2.2.7 Group Traffic Encryption Key (GTEK)

The GTEK is used to encrypt multicast data packets and it is shared among all SSs that belongs to the multicast group. There are two GTEKs per GSA.

The GTEK is randomly generated at the BS or at certain network node and is encrypted using same algorithms applied to encryption for TEK and transmitted to the SS in multicast or unicast messages. The GTEK in a PKMv2 Key-Request and PKMv2 Key-Reply messages will be encrypted by the KEK. Also, the GTEK in a PKMv2 Group Key Update Command message will be encrypted by the GKEK.

#### 7.2.2.2.8 MBS Traffic Key (MTK)

The generation and transport of the MAK (MBS AK) is outside the scope of the IEEE 802.16 standard. It is provided through means defined at higher layers. However, the key such as the MTK is used in the link cipher; therefore, its existence needs to be defined in layer 2.

The MTK is used to encrypt the MBS traffic data. It is defined as follows:

MTK <= Dot16KDF(MAK, MGTEK | “MTK”, 128)

The MGTEK is the GTEK for the MBS. An SS can get the GTEK by exchanging the PKMv2 Key Request message and the PKMv2 Key Reply message with a BS or by receiving the PKMv2 Group Key Update Command message from a BS. The generation and transport of the GTEK is defined as in 6.3.2.3.9 and 7.9.

#### 7.2.2.2.9 Message authentication keys (HMAC/CMAC) and KEK derivation

MAC (message authentication code) keys are used to sign management messages in order to validate the authenticity of these messages. The MAC to be used is negotiated at SS Basic Capabilities negotiation.

There is a different key for UL and DL messages. Also, a different message authentication key is generated for a multicast message (this is DL direction only) and for a unicast message.

In general, the message authentication keys used to generate the CMAC value and the HMAC-Digest are derived from the AK.

The keys used for CMAC key and for KEK are as follows:

CMAC_KEY_U | CMAC_KEY_D | KEK ⇐ Dot16KDF(AK, SS MAC Address | BSID | “CMAC_KEYS+KEK”, 384)
CMAC_KEY_GD ⇐ Dot16KDF(GKEK, “GROUP CMAC KEY”,128) (Used for multicast MAC message such as a PKMv2 Group-Key-Update-Command message)

The keys used for HMAC key and for KEK are as follows:

HMAC_KEY_U | HMAC_KEY_D | KEK ⇐ Dot16KDF(AK, SS MAC Address | BSID | “HMAC_KEYS+KEK”, 448)
HMAC_KEY_GD ⇐ Dot16KDF(GKEK, “GROUP HMAC KEY”, 160) (Used for multicast MAC message such as a PKMv2 Group-Key-Update-Command message)

Exceptionally, the message authentication keys for the HMAC/CMAC Digest included in a PKMv2 Authenticated-EAP-Transfer message are derived from the EIK instead of the AK

The keys used for CMAC key and for KEK are as follows:

CMAC_KEY_U | CMAC_KEY_D ⇐ Dot16KDF(EIK, SS MAC Address | BSID | “CMAC_KEYS”, 256)

The keys used for HMAC key and for KEK are as follows:

HMAC_KEY_U | HMAC_KEY_D ⇐ Dot16KDF(EIK, SS MAC Address | BSID | “HMAC_KEYS”, 320)

#### 7.2.2.2.10 Key hierarchy

Figure 130k outlines the process to calculate the AK when the RSA-based authorization process has taken place, but where the EAP based authentication process has not taken place, or the EAP method used has not yielded an MSK.

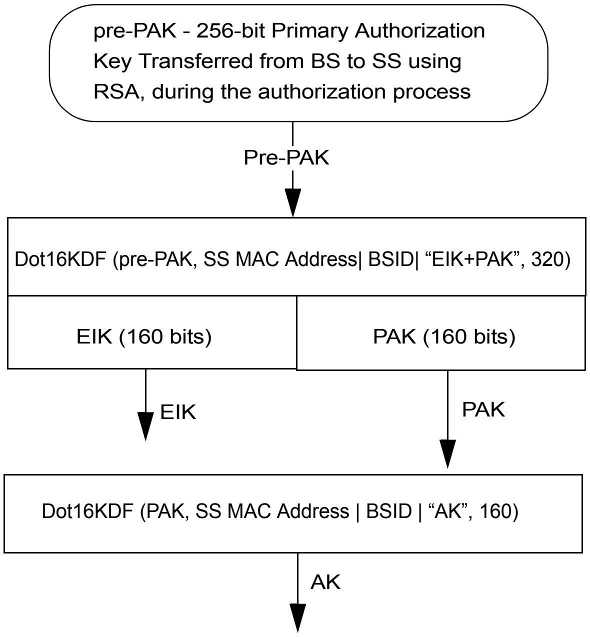
pre-PAK - 256-bit Primary Authorization Key Transferred from BS to SS using RSA, during the authorization process
Pre-PAK
Dot16KDF (pre-PAK, SS MAC Address| BSID| "EIK+PAK", 320)
EIK (160 bits)
PAK (160 bits)
EIK
PAK
Dot16KDF (PAK, SS MAC Address | BSID | "AK", 160)
AK

**Figure 130k—AK from PAK only (from RSA-based authorization)**

Figure 130l outlines the process to calculate the AK when both the RSA-based authorization exchange has taken place, yielding a PAK and the EAP based authentication exchange has taken place, yielding an MSK.

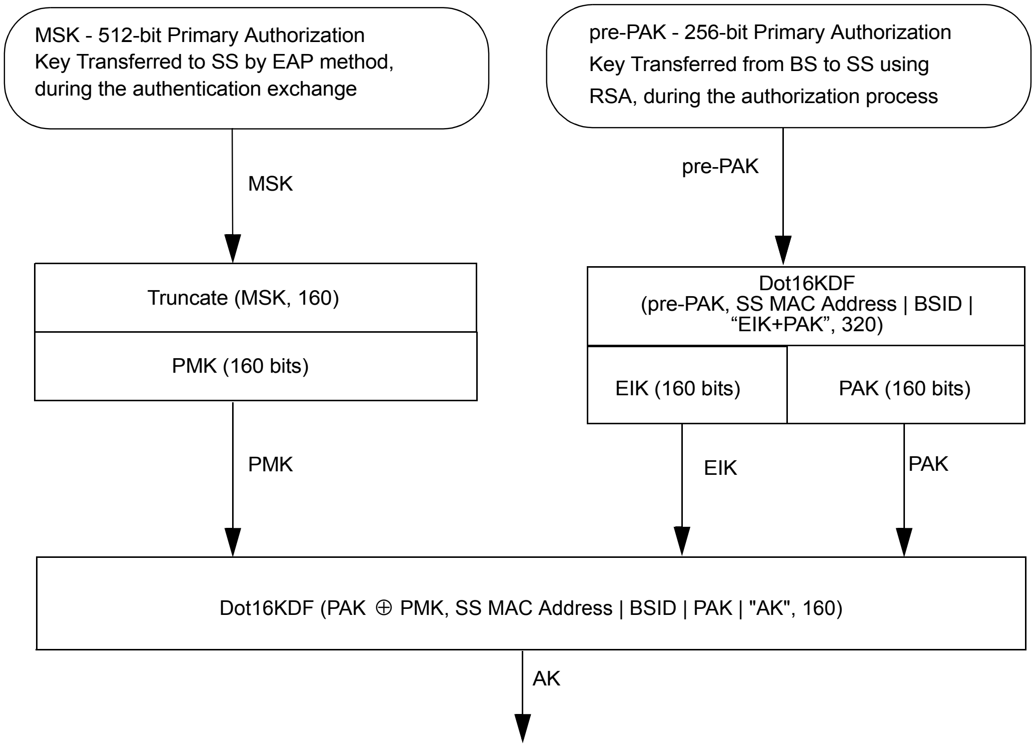
MSK - 512-bit Primary Authorization Key Transferred to SS by EAP method, during the authentication exchange
pre-PAK - 256-bit Primary Authorization Key Transferred from BS to SS using RSA, during the authorization process
MSK
pre-PAK
Truncate (MSK, 160)
PMK (160 bits)
Dot16KDF (pre-PAK, SS MAC Address | BSID | "EIK+PAK", 320)
EIK (160 bits)
PAK (160 bits)
PMK
EIK
PAK
Dot16KDF (PAK ⊕ PMK, SS MAC Address | BSID | PAK | "AK", 160)
AK

**Figure 130l—AK from PAK and PMK (RSA-based and EAP-based authorization)**

Figure 130m outlines the process to calculate the AK when only the EAP based authentication exchange has taken place, yielding an MSK:

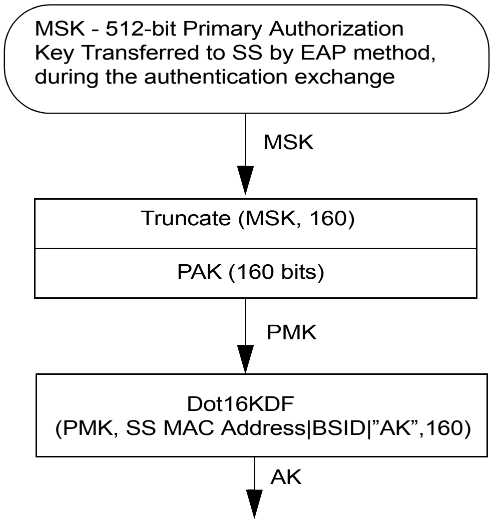
MSK - 512-bit Primary Authorization Key Transferred to SS by EAP method, during the authentication exchange
MSK
Truncate (MSK, 160)
PAK (160 bits)
PMK
Dot16KDF (PMK, SS MAC Address|BSID|"AK",160)
AK

**Figure 130m—AK from PMK (from EAP-based authorization)**

Figure 130n outlines the process to calculate the AK when EAP in EAP mode authentication exchange has taken place, first EAP yielding EIK and MSK and second EAP yielding MSK2.

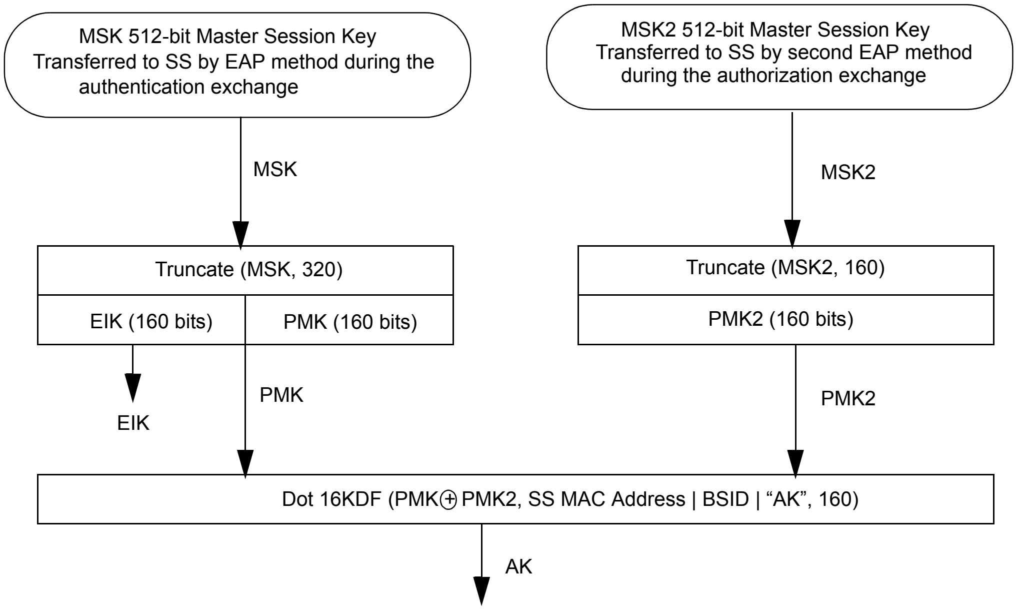
MSK 512-bit Master Session Key
Transferred to SS by EAP method during the authentication exchange
MSK2 512-bit Master Session Key
Transferred to SS by second EAP method during the authorization exchange
MSK
MSK2
Truncate (MSK, 320)
EIK (160 bits)
PMK (160 bits)
Truncate (MSK2, 160)
PMK2 (160 bits)
EIK
PMK
PMK2
Dot 16KDF (PMK⊕PMK2, SS MAC Address | BSID | "AK", 160)
AK

**Figure 130n—AK with PMK and PMK2 (EAP-based authorization and Authenticated EAP-based authorization)**

Figure 130o outlines the unicast key hierarchy starting from the AK.

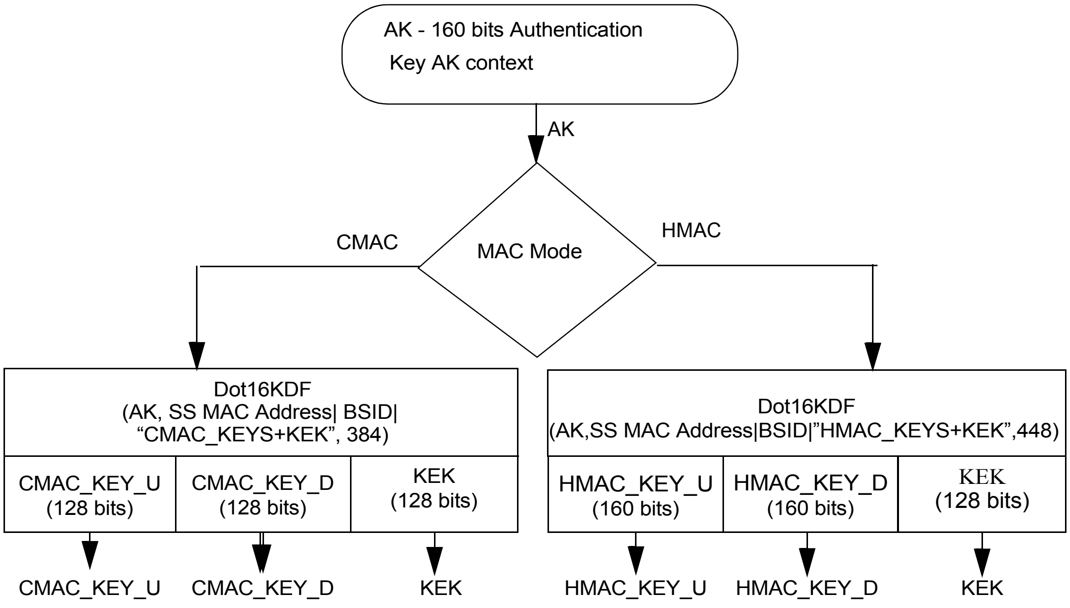
AK - 160 bits Authentication
Key AK context
AK
CMAC
MAC Mode
HMAC
Dot16KDF
(AK, SS MAC Address| BSID| "CMAC_KEYS+KEK", 384)
CMAC_KEY_U (128 bits)
CMAC_KEY_D (128 bits)
KEK (128 bits)
Dot16KDF
(AK,SS MAC Address|BSID|"HMAC_KEYS+KEK",448)
HMAC_KEY_U (160 bits)
HMAC_KEY_D (160 bits)
KEK (128 bits)
CMAC_KEY_U
CMAC_KEY_D
KEK
HMAC_KEY_U
HMAC_KEY_D
KEK

**Figure 130o—HMAC/CMAC/KEK derivation from AK**

Figure 130p outlines the MBS key hierarchies starting from the MAK.

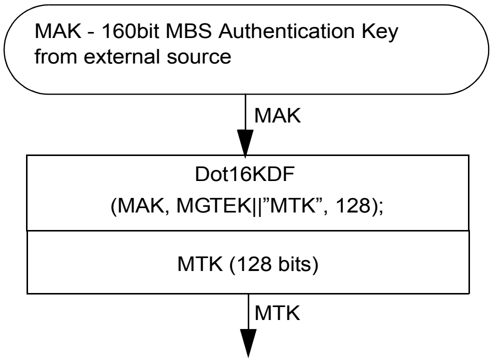
MAK - 160bit MBS Authentication Key
from external source
MAK
Dot16KDF
(MAK, MGTEK||"MTK", 128);
MTK (128 bits)
MTK

**Figure 130p—MTK key derivation from MAK**

Figure 130q outlines the process to calculate message authentication keys derived from the EIK. The message authentication keys are used to generate the CMAC value or the HMAC-Digest included in a PKMv2 Authenticated-EAP-Transfer message.

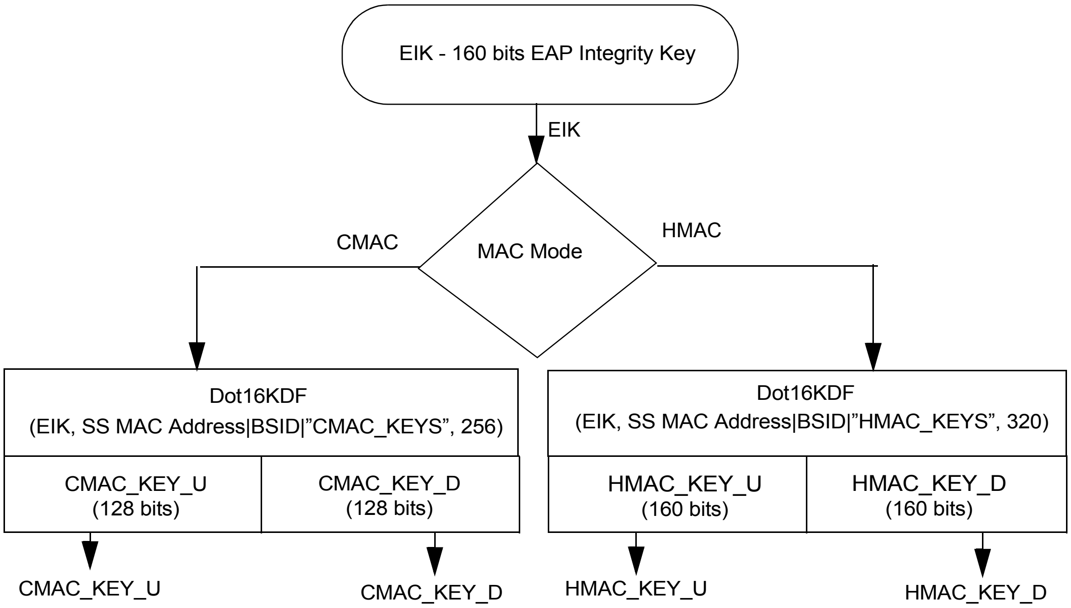
EIK - 160 bits EAP Integrity Key
EIK
CMAC
MAC Mode
HMAC
Dot16KDF
(EIK, SS MAC Address|BSID|"CMAC_KEYS", 256)
CMAC_KEY_U
(128 bits)
CMAC_KEY_D
(128 bits)
Dot16KDF
(EIK, SS MAC Address|BSID|"HMAC_KEYS", 320)
HMAC_KEY_U
(160 bits)
HMAC_KEY_D
(160 bits)
CMAC_KEY_U
CMAC_KEY_D
HMAC_KEY_U
HMAC_KEY_D

**Figure 130q—HMAC/CMAC authentication key derivation from EIK**

### 7.2.2.2.11 Maintenance of PMK and AK

The BS and SS maintain cached PMK and AK as follows:

a) PMK caching

An SS caches a PMK upon successful EAP authentication. An Authenticator caches a PMK upon its receipt via the AAA protocol. Upon caching a new PMK for a particular SS, an Authenticator shall delete any PMK for that SS (as well as all associated AKs).

For the case of reauthentication, deletion of old PMKs at Authenticator and SS is accomplished via the switchover mechanism described in this subclause using the messages in 6.3.2.3.9.20.

The Authenticator and SS will additionally delete PMKs and/or associated AKs in various situations—including lifetime expiration, reauthentication, and reclamation of memory resources, or as the result of other mechanisms beyond the scope of this specification.

In the case of re-authentication, the older PMK and its AKs shall be deleted by the SS after verifying the HMAC or CMAC of the PKMv2 SA-TEK challenge message and the BS after verifying the HMAC/CMAC of the PKMv2 SA-TEK request message.

b) AK activation and deactivation

Successful completion of the 3-way SA-TEK handshake causes the activation of all the AKs associated with the new PMK (i.e., all AKs on BSs associated with the current authenticator will be active).

If the packet counter belonging to a short HMAC or a CMAC key reaches its maximum value, the associated AK becomes permanently deactivated.

The BS and SS must maintain the AK context (i.e., replay counters etc.) as long as they retain the AK.

### 7.2.2.2.12 PKMv2 PMK and AK switching methods

Once the PKMv2 SA-TEK 3-way handshake begins, the BS and SS shall use the new AK matching the new PMK context for the 3-way handshake messages. Other messages shall continue to use the old AK until the 3-way handshake completes successfully. Upon successful completion of the 3-way handshake, all messages shall use the new AK.

The old AK matching the old PMK context may be used for receiving packets before the “frame number” attribute specified in PKMv2 SA-TEK-response message.

### 7.2.2.3 Associations

Keying material is held within associations. There are three types of association: The security associations (SA) that maintain keying material for unicast connections; group security associations (GSA) that hold keying material for multicast groups; and MBSGSAs that hold keying material for MBS services.

If SS and BS decide “No authorization” as their authorization policy, they do not have any security association. In this case, Null SAID shall be used as the target SAID field in DSA-REQ/RSP messages.

### 7.2.2.3.1 Security associations

A security association contains keying material that is used to protect unicast connections. The contents of an SA are as follows:

The SAID, a 16-bit identifier for the SA. The SAID shall be unique within a BS.

The KEK, a 128-bit key encryption key, derived from the AK.

TEK0 and TEK1, 128-bit traffic encryption keys, generated within the BS and transferred from the BS to the SS using a secure key exchange.

The TEK Lifetimes TEK0 and TEK1, a key aging lifetime value.

PN0 and PN1, 32-bit packet numbers for use by the link cipher.

RxPN0 and RxPN1, 32-bit receive sequence counter, for use by the link cipher.

A security association is shared between an SS and a BS or, in case of ongoing MDHO(FBSS) between MS and BSs from Diversity Set.

### 7.2.2.3.2 Group Security Association

The Group Security Association (GSA) contains keying material used to secure multicast groups. These are defined separately from SAs since GSA offer a lower security bound than unicast security associations, since keying material is shared between all members of the group, allowing any member of the group to forge traffic as if it came from any other member of the group.

The contents of a GSA are as follows:

The Group Key Encryption Key (GKEK). Serves the same function as an SA KEK but for a GSA.

The Group Traffic Encryption Key (GTEK). Served the same function as an SA TEK but for a GSA.

### 7.2.2.3.3 MBS Group Security Association

The primary keying material in the MBS Group Security Association is the MAK. The MAK is provisioned by an external entity, such as an MBS server. The MAK may be common among members of an MBS group.

The contents of an MBSGSA are as follows:

The MAK, a 160-bit MBS AK, serves the same function as the AK but local to the MBSGSA.

The MGTEK, a 128-bit MBS Group Traffic Encryption Key, used indirectly to protect MBS traffic. It is updated more frequently that the MAK.

The MTK (MBS Traffic Key) a 128-bit key used to protect MBS traffic, derived from the MAK and MGTEK.

The MGTEK is a random number provisioned by the access network such as a BS as an access network authorization key. It is only used for generating MTK together with MAK.

In MBS Group Security Association, the usage of MGTEK is same as that of GTEK.

Key encryption algorithm and key transport mechanism of GTEK shall be also applied for MGTEK.

### 7.2.2.4 Security context

The security context is a set of parameters linked to a key in each hierarchy that defines the scope while the key usage is considered to be secure.

Examples of these parameters are key lifetime and counters ensuring the same encryption will not be used more than once. When the context of the key expires, a new key should be obtained to continue working.

The purpose of this subclause is to define the context that belongs to each key, how it is obtained and the scope of its usage.

#### 7.2.2.4.1 AK context

The PMK key has two phases of lifetime: the first begins at PMK creation and the second begins after validation by the 3-way handshake.

The phases ensure that when the PMK is created it will be defined with the PMK or PAK pre-handshake lifetime and after successful 3-way handshake, this lifetime may be enlarged using the PMK lifetime TLV within the 3-way handshake.

If the cached AK and associated context is lost by either BS or SS, no new AKs can be derived from this PMK on handover.

Cached AKs that were derived from the PMK can continue to be used in HO.

Reauthentication is required to obtain a new PMK so as to derive new AKs.

The AK context is described in Table 133a.

**Table 133a—AK Context in PKMv2**

| Parameter | Size (bits) | Usage |
|---|---|---|
| AK | 160 | The authorization key, calculated as defined in 7.2.2.2.3. |
| AKID | 64 | AKID = Dot16KDF(AK, AK SN\|SS MAC Address\|BSID\|“AK”, 64)<br>The AK_SN in the Dot16KDF function is an 8-bit number which consists of leading 4 zero bits and appending 4-bit AK_SN in MSB first order. |
| AK Sequence Number | 4 | Sequence number of root keys (PAK and PMK) for the AK. This value is the most significant 2-bit of PAK sequence number concatenated with the least significant 2-bit of PMK sequence number.<br>If AK = f (PAK and PMK), then AK SN = PAK SN + PMK SN<br>If AK = f (PAK), then AK SN = PAK SN<br>If AK = f (PMK), then AK SN = PMK SN |
| AK Lifetime | — | This is the time this key is valid; it is calculated AK lifetime = MIN(PAK lifetime, PMK lifetime)—when this expires, re-authentication is needed. |
| PMK Sequence Number | 4 | The sequence number of the PMK from which this AK is derived. |
| HMAC/CMAC_KEY_U | 160/128 | The key which is used for signing UL management messages. |
| HMAC/CMAC_PN_U | 32 | Used to avoid UL replay attack on the management connection—when this expires re-authentication is needed. |
| HMAC/CMAC_KEY_D | 160/128 | The key which is used for signing DL management messages. |
| HMAC/CMAC_PN_D | 32 | Used to avoid DL reply attack on the management connection—when this expires re-authentication is needed. |
| KEK | 160 | Used to encrypt transport keys from the BS to the SS. |
| EIK | 160 | EAP Integrity Key for authenticating Authenticated EAP message. |

### 7.2.2.4.2 GKEK context

The GKEK is the head of the group key hierarchy. There is a separate GKEK for each group (each GSA). This key is randomly generated by the BS and transferred to the SS encrypted with KEK. It is used to encrypt group TEKs (GTEK) when broadcasting them to all SSs. The GKEK context is described in Table 133b.

**Table 133b—GKEK Context**

| Parameter | Size (bits) | Usage |
|---|---|---|
| GKEK | 128 | Randomly generated by BS and transmitted to SS under KEK. |
| GKEKID | 64 | Arrives from BS with GKEK. |
| GKEK lifetime | — | Arrives from BS with GKEK; when this expires a new GKEK should be obtained. |
| HMAC_KEY_G/ CMAC_KEY_G | 160 or 128 | The key which is used for signing group DL GTEK update messages, calculated by KDF(CMAC_PAD,GKEK). |
| HMAC_PN_G/ CMAC_PN_G | 32 | Used to avoid DL replay attack on management. When this expires a new GKEK should be obtained. |
| H/CMAC_KEY_U | 160 or128 | The key that is used for signing UL management messages. |

GKEK or KEK can be used for encrypting MGTEK for MBS GSA.

***Insert new subclause 7.2.2.4.3:***

### 7.2.2.4.3 PMK context

The PMK context includes all parameters associated with the PMK. This context is created when EAP Authentication completes.

The PMK context is described in Table 133c.

**Table 133c—PMK context**

| Parameter | Size (bits) | Usage |
|---|---|---|
| PMK | 160 | A key yielded from the EAP-based authentication. |
| PMK sequence number | 4 | PMK sequence number, when the EAP-based authorization is achieved and a key is generated. The least significant 2 bits are the sequence counter. And the most significant 2 bits set to 0. |

#### 7.2.2.4.4 PAK context

The PAK context includes all parameters associated with the PAK. This context is created when RSA Authentication completes.

The PAK context is described in Table 133d.

Table 133d—PAK context

| Parameter | Size (bits) | Usage |
|---|---|---|
| PAK | 160 | A key yielded from the EAP-based authentication. |
| PAK Lifetime | 4 | PAK lifetime, from when the RSA-based authorization is achieved. The value of PAK lifetime is initially set to a default value. The 3-way handshake may subsequently change this value. |
| PAK sequence number | 4 | PAK sequence number, when the RSA-based authorization is achieved and a key is generated. The most significant 2 bits are the sequence counter. And the least significant 2 bits set to 0. |

### 7.2.2.5 TEK state machine

The TEK state machine consists of seven states and eleven events (including receipt of messages) that may trigger state transitions. Like the Authorization state machine, the TEK state machine is presented in both a state flow diagram (Figure 134) and a state transition matrix (Table 134). As was the case for the Authorization state machine, the state transition matrix shall be used as the definitive specification of protocol actions associated with each state transition.

Shaded states in Figure 131 (Operational, Rekey Wait, Rekey Reauthorize Wait, and M&B Rekey Interim Wait) have valid keying material and encrypted traffic may be sent.

The SAID may be replaced by the GSAID for the multicast service or the broadcast service. And, the TEK may be also replaced by the GTEK for the multicast service or the broadcast service.

The Authorization state machine starts an independent TEK state machine for each of its authorized SAIDs. As mentioned in 7.2.2, the BS maintains two active TEKs per SAID.

For the unicast service, the BS includes in its Key Replies both of these TEKs, along with their remaining lifetimes. The BS encrypts downlink traffic with the older of its two TEKs and decrypts uplink traffic with either the older or newer TEK, depending upon which of the two keys the SS was using at the time. The SS encrypts uplink traffic with the newer of its two TEKs and decrypts downlink traffic with either the older or newer TEK, depending upon which of the two keys the BS was using at the time. See 7.3 for details on SS and BS key usage requirements.

For the multicast service or the broadcast service, the BS may include both of GTEKs in its Key Reply messages, when an SS request traffic keying material. And, the BS may include the newer GTEK in the Key Update Command message, when the BS transmits the new traffic keying material in key push mode. The BS encrypts downlink traffic with current GTEK. The SS decrypts downlink traffic with either the older or newer GTEK, depending upon which of the two keys the BS is using at the time. See 7.9 for details on SS and BS key usage requirements.

Through operation of a TEK state machine, the SS attempts to keep its copies of an SAID's TEKs synchronized with those of its BS. A TEK state machine issues Key Requests to refresh copies of its SAID's keying material soon after the scheduled expiration time of the older of its two TEKs and before the expiration of its newer TEK. To accommodate for SS/BS clock skew and other system processing and transmission delays, the SS schedules its Key Requests a configurable number of seconds before the newer TEK's estimated expiration in the BS. With the receipt of the Key Reply, the SS shall always update its records with the TEK Parameters from both TEKs contained in the Key Reply message. TEK Parameters contained in the two Key Update Command messages for the multicast service or the broadcast service.

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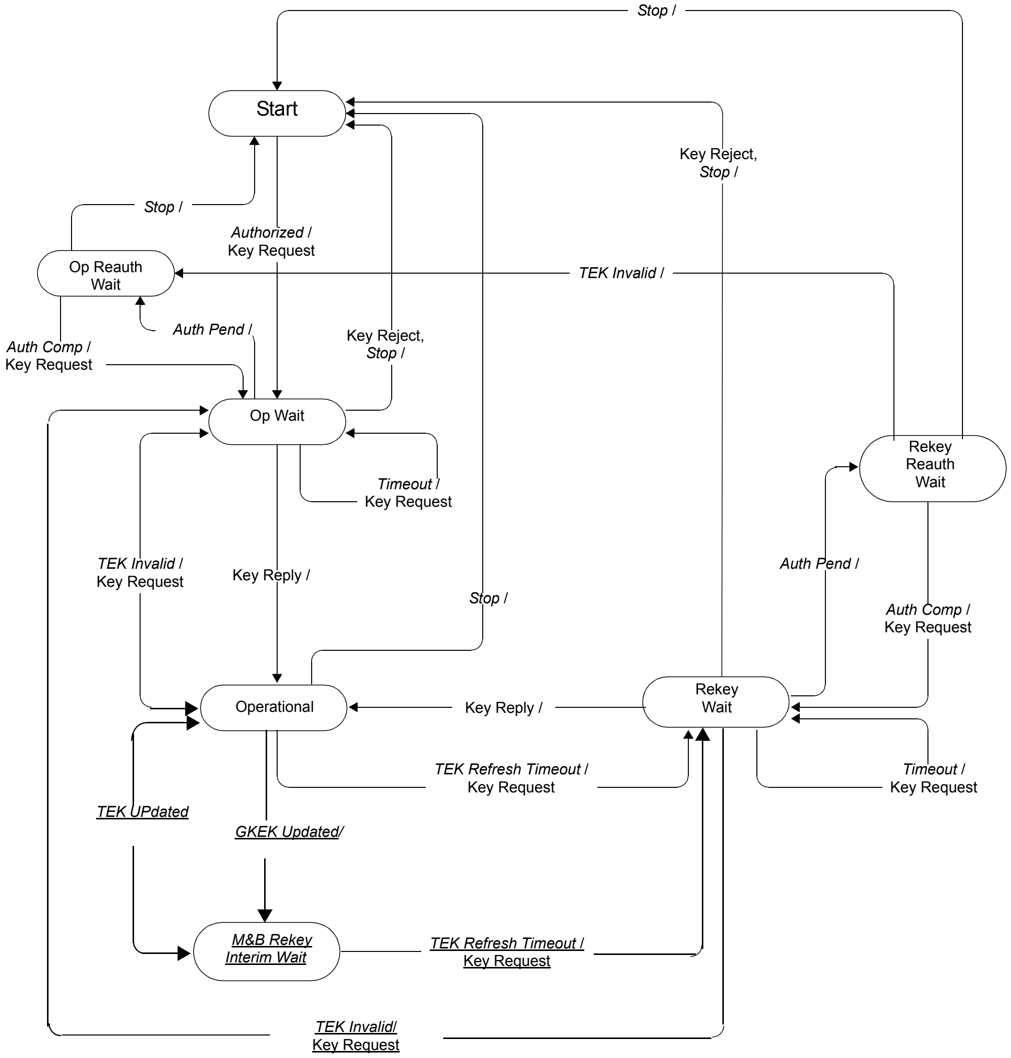

Stop /
Start
Key Reject,
Stop /
Stop /
Authorized /
Key Request
Op Reauth
Wait
TEK Invalid /
Auth Pend /
Auth Comp /
Key Request
Key Reject,
Stop /
Op Wait
Timeout /
Key Request
Rekey
Reauth
Wait
TEK Invalid /
Key Request
Key Reply /
Stop /
Auth Pend /
Auth Comp /
Key Request
Operational
Key Reply /
Rekey
Wait
TEK Refresh Timeout /
Key Request
Timeout /
Key Request
TEK UPdated
GKEK Updated/
M&B Rekey
Interim Wait
TEK Refresh Timeout /
Key Request
TEK Invalid/
Key Request

Figure 131—TEK state machine flow diagram

### Table 134—TEK FSM state transition matrix

| **State Event or Rcvd Message** | **(A) Start** | **(B) Op Wait** | **(C) Op Reauth Wait** | **(D) Op** | **(E) Rekey Wait** | **(F) Rekey Reauth Wait** | **(G) M&B Rekey Interim Wait** |
|---|---|---|---|---|---|---|---|
| (1)<br>*Stop* | | Start | Start | Start | Start | Start | |
| (2)<br>*Authorized* | Op Wait | | | | | | |
| (3)<br>*Auth Pend* | | Op Reauth Wait | | | Rekey Reauth Wait | | |
| (4)<br>*Auth Comp* | | | Op Wait | | | Rekey Wait | |
| (5)<br>*TEK Invalid* | | | | Op Wait | Op Wait | Op Reauth Wait | |
| (6)<br>*Timeout* | | Op Wait | | | Rekey Wait | | |
| (7)<br>*TEK Refresh Timeout* | | | | Rekey Wait | | | Rekey Wait |
| (8)<br>Key Reply | | Operational | | | Operational | | |
| (9)<br>Key Reject | | Start | | | Start | | |
| (10)<br>GKEK Updated | | | | M&B Rekey Interim Wait | | | |
| (11)<br>GTEK Updated | | | | | | | Operational |

#### 7.2.2.5.1 States

*Start:* This is the initial state of the FSM. No resources are assigned to or used by the FSM in this state—e.g., all timers are off, and no processing is scheduled.

*Operational Wait (Op Wait):* The TEK state machine has sent its initial request (Key Request) for its SAID's keying material (TEK and CBC initialization vector), and is waiting for a reply from the BS.

*Operational Reauthorize Wait (Op Reauth Wait):* The wait state the TEK state machine is placed in if it does not have valid keying material while the Authorization state machine is in the middle of a reauthorization cycle.

*Operational:* The SS has valid keying material for the associated SAID.

*Rekey Wait:* The TEK Refresh Timer has expired and the SS has requested a key update for this SAID. Note that the newer of its two TEKs has not expired and may still be used for both encrypting and decrypting data traffic.

*Rekey Reauthorize Wait (Rekey Reauth Wait):* The wait state the TEK state machine is placed in if the TEK state machine has valid traffic keying material, has an outstanding request for the latest keying material, and the Authorization state machine initiates a reauthorization cycle.

*M&B Rekey Interim Wait (Multicast & Broadcast Rekey Interim Wait):* This state is defined only for the multicast service or the broadcast service. This state is the wait state the TEK state machine is placed in if the TEK state machine has valid traffic keying material and receives the new GKEK from the BS.

#### 7.2.2.5.2 Messages

Note that the message formats are defined in detail in 6.3.2.3.9.

*Key Request:* Request a TEK for this SAID. Sent by the SS to the BS and authenticated with keyed message digest. The message authentication key is derived from the AK.

*Key Reply:* Response from the BS carrying the two diversity sets of traffic keying material for this SAID. Sent by the BS to the SS, it includes the SAID's TEKs, encrypted with a KEK derived from the AK or the GSAID's GTEK, encrypted with a GKEK randomly generated from the BS or the ASA server. The Key Reply message is authenticated with a keyed message digest; the authentication key is derived from the AK.

*Key Reject:* Response from the BS to the SS to indicate this SAID is no longer valid and no key will be sent. The Key Reject message is authenticated with a keyed message digest; the authentication key is derived from the AK.

*TEK Invalid:* The BS sends an SS this message if it determines that the SS encrypted an uplink PDU with an invalid TEK, i.e., an SAID's TEK key sequence number, contained within the received PDU's MAC Header, is out of the BS's range of known, valid sequence numbers for that SAID.

*Key Update Command:* Push a GTEK for this GSAID for the multicast service or the broadcast service. Sent by the BS to the SS and authenticate with keyed message digest. The message authentication key is derived from the AK in the Key Update Command message for the GKEK update mode. The message authentication key is derived from the GKEK in the Key Update Command message for the GTEK update mode.

#### 7.2.2.5.3 Events

*Stop:* Sent by the Authorization FSM to an active (non-START state) TEK FSM to terminate TEK FSM and remove the corresponding SAID's keying material from the SS's key table. See Figure 130k.

*Authorized:* Sent by the Authorization FSM to a non-active (START state) TEK FSM to notify TEK FSM of successful authorization. See Figure 130k.

*Authorization Pending (Auth Pend):* Sent by the Authorization FSM to TEK FSM to place TEK FSM in a wait state while Authorization FSM completes reauthorization. See Figure 130k.

*Authorization Complete (Auth Comp):* Sent by the Authorization FSM to a TEK FSM in the Operational Reauthorize Wait or Rekey Reauthorize Wait states to clear the wait state begun by the prior Authorization Pending event. See Figure 130k.

*TEK Invalid:* This event is triggered by either an SS's data packet decryption logic or by the receipt of a TEK Invalid message from the BS.

An SS's data packet decryption logic triggers a TEK Invalid event if it recognizes a loss of TEK key synchronization between itself and the encrypting BS. For example, an SAID's TEK key sequence number, contained within the received downlink MAC PDU header, is out of the SS's range of known sequence numbers for that SAID.

A BS sends an SS a TEK Invalid message, triggering a TEK Invalid event within the SS, if the BS's decryption logic recognizes a loss of TEK key synchronization between itself and the SS.

*Timeout:* A retry timer timeout. Generally, the particular request is retransmitted.

*TEK Refresh Timeout:* The TEK refresh timer timed out. This timer event signals the TEK state machine to issue a new Key Request in order to refresh its keying material. The refresh timer is set to fire a configurable duration of time (*TEK Grace Time*) before the expiration of the newer TEK the SS currently holds. This is configured via the BS to occur after the scheduled expiration of the older of the two TEKs.

*GKEK Updated:* This event is triggered when the SS receives the new GKEK through the Key Update Command message for the GKEK update mode.

*GTEK Updated:* This event is triggered when the SS receives the new GTEK and traffic keying material through the Key Update Command message for the GTEK update mode.

#### 7.2.2.5.4 Parameters

All configuration parameter values take the default values from Table 343 or may be specified in Auth Reply message.

*Operational Wait Timeout:* Timeout period between sending of Key Request messages from the Op Wait state (see 11.9.19.4).

*Rekey Wait Timeout:* Timeout period between sending of Key Request messages from the Rekey Wait state (see 11.9.19.5).

*TEK Grace Time:* Time interval, in seconds, before the estimated expiration of a TEK that the SS starts rekeying for a new TEK. TEK Grace Time takes the default value from Table 343 or may be specified in a configuration setting within the Auth Reply message and is the same across all SAIDs (see 11.9.19.6).

*M&B TEK Grace Time (Multicast & Broadcast TEK Grace Time):* Time interval, in seconds, before the estimated expiration of an old distributed GTEK.

#### 7.2.2.5.5 Actions

Actions taken in association with state transitions are listed by <event> (<rcvd message>) --> <state>:

1-B Op Wait (*Stop*) → Start

a) Clear Key Request retry timer
b) Terminate TEK FSM

1-C Op Reauth Wait (*Stop*) → Start

a) Terminate TEK FSM

1-D Operational (*Stop*) → Start

a) Clear TEK refresh timer, which is timer set to go off *"TEK Grace Time"* seconds prior to the TEK's scheduled expiration time
b) Terminate TEK FSM
c) Remove SAID keying material from key table

1-E Rekey Wait (*Stop*) → Start

a) Clear Key Request retry timer
b) Terminate TEK FSM
c) Remove SAID keying material from key table

1-F Rekey Reauth Wait (*Stop*) → Start

a) Terminate TEK FSM
b) Remove SAID keying material from key table

2-A Start (*Authorized*) → Op Wait

a) Send Key Request message to BS
b) Set Key Request retry timer to Operational Wait Timeout

3-B Op Wait (*Auth Pend*) → Op Reauth Wait

a) Clear Key Request retry timer

3-E Rekey Wait (*Auth Pend*) → Rekey Reauth Wait

a) Clear Key Request retry timer

4-C Op Reauth Wait (*Auth Comp*) → Op Wait

a) Send Key Request message to BS
b) Set Key Request retry timer to Operational Wait Timeout

4-F Rekey Reauth Wait (*Auth Comp*) → Rekey Wait

a) Send Key Request message to BS
b) Set Key Request retry timer to Rekey Wait Timeout

5-D Operational (*TEK Invalid*) → Op Wait

a) Clear TEK refresh timer
b) Send Key Request message to BS
c) Set Key Request retry timer to Operational Wait Timeout
d) Remove SAID keying material from key table

5-E Rekey Wait (*TEK Invalid*) → Op Wait

a) Clear TEK refresh timer
b) Send Key Request message to BS
c) Set Key Request retry timer to Operational Wait Timeout
d) Remove SAID keying material from key table

5-F Rekey Reauth Wait (*TEK Invalid*) → Op Reauth Wait

a) Remove SAID keying material from key table

6-B Op Wait (*Timeout*) → Op Wait

a) Send Key Request message to BS
b) Set Key Request retry timer to Operational Wait Timeout

6-E Rekey Wait (*Timeout*) → Rekey Wait

a) Send Key Request message to BS
b) Set Key Request retry timer to Rekey Wait Timeout

7-D Operational (*TEK Refresh Timeout*) → Rekey Wait

a) Send Key Request message to BS
b) Set Key Request retry timer to Rekey Wait Timeout

7-G M&B Rekey Interim Wait (*TEK Refresh Timeout*) -> Rekey Wait

a) Send Key Request message to BS
b) Set Key Request retry timer to Rekey Wait Timeout

8-B Op Wait (Key Reply) → Operational

a) Clear Key Request retry timer
b) Process contents of Key Reply message and incorporate new keying material into key database
c) Set the TEK refresh timer to go off “TEK Grace Time” seconds prior to the newer key’s scheduled expiration

8-E Rekey Wait (Key Reply) → Operational

a) Clear Key Request retry timer
b) Process contents of Key Reply message and incorporate new keying material into key database
c) Set the TEK refresh timer to go off “TEK Grace Time” seconds prior to the newer key’s scheduled expiration

9-B Op Wait (Key Reject) → Start

a) Clear Key Request retry timer
b) Terminate TEK FSM

9-E Rekey Wait (Key Reject) → Start

a) Clear Key Request retry timer
b) Terminate TEK FSM
c) Remove SAID keying material from key table

10-D Operational (*GKEK Updated*) -> M&B Rekey Interim Wait

a) Process contents of Key Update Command message for the GKEK update mode and incorporate new GKEK into key database

11-G M&B Rekey Interim Wait (*GTEK Updated*) -> Operational

a) Clear Key Request retry timer
b) Process contents of Key Update Command message for the GTEK update mode and incorporate new traffic keying material into key database
c) Set the TEK refresh timer to go off “TEK Grace Time” seconds prior to the key’s scheduled expiration

## 7.3 Key Usage

***Replace Figure 134 TEK Management in BS and SS with the following figure:***

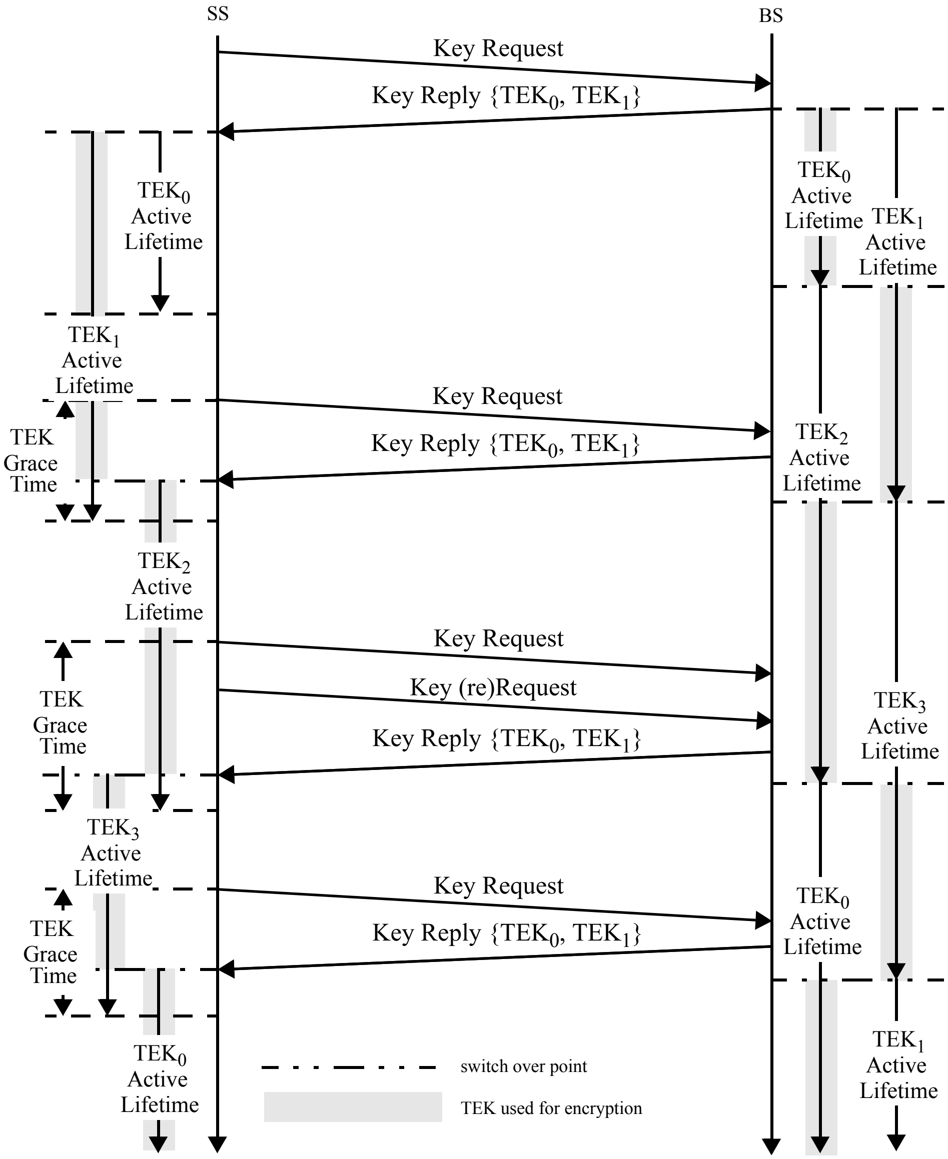

SS
BS
Key Request
Key Reply {TEK0, TEK1}
TEK0 Active Lifetime
TEK1 Active Lifetime
TEK0 Active Lifetime
TEK1 Active Lifetime
Key Request
Key Reply {TEK0, TEK1}
TEK Grace Time
TEK2 Active Lifetime
TEK2 Active Lifetime
Key Request
Key (re)Request
Key Reply {TEK0, TEK1}
TEK Grace Time
TEK3 Active Lifetime
TEK3 Active Lifetime
Key Request
Key Reply {TEK0, TEK1}
TEK Grace Time
TEK0 Active Lifetime
TEK0 Active Lifetime
TEK1 Active Lifetime
switch over point
TEK used for encryption

Figure 134—TEK management in BS and SS

## 7.5 Cryptographic methods

### 7.5.1 Data Encryption methods

### 7.5.1.1 Data encryption with DES in CBC mode

***Change the second paragraph as indicated:***

The CBC IV shall be calculated as follows: in the downlink, the CBC shall be initialized with the exclusive-or (XOR) of (1) the IV parameter included in the TEK keying information, and (2) the ~~content of the PHY Synchronization field~~current Frame Number (right justified) ~~of the latest DL-MAP~~. In the uplink, the CBC shall be initialized with the XOR of (1) the IV parameter included in the TEK keying information, and (2) the ~~content of the PHY Synchronization field of the DL-MAP that is in effect when the UL-MAP for the uplink transmission is created/received~~ Frame Number of the frame where the relevant UL-MAP was transmitted.

### 7.5.1.2 Data encryption with AES in CCM mode

***Change the title of 7.5.1.2.1 as indicated:***

#### 7.5.1.2.1 PDU ~~P~~payload ~~F~~format

***Change the first and third paragraph as indicated:***

The PDU payload shall be prepended with a 4-byte PN (Packet Number). The PN shall be transmitted ~~in little endian byte order~~ LSB first. The PN shall not be encrypted.

The ciphertext ~~ICV~~ Message Authentication Code is transmitted such that byte index 0 (as enumerated in the NIST AES Specification) is transmitted first and byte index 7 is transmitted last (i.e., LSB First) ~~in little endian byte order~~.

***Replace Figure 135 with the following figure:***

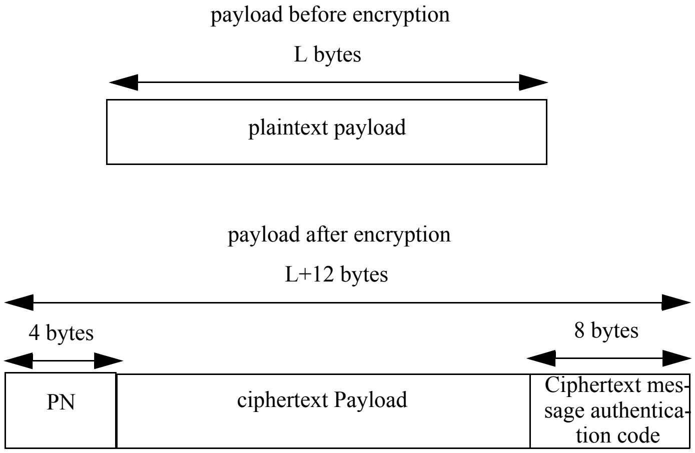


**Figure 135—Encrypted payload format in AES-CCM mode**

#### 7.5.1.2.2 PN (Packet Number)

***Change the first paragraph as indicated:***

The PN associated with an SA shall be set to 1 when the SA is established and when a new TEK is installed. ~~The PN shall be transmitted little endian order in the MAC PDU as described in 7.5.1.2.1.~~ After each PDU transmission, the PN shall be incremented by 1. On uplink connections, the PN shall be XORed with 0x80000000 prior to encryption and transmission. On downlink connections, the PN shall be used without such modification.

***Change the title of 7.5.1.2.3 as indicated:***

### 7.5.1.2.3 CCM ~~A~~algorithm

***Change this subclause as indicated:***

The NIST CCM specification defines a number of algorithm parameters. These parameters shall be fixed to specific values when used in SAs with a data encryption algorithm identifier of 0x02.

~~The~~ 'Tlen' shall equal 64 and t shall equal 8, meaning, the number of ~~octets~~ bytes in the Message Authentication field ~~authentication field M~~ shall be set to 8. Consistent with the CCM specification the 3-bit binary encoding $[(t-2)/2)]_3$ of ~~M~~ bits 5, 4, and 3 of the 'Flags' byte in $B_0$ shall be 011.

The size q of the length field Q shall be set to 2. Consistent with the CCM specification, the 3-bit binary encoding $[q-1]_3$ of the q ~~DLEN size~~ field in bits 2, 1 and 0 of the 'Flags' byte in $B_0$ shall be 001.

The length a of the ~~additional authenticated~~ associated data string A ~~l(a)~~ shall be set to 0.

The nonce shall be 13 bytes long as shown in Figure 135a. Bytes 0 through 4 ~~1 through 5~~ shall be set to the first five bytes of the Generic MAC header ~~GMH~~ (thus excluding the HCS). The HCS of the Generic MAC header is not included in the nonce since it is redundant. Bytes 5 through 8 ~~Bytes 6 through 9~~ are reserved and shall be set to 0x00000000. Bytes 9 through 12 ~~10 through 13~~ shall be set to the value of the PN. The PN Bytes shall be ordered such that Byte 9 ~~10~~ shall take the least significant byte and byte 12 ~~13~~ shall take the most significant byte.

| Byte number | 0 4 | 5 8 | 9 12 |
|---|---|---|---|
| Field | Generic MAC header | *Reserved* | PN |
| Contents | Generic MAC header omitting HCS | 0x00000000 | packet number field from payload |

**Figure 135a—Nonce N Construction**

Consistent with the CCM specification, the initial block $B_0$ is formatted as shown in Figure 136.

***Replace Figure 136 with the following figure:.***

| Byte number | 0 | 1 13 | 14 15 |
|---|---|---|---|
| Byte significance: | | | MSB LSB |
| Number of bytes | 1 | 13 | 2 |
| Field | Flag | Nonce | L |
| Contents | 0x19 | As specified in Figure 135a | Length of plain text payload |

**Figure 136—Initial CCM Block $B_0$**

Note the ~~big endian~~ ordering of the DLEN value is MSB first, consistent ~~opposite that of the normal little endian representation. This is to remain compliant~~ with the ~~letter of the~~ NIST CCM specification.

~~The sixth byte of the GMH is not included in the nonce since it is redundant.~~

Consistent with the NIST CCM specification the counter blocks $\text{Ctr}_i$ ~~$A_i$~~ are formatted as shown in Figure 137.

***Replace Figure 137 with the following figure:***

| | | | |
|---|---|---|---|
| Byte number | 0 | 1 13 | 14 15 |
| Byte significance: | | | MSB LSB |
| Number of bytes | 1 | 13 | 2 |
| Field | Flag | Nonce | Counter |
| Contents | 0x1 | As specified in Figure 135a | i |

**Figure 137—Construction of counter blocks Ctr$_j$**

***Insert a new subclause 7.5.1.2.5:***

### 7.5.1.2.5 AES-CCM Mode example encrypted MPDUs

The following two examples show MPDUs in both plaintext and enciphered form in transmission order. In addition, the post-decryption plaintext of the Message Authentication Code is shown.

Example AES-CCM PDU #1 (Hex)

**Plaintext PDU**
Generic MAC header = 00 40 0A 06 C4 30
Payload = 00 01 02 03
**Ciphertext PDU where TEK = 0xD50E18A844AC5BF38E4CD72D9B0942E5**
**and PN=0x2157F6BC**
Generic MAC header = 40 40 1A 06 C4 5A
PN field = BC F6 57 21
Encrypted payload = E7 55 36 C8
Encrypted message authentication code =27 A8 D7 1B 43 2C A5 48
CRC32 for SC, SCa, and OFDM mode = CB B6 5F 48
CRC32 for OFDMA mode = 1B D1 BA 21
**After decryption**
Plaintext message authentication code = 01 59 09 A0 ED CC 21 D3

Example AES-CCM PDU #2 (Hex)

**Plaintext PDU**
Generic MAC header = 00 40 27 7E B2 AD
Payload = 00 01 02 03 04 05 06 07 08 09 0A 0B 0C 0D 0E 0F
10 11 12 13 14 15 16 17 18 19 1A 1B 1C 1D 1E 1F
20
**Ciphertext PDU where TEK = 0xB74EB0E4F81AD63D121B7E9AECCD268F**
**and PN=0x78D07D08**
Generic MAC header = 40 40 37 7E B2 C7
PN field = 08 7D D0 78
Encrypted payload = 71 3F B1 22 B9 73 4F DB FD 68 2E AD 9D CA 9F 44
1F 62 FE 0F 4A 2C 45 B5 53 17 3D 66 5B 2D 53 C1
B3
Encrypted message authentication code = E7 E4 8D 2D B7 61 CF 94
CRC32 for SC, SCa, and OFDM mode = 92 1B 32 41
CRC32 for OFDMA mode = FD 03 7B 1D
**After decryption**
Plaintext message authentication code = 0B DB 85 3C 0A CA E6 5F

***Insert new subclause 7.5.1.3:***

### 7.5.1.3 Data encryption with AES in CTR mode

If the data encryption algorithm identifier in the cryptographic suite of an MBS GSA equals 0x80, data on connections associated with that SA shall use the CTR mode of the US Advanced Encryption Standard (AES) algorithm [NIST Special Publication 800-38A, FIPS 197, RFC 3686] to encrypt the MAC PDU payloads. In MBS, the AES block size and cipher counter block are 128 bits.

#### 7.5.1.3.1 Encrypted MBS PDU payload format

Counter mode requires unique initial counter and key pair across all messages. This subclause describes the initialization of the 128-bit initial counter, constructed from the 24-bit PHY synchronization field or frame number and a new 8-bit Rollover counter (ROC).

NOTE—When we start to deal with a new PDU we have a new frame number and therefore re-initialize the counter. When the frame number reaches 0x000000 (from 0xFFFFFF), we increment ROC.

The PDU payload for AES-CTR encryption shall be prepended with the 8-bit ROC, i.e., the ROC is the 8 MSBs of the 32-bit nonce. The ROC shall not be encrypted.

Any tuple value of {AES Counter, KEY} shall not be used more than once for the purposes of encrypting a block. SS and BS shall ensure that a new MGTEK is requested and transferred before the ROC reaches 0xFF.

A 32-bit nonce NONCE = n0 | n1 | n2 | n3 (n0 being the MSByte and n3 the LSByte) is made of ROC and 24 bits frame number in the following way: n0=ROC and n1, n2, n3 are the byte representation of frame-number in MSB first order. NONCE shall be repeated four times to construct the 128-bit counter block required by the AES-128 cipher. (initial counter = NONCE|NONCE|NONCE|NONCE). When incremented, this 16-byte counter will be treated as a Big Endian number.

This mechanism can reduce per-PDU overhead of transmitting the full counter. At the most 2^32 PDUs can be encrypted with a single MTK.

The plaintext PDU shall be encrypted using the active MBS_Traffic_key (MTK) derived from MAK and MGTEK, according to CTR mode specification. A different 128-bit counter value is used to encrypt each 128-bit block within a PDU.

The processing yields a payload that is 8 bits longer than the plaintext payload.

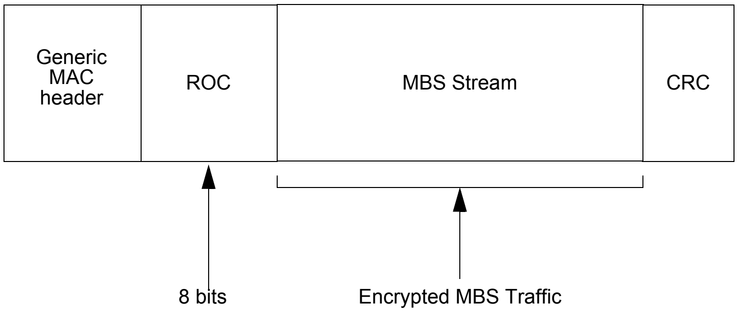


Figure 137a—MBS MAC PDU Ciphertext payload format

#### 7.5.1.4 Data encryption with AES in CBC mode

If the data encryption algorithm identifier in the cryptographic suite of an SA equals 0x03, data on connections associated with that SA shall use the CBC mode of the US Advanced Encryption Standard (AES) algorithm [NIST Special Publication 800-38A, FIPS 197] to encrypt the MAC PDU payloads.

Residual termination block processing shall be used to encrypt the final block of plaintext when the final block is less than the cipher block size. Given a final block having n bits, where n is less than the cipher block size m, the next-to-last ciphertext block shall be divided into two parts. One of the two parts is n bits, the other part is m-n bits. The former will be sent to receiver as the final block ciphertext. Padding the final short block to obtain a complete plaintext block, then encrypt it with AES algorithm in CBC mode. The encryption and decryption procedure is depicted in Figure 137b.

In the special case when the payload portion of the MAC PDU is less than the cipher block size, the most significant n bits of the generated CBC-IV, corresponding to the number of bits of the payload, shall be XORed with the n bits of the payload to generate the short cipher block.

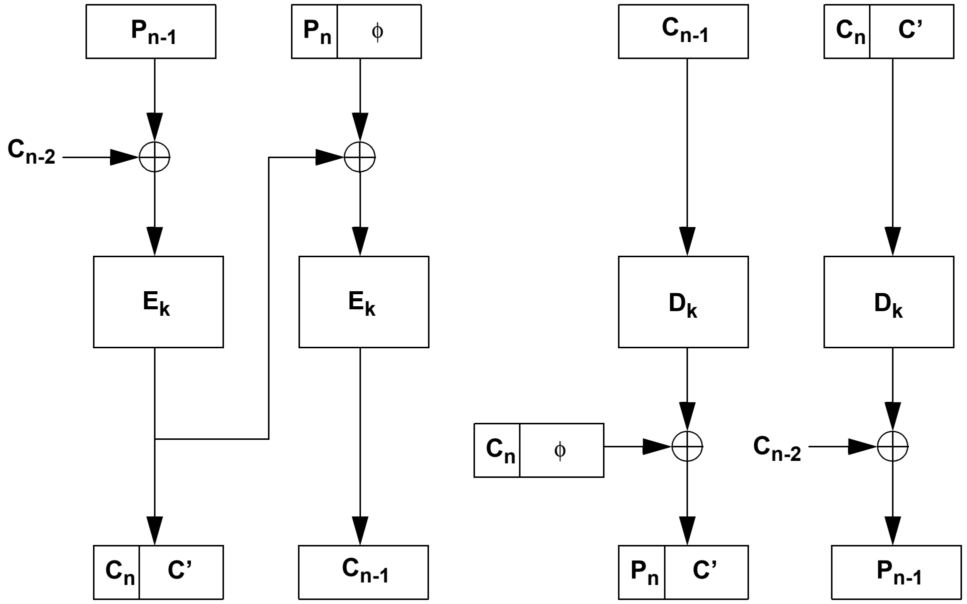


Figure 137b—Residual termination block processing with CTS

##### 7.5.1.4.1 CBC IV generation

The Zero Hit Counter is initialized into zero when the Key Reply message is received, and updates whenever either the PHY Frame number is zero or MAC PDU is received in a frame. The Zero Hit Counter increases by one if the previous PHY Frame number is equal to or greater than the current PHY Frame number.

The CBC IV is generated as the result of the AES block ciphering algorithm with the key of TEK. Its plain text for the CBC IV generation is calculated with the exclusive-or (XOR) of (1) the CBC IV parameter value included in the TEK keying information, and (2) the 128-bits content which is a concatenation of the 48-bit

MAC PDU header, the 32-bit PHY Synchronization value of the MAP that a data transmission occurs, and the XOR value of the 48-bit SS MAC address and the Zero Hit Counter.

The CBC IV shall be updated every MAC PDUs.

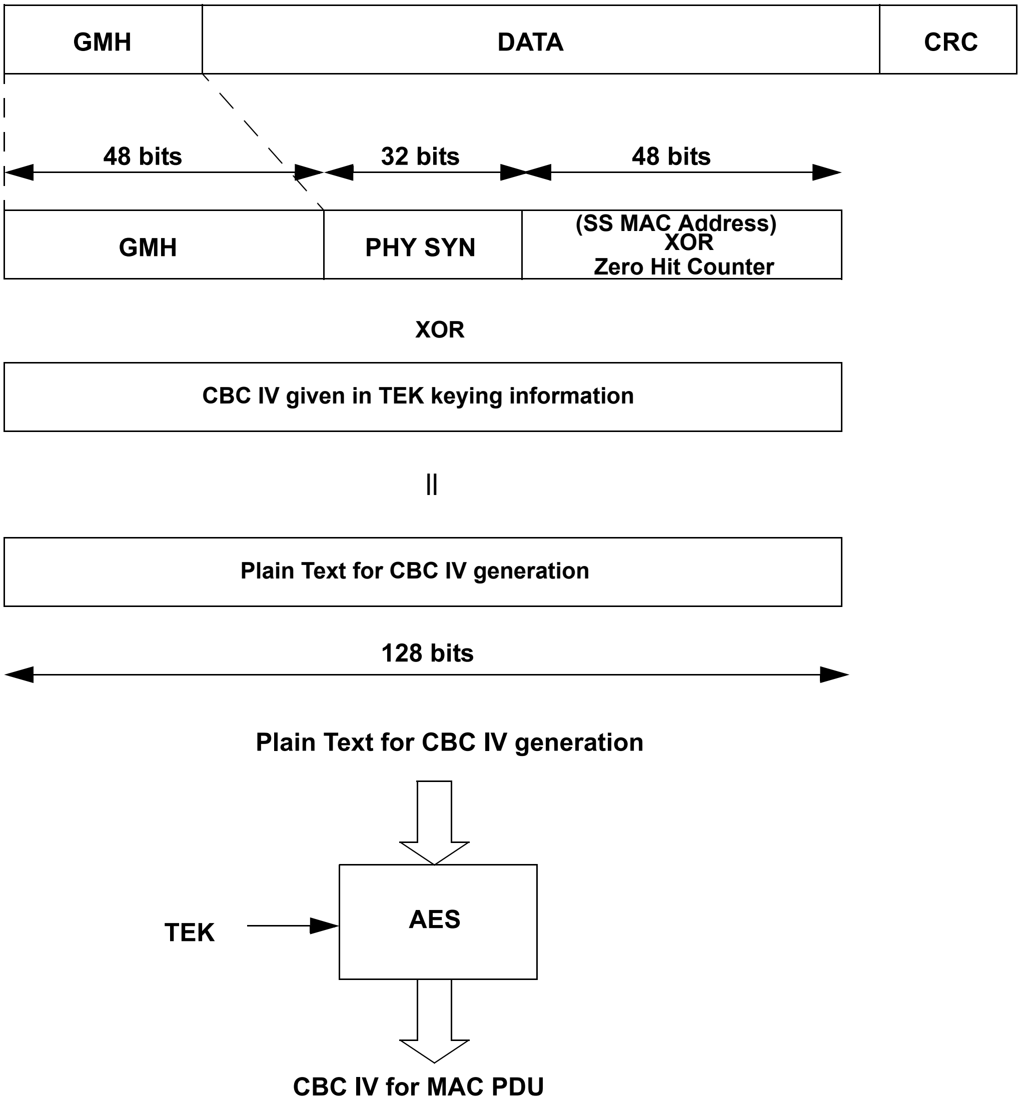

GMH
DATA
CRC
48 bits
32 bits
48 bits
GMH
PHY SYN
(SS MAC Address)
XOR
Zero Hit Counter
XOR
CBC IV given in TEK keying information
||
Plain Text for CBC IV generation
128 bits
Plain Text for CBC IV generation
TEK
AES
CBC IV for MAC PDU

Figure 137c—CBC IV generation

If the MAC PDU is decoded from several channel coded blocks transmitted at different frames in HARQ operation, the MAC PDU payload must be decrypted with the CBC IV value which are generated from the PHY Synchronization value of the MAP when spid = 0.

#### 7.5.1.2.4 Receive Processing Rules

***Insert at the end of 7.5.1.2.4:***

The receiver shall maintain a PN window whose size is specified by the PN_WINDOW_SIZE parameter for SAs and management connections as defined in 11.9.36. Any received PDU with a PN lower than the beginning of the PN window shall be discarded as a replay attempt. The receiver shall track PNs within the PN window. Any PN that is received more than once shall be discarded as a replay attempt. Upon reception of a PN, which is greater than the end of the PN window, the PN window shall be advanced to cover this PN.

***Insert new subclause 7.5.2.4***

#### 7.5.2.4 Encryption of TEK-128 with AES Key Wrap

This method of encrypting the TEK-128 shall be used for SAs with the TEK encryption algorithm identifier in the cryptographic suite equal to 0x04.

The BS encrypts the value fields of the TEK-128 in the Key Reply messages it sends to client SS. This field is encrypted using the AES Key Wrap Algorithm.

encryption: C,I = Ek[P]
decryption: P,I = Dk[C]
P = Plaintext 128-bit TEK
C = Ciphertext 128-bit TEK
I = Integrity Check Value
k = the 128-bit KEK
Ek[ ] = AES Key Wrap encryption with key k
Dk[ ] = AES Key Wrap decryption with key k

The AES key wrap encryption algorithm accepts both a ciphertext and an integrity check value. The decryption algorithm returns a plaintext key and the integrity check value. The default integrity check value in the NIST AES Key Wrap algorithm shall be used.

### 7.5.3 Calculation of HMAC-Digests

***Replace the last sentence of the subclause with the following sentence:***

~~The digest shall be calculated over the entire MAC Management message with the exception of the HMAC-Digest and HMAC Tuple attributes.~~

The HMAC sequence number in the HMAC tuple or Short-HMAC tuple shall be equal to the AK sequence number of the AK from which the HMAC_KEY_x was derived.

In the case of PKMv2, Short-HMAC Digest Calculations shall include the HMAC_PN_* that should be concatenated after the MAC Management message.

### 7.5.4 Derivation of TEKs, KEKs, and message authentication keys

***Change the title of subclause 7.5.4.2 as indicated:***

#### 7.5.4.2 ~~3-DES~~ KEKs

***Insert the following paragraph at the end of the subclause:***

The construction of the KEK for use with TEK-128 keys shall be the same as for 3-DES KEKs except that the full 128 bits of the KEK are used directly as the 128-bit AES key, instead of the KEK being split into two 64-bit DES keys.

***Insert new subclause 7.5.4.4 as follows:***

### 7.5.4.4 Cipher-based MAC (CMAC)

A BS or SS may support management message integrity protection based on Cipher-based MAC—together with the AES block cipher. The CMAC construction as specified in Special Publication 800-38B—Recommendation for Block Cipher Modes of Operation: the CMAC Mode for Authentication: May 2005 shall be used.

### 7.5.4.4.1 Calculation of CMAC Value

The calculation of the keyed hash value contained in the CMAC-Digest attribute and the CMAC Tuple shall use the CMAC Algorithm with AES. The downlink authentication key CMAC_KEY_D shall be used for authenticating messages in the downlink direction. The uplink authentication key CMAC_KEY_U shall be used for authenticating messages in the uplink direction. Uplink and downlink message authentication keys are derived from the AK (see 7.5.4 below for details).

For authentication multicast messages (in the DL only) a CMAC_KEY_GD shall be used (one for each group), group authentication key is derived from GKEK

The CMAC-Digest and CMAC Tuple attributes shall be only applicable to the PKM version 2. In the PKM version 2 protocol, the AKID ~~CMAC key sequence number~~ used in the computation of the CMAC value ~~tuple~~ shall be the 64 bit AKID ~~equal to the 4-bit AK sequence number~~ of the AK from which the CMAC_KEY_x was derived. See 6.3.2.3.9.18 for the SA-TEK-Challenge message attributes in which the mapping between the AK Sequence number and the AKID is communicated and see 7.2.2.4.1 for a description of the AK context that contains the AK and AKID.

The CMAC Packet Number Counter (CMAC_PN_*) is a 4-byte sequential counter that is incremented in the context of UL messages by the SS, and in the context of DL messages by the BS,. The BS will also maintain a separate CMAC_PN_* for multicast packets per each GSA and increment that counter in the context of each multicast packet from the group. For MAC messages that have no CID e.g., RNG-REQ message, the CMAC_PN_* context will be the same as used on the basic CID. If basic CID is unknown (e.g., in network reentry situation) then CID 0 should be used.

The CMAC Packet Number Counter, CMAC_PN_*, is part of the CMAC security context and must be unique for each MAC management message with the CMAC tuple or digest. Any tuple value of {CMAC_PN_*, AK} shall not be used more than once. The reauthentication process should be initiated (by BS or SS) to establish a new AK before the CMAC_PN_* reaches the end of its number space.

The digest shall be calculated over a field consisting of the AKID ~~CMAC key sequence number~~ followed by the CMAC Packet Number Counter, expressed as an unsigned 32-bit number, followed by the 16-bit Connection ID on which the message is sent, followed by 16-bit of zero padding (for the header to be aligned with AES block size) and followed by the entire MAC management message with the exception of the CMAC-TLV.

The least significant bits of the digest shall be truncated to yield a 64-bit length digest. ~~The CMAC key sequence number shall be equal to the 4-bit AK sequence number of the AK from which the CMAC_KEY_x was derived.~~

i.e.,:

CMAC value <= Truncate64 (CMAC (CMAC_KEY_*, AKID ~~CMAC key sequence number~~ | CMAC_PN | CID |16-bit zero padding | MAC_Management_Message))

If the digest is included in an MPDU that has no CID, e.g., A RNG-REQ message, the CID used shall take the value of the basic CID. If basic CID is unknown (e.g., in network reentry situation) then CID 0 should be used.

***Insert new subclause 7.5.4.5:***

#### 7.5.4.5 Derivation of TEKs, KEKs, message authentication keys and GKEKs in PKMv2

***Insert new subclause 7.5.4.5.1:***

#### 7.5.4.5.1 AES KEKs in PKMv2

The construction of the KEK for use with TEK-128 keys shall be the same as for 3-DES KEKs as described in 7.5.4.2 except that the full 128 bits of the KEK are used directly as the 128-bit AES key, instead of the KEK being split into two 64-bit DES keys.

***Insert new subclause 7.5.4.5.2:***

#### 7.5.4.5.2 Encryption of GKEK in PKMv2

The BS encrypts the value fields of the GKEK in the Key Update Command message for the GKEK update mode and sends the encrypted GKEK to each SS served with the specific multicast service or the broadcast service. The following options for encryption of GKEK may be used. The encryption algorithm is determined according to the value of cryptographic suite. Also, the value of cryptographic suite for GKEK encryption is identical to the one for GTEK encryption.

***Insert new subclause 7.5.4.5.2.1:***

#### 7.5.4.5.2.1 Encryption of GKEK with 3-DES in PKMv2

This method of encrypting the GKEK shall be used for SAs with the TEK (or GTEK) encryption algorithm identifier in the cryptographic suite equal to 0x01.

The BS encrypts the value fields of the GKEK in the Key Update Command messages (for the GKEK update mode) it sends to client SS. This field is encrypted using two-key 3-DES in the EDE mode:

Encryption: C = Ek1[Dk2[Ek1[P]]]

Decryption: P = Dk1[Ek2[Dk1[C]]]

P = Plaintext 128-bit GKEK

C = Ciphertext 128-bit GKEK

k1 = leftmost 64 bits of the 128-bit KEK

k2 = rightmost 64 bits of the 128-bit KEK

E [ ] = 56-bit DES ECB mode encryption

D [ ] = 56-bit DES ECB mode decryption

***Insert new subclause 7.5.4.5.2.2:***

### 7.5.4.5.2.2 Encryption of GKEK with RSA in PKMv2

The RSA method of encrypting the GKEK (PKCS #1 v2.1, RSA Cryptography Standard, RSA Laboratories, June 2002) shall be used for SAs with the TEK (or GTEK) encryption algorithm identifier in the cryptographic suite equal to 0x02.

***Insert new subclause 7.5.4.5.2.3:***

### 7.5.4.5.2.3 Encryption of GKEK with ECB mode AES in PKMv2

This method of encrypting the GKEK shall be used for SAs with the TEK (or GTEK) encryption algorithm identifier in the cryptographic suite equal to 0x03.

The BS encrypts the value fields of the GKEK in the Key Update Command messages (for the GKEK update mode) it sends to client SS. This field is encrypted using 128-bit AES in ECB mode.

Encryption: C = Ek1[P]

Decryption: P = Dk1[C]

P = Plaintext 128-bit GKEK

C = Ciphertext 128-bit GKEK

k1 = the 128-bit KEK

E [ ] = 128-bit AES ECB mode encryption

D [ ] = 128-bit AES ECB mode decryption

***Insert new subclause 7.5.4.5.2.4:***

### 7.5.4.5.2.4 Encryption of GKEK with AES Key Wrap in PKMv2

This method of encrypting the GKEK shall be used for SAs with the TEK (or GTEK) encryption algorithm identifier in the cryptographic suite equal to 0x04.

The BS encrypts the value fields of the GKEK in the Key Update Command messages (for the GKEK update mode) it sends to client SS. This field is encrypted using 128-bit AES Key Wrap Algorithm. This 128-bit AES Key Wrap Algorithm is defined only for PKM version 2.

Encryption: C,I = Ek[P]

Decryption: P,I = Dk[C]

P = Plaintext 128-bit GKEK

C = Ciphertext 128-bit GKEK

k = the 128-bit KEK derived from the AK

Ek[ ] = AES Key Wrap encryption with key k

Dk[ ] = AES Key Wrap decryption with key k

***Insert new subclause 7.5.4.6:***

### 7.5.4.6 Key derivation functions for PKMv2

#### 7.5.4.6.1 Dot16KDF for PKMv2

The Dot16KDF algorithm is a CTR mode construction that may be used to derive an arbitrary amount of keying material from source keying material.

In the case that the HMAC/CMAC setting in the MAC (Message Authentication Code) mode is set to CMAC, the algorithm is defined as:

```
Dot16KDF(key, astring, keylength)

{

        result = null;

        Kin = Truncate (key, 128);

        for (i = 0;i <= int((keylength-1)/128); i++) {

                result = result | CMAC(Kin, i | astring | keylength);

        }

        return Truncate (result, keylength);

}
```

In the case that the HMAC/CMAC setting in the authentication policy bits is set to HMAC, the algorithm is defined as:

```
Dot16KDF(key, astring, keylength)

{

        result = null;

        Kin = Truncate (key, 160);

        For (i=0; i <= int( (keylength-1)/160 ); i++) {

                result = result | SHA-1( i| astring | keylength | Kin);

        }

        return Truncate (result, keylength);

}
```

The key is a cryptographic key that is used by the underlying digest algorithm (SHA-1 or CMAC-AES). ‘astring’ is an octet string used to alter the output of the algorithm. ‘keylength’ is used to determine the length of key material to generate and is used in the digest input data to prevent extension attacks. Truncate($x, y$) is the rightmost $y$ bits of a value $x$ only if $y \leqq x$.

***Insert new subclause 7.6.1.4.3:***

#### 7.6.1.4.3 BS certificate

countryName=<Country of Operation>
organizationName=< Name of Infrastructure Operator>
organizationalUnitName=<WirelessMAN>
commonName=<Serial Number>
commonName=<BS Id>

The BS Id field shall contain the operator-defined BSId.[7] It is expressed as six pairs of hexadecimal digits separated by colons (:), e.g., “00:60:21:A5:0A:23.” The Alpha HEX characters (A-F) shall be expressed as uppercase letters.

The attributes listed above shall be included.

***Change 7.6.1.6 as follows:***

### 7.6.1.6 tbsCertificate.issuerUniqueID and tbsCertificate.subjectUniqueID

The issuerUniqueID and subjectUniqueID fields shall be omitted for all ~~both~~ of the PKM’s certificate types.

***Insert new subclause 7.7:***

## 7.7 Pre-Authentication

In anticipation of a handover, an MS may seek to use pre-authentication to facilitate an accelerated reentry at a particular target BS.

Pre-authentication results in establishment of an Authorization Key (with a unique AK Name) in the MS and target BS. The specific mechanism for Pre-authentication is out of the scope of this specification.

***Insert new subclause 7.8 and its subclauses:***

## 7.8 PKMv2

### 7.8.1 PKMv2 SA-TEK 3-way handshake

The AK can be derived in one of three different ways depending on the authentication scheme used as documented in 7.2.2.2.3. Before the 3-way handshake begins, the BS and SS shall both derive a shared KEK and HMAC/CMAC keys as per 7.2.2.2.

The PKMv2 SA-TEK 3-way handshake sequence proceeds as follows:

---

[7] The BSId is an operator-defined value, consequently the BS certificate is typically issued by the Operator, who must ensure that the BS ID is unique within the operator’s network.

1) During initial network entry or reauthorization, the BS shall send PKMv2 SA-TEK-Challenge (including a random number BS_Random) to the SS after protecting it with the HMAC/CMAC Tuple. If the BS does not receive PKMv2 SA-TEK-Request from the SS within SAChallenge-Timer, it shall resend the previous PKMv2 SA-TEK-Challenge up to SAChallengeMaxResends times. If thBit #e BS reaches its maximum number of resends, it shall initiate another full authentication or drop the SS.
2) If HO Process Optimization Bit #1 is set indicating that PKM Authentication phase is omitted during network re-entry or handover, the BS begins the 3-way-handshake by appending the SA Challenge Tuple TLV to the RNG-RSP. If the BS does not receive PKMv2 SA-TEK-Request from the MS within SaChallengeTimer (suggested to be several times greater than the length of SaChallengeTimer), it may initiate full re-authentication or drop the MS. If the BS receives an initial RNG-REQ during the period that PKMv2 SA-TEK-Request is expected, it shall send a new RNG-RSP with another SaChallenge TLV.
3) The SS shall send PKMv2 SA-TEK-Request to the BS after protecting it with the HMAC/CMAC. If the SS does not receive PKMv2 SA-TEK-Response from the BS within SATEK-Timer, it shall resend the request. The SS may resend the PKMv2 SA-TEK-Request up to SATEKRequestMaxResends times. If the SS reaches its maximum number of resends, it shall initiate another full authentication or attempt to connect to another BS. The SS shall include, through the Security Negotiation Parameters attribute, the security capabilities that it included in the SBC-REQ message during the basic capabilities negotiation phase.
4) Upon receipt of PKMv2 SA-TEK-Request, a BS shall confirm that the supplied AKID refers to an AK that it has available. If the AKID is unrecognized, the BS shall ignore the message. The BS shall verify the HMAC/CMAC. If the HMAC/CMAC is invalid, the BS shall ignore the message. The BS shall verify that the BS_Random in the SA TEK Request matches the value provided by the BS in the SA Challenge message. If the BS_Random value does not match, the BS shall ignore the message. In addition, the BS must verify the SS's security capabilities encoded in the Security Negotiation Parameters attribute against the security capabilities provided by the SS through the SBC-REG message. If security negotiation parameters do not match, the BS should report the discrepancy to higher layers.
5) Upon successful validation of the PKMv2 SA-TEK-Request, the BS shall send PKMv2 SA-TEK-Response back to the SS. The message shall include a compound TLV list each of which identifies the Primary and static SAs, their SA identifiers (SAID) and additional properties of the SA (e.g., type, cryptographic suite) that the SS is authorized to access. In case of HO, the details of any Dynamic SAs that the requesting MS was authorized in the previous serving BS are also included. In addition, the BS must include, through the Security Negotiation Parameters attribute, the security capabilities that it wishes to specify for the session with the SS (these will generally be the same as the ones insecurely negotiated in SBC-REQ/RSP).

   Additionally, in case of HO, for each active SA in previous serving BS, corresponding TEK, GTEK and GKEK parameters are also included. Thus, SA_TEK_Update provides a shorthand method for renewing active SAs used by the MS in its previous serving BS. The TLVs specify SAID in the target BS that shall replace active SAID used in the previous serving BS and also "older" TEK-Parameters and "newer" TEK-Parameters relevant to the active SAIDs. The update may also include multicast/broadcast Group SAIDs (GSAIDs) and associated GTEK-Parameters pairs.

   In case of unicast SAs, the TEK-Parameters attribute contains all of the keying material corresponding to a particular generation of an SAID's TEK. This would include the TEK, the TEK's remaining key lifetime, its key sequence number and the cipher block chaining (CBC) initialization vector. The TEKs are encrypted with KEK.

   In case of group or multicast SAs, the TEK-Parameters attribute contains all of the keying material corresponding to a particular generation of a GSAID's GTEK. This would include the

GTEK, the GKEK, the GTEK's remaining key lifetime, the GTEK's key sequence number, and the cipher block chaining (CBC) initialization vector. The type and length of the GTEK is equal to ones of the TEK. The GKEK should be identically shared within the same multicast group or the broadcast group. Contrary Key-Update Command, the GTEKs and GKEKs are encrypted with KEK because they are transmitted as a unicast here.

Multiple iterations of these TLVs may occur suitable to re-creating and re-assigning all active SAs and their (G)TEK pairs for the SS from its previous serving BS. If any of the Security Associations parameters change, then those Security Associations parameters encoding TLVs that have changed will be added.

The HMAC/CMAC shall be the final attribute in the message's attribute list.

6) Upon receipt of PKMv2 SA-TEK-Response, an SS shall verify the HMAC/CMAC. If the HMAC/CMAC is invalid, the SS shall ignore the message. Upon successful validation of the received PKMv2 SA-TEK-Response, the SS shall install the received TEKs and associated parameters appropriately. Verification of HMAC/CMAC is done as per subclauses 7.5.3 and 7.5.4.4.

The SS also must verify the BS's security negotiation parameters TLV encoded in the Security Negotiation Parameters attribute against the security negotiation parameters TLV provided by the BS through the SBC-RSP message. If security capabilities do not match, the SS should report the discrepancy to upper layers. The SS may choose to continue the communication with the BS. In this case, the SS may adopt the security negotiation parameters encoded in SA-TEK-Response message.

### 7.8.2 BS and SS RSA mutual authentication and AK exchange overview

The BS mutual authentication can take place in one of two modes of operation. In one mode, only mutual authentication is used. In the other mode, the mutual authentication is followed by EAP authentication. In this second mode, the mutual authentication is performed only for initial network entry and only EAP authentication is performed in the case that authentication is needed in re-entry.

SS mutual authorization, controlled by the PKMv2 Authorization state machine, is the process of

a) The BS authenticating a client SS's identity.
b) The SS authenticating the BS's identity.
c) The BS providing the authenticated SS with an AK, from which a key encryption key (KEK) and message authentication keys are derived.
d) The BS providing the authenticated SS with the identities (i.e., the SAIDs) and properties of primary and static SAs the SS is authorized to obtain keying information for.

After achieving initial authorization, an SS periodically seeks reauthorization with the BS; reauthorization is also managed by the SS's PKMv2 Authorization state machine. An SS must maintain its authorization status with the BS in order to be able to refresh aging TEKs and GTEKs. TEK state machines manage the refreshing of TEKs. The SS or BS may run optional authenticated EAP messages for additional authentication.

The SS sends an Authorization Request message to its BS immediately after sending the Authentication Information message. This is a request for an AK, as well as for the SAIDs identifying any Static Security SAs the SS is authorized to participate in. The Authorization Request includes (see 6.3.2.3.9.19):

- A manufacturer-issued X.509 certificate.

- A description of the cryptographic algorithms the requesting SS supports; an SS's cryptographic capabilities are presented to the BS as a list of cryptographic suite identifiers, each indicating a particular pairing of packet data encryption and packet data authentication algorithms the SS supports.
- The SS's Basic CID. The Basic CID is the first static CID the BS assigns to an SS during initial ranging-the primary SAID is equal to the Basic CID.
- A 64-bit random number generated in the SS.

In response to an Authorization Request message, a BS validates the requesting SS's identity, determines the encryption algorithm and protocol support it shares with the SS, activates an AK for the SS, encrypts it with the SS's public key, and sends it back to the SS in an Authorization Reply message. Random numbers are included in the exchange to ensure liveness. The Authorization Reply includes (see 6.3.2.3.9.20)

- The BS's X.509 certificate, used to verify the BS's identity.
- A pre-PAK encrypted with the SS's public key.
- A 4-bit PAK sequence number, used to distinguish between successive generations of AKs.
- A PAK lifetime.
- The identities (i.e., the SAIDs) and properties of the single primary and zero or more static SAs the SS is authorized to obtain keying information for.
- The 64-bit random number generated in the SS.
- A 64-bit random number generated in the BS, used to ensure key of liveness along with the random number of SS.
- The RSA signature over all the other attributes in the auth-reply message by BS, used to assure the the authenticity of the above PKMv2 RSA-Reply messages.

An SS shall periodically refresh its AK by reissuing an Authorization Request to the BS. Reauthorization is identical to authorization. To avoid service interruptions during reauthorization, successive generations of the SS's AKs have overlapping lifetimes. Both SS and BS shall be able to support up to two simultaneously active AKs during these transition periods. The operation of the Authorization state machine's Authorization Request scheduling algorithm, combined with the BS's regimen for updating and using a client SS's AKs (see 7.4), ensures that the SS can refresh TEK keying information without interruption over the course of the SS's reauthorization periods.

After successful RSA based authorization either EAP based authorization or Authenticated EAP based authorization maybe supported according to the value of Authorization policy negotiated in the SBC-REQ/RSP messages. It shall cryptographically bind RSA and further EAP authentication.

### 7.8.3 Multicast Broadcast Service (MBS) support

MBS is an efficient and power saving mechanism that requires PKMv2 to send multimedia broadcast information. It provides subscribers with strong protection from theft of service across broadband wireless mobile network by encrypting broadcast connections between SSs and BSs.

#### 7.8.3.1 MBS security associations

In addition to existing three Security Association, MBS requires a MBS Group Security Association. It is the set of security information that multiple BS and one or more of its client SSs share but not bound to any MS authorization state in order to support secure and access controlled MBS content reception across the IEEE 802.16 network. Each MBS capable MS may establish a MBS security association during the MS initialization process. MBS GSAs shall be provisioned within the BS. A MBS GSA's shared information shall include the Cryptographic Suite employed within the GSA and key material information such as MAKs (MBS Authorization Key) and MGTEKs (MBS Group Traffic Encryption Key). The exact content of the

MGSA is dependent on the MGSA's Cryptographic Suite. As like any other Unicast SAs, MBS GSA is also identified using 16bits SAIDs. Each MS shall establish one or more MBS GSA with its serving BS.

Using the PKMv2 protocol, an MS receives or establishes an MBS GSA's keying material. The BS and MBS content server shall ensure that each client MS only has access to the MGSAs it is authorized to access.

An SA's keying material (e.g., MAK and MGTEK) has a limited lifetime. When the MBS content server or BS delivers MBS SA keying material to an MS, it also provides the MS with that material's remaining lifetime. It is the responsibility of the MS to request new keying material from the MBS server or BS before the set of keying material that the MS currently holds expires at the MBS Server or BS.

### 7.8.3.2 MBS Key Management

#### 7.8.3.2.1 MBS Authorization Key (MAK) establishment

The MAK establishment procedure in MS and BS is outside of scope of this specification.

#### 7.8.3.2.2 MGTEK establishment

See 7.2.2.3.3 MBS Group Security Association and PKMv2 Key Derivation (7.2.2.2).

#### 7.8.3.2.3 MBS Traffic Key establishment

See 7.2.2.2 PKMv2 Key Derivation.

***Insert new subclause 7.9:***

## 7.9 Optional multicast and broadcast rekeying algorithm (MBRA)

When MBRA is supported, the MBRA shall be used to refresh traffic keying material efficiently not for the unicast service, but for the multicast service or the broadcast service.

### 7.9.1 MBRA flow

The MBRA overall flow is shown in the Figure 137d.

An SS may get the traffic keying material before an SS is served with the specific multicast service or the broadcast service. The initial GTEK request exchange procedure is executed by using the Key Request and Key Reply messages that are carried on the Primary Management connection. The GTEK (Group Traffic Encryption Key) is the TEK for multicast or broadcast service. Once an SS shares the traffic keying material with a BS, an SS does not need to request the new traffic keying material. A BS updates and distributes the traffic keying material periodically by sending two Key Update Command messages.

A BS manages the M&B (Multicast & Broadcast) TEK Grace Time for the respective GSA-ID in itself. The GSA-ID (Group Security Association Identifier) is the SA-ID for multicast or broadcast service. This M&B TEK Grace Time is defined only for the multicast service or the broadcast service. This parameter means time interval (in seconds), before the estimated expiration of an old distributed GTEK. In addition, the M&B TEK Grace Time is longer than the TEK Grace Time managed in an SS.

A BS distributes updated traffic keying material by sending two Key Update Command messages before old distributed GTEK is expired. The usage type of these messages is distinguished according to the Key Push Modes included in the Key Update Command message.

A BS transmits the PKMv2 Group Key Update Command message for the GKEK update mode to each SS served with the specific multicast service or the broadcast service before the M&B TEK Grace Time starts. The purpose of the Key Update Command message for the GKEK update mode is to distribute the GKEK (Group Key Encryption Key). The Key Update Command message for the GKEK update mode is carried on the Primary Management connection. A BS intermittently transmits the Key Update Command message for the GKEK update mode to each SS in order to reduce the BS's load in refreshing traffic key material. The GKEK is needed to encrypt the new GTEK. The GKEK may be randomly generated in a BS or an ASA server.

A BS transmits the PKMv2 Group Key Update Command message for the GTEK update mode carried on the broadcast connection after the M&B TEK Grace Time starts. The aim of the Key Update Command message for the GTEK update mode is to distribute new GTEK and the other traffic keying material to all SSs served with the specific multicast service or the broadcast service. This GTEK is encrypted with already transmitted GKEK.

An SS shall be capable of maintaining two successive sets of traffic keying material per authorized GSA-ID. Through operation of its GTEK state machines, an SS shall check whether it receives new traffic keying material or not. If an SS gets new traffic keying material, then its TEK Grace Time is not operated. However, if it does not have that, then an SS shall request a new set of traffic keying material a configurable amount of time, the TEK Grace Time, before the SS's latest GTEK is scheduled to expire.

If an SS receives the valid two Key Update Command messages and shares new valid GKEK and GTEK with a BS, then that SS does not need to request a new set of traffic keying material.

If an SS does not receive at least one of two Key Update Command messages, then that SS sends the Key Request message to get a new traffic keying material. A BS responds to the Key Request message with the Key Reply message. In other words, if an SS does not get valid new GKEK or GTEK, then the GTEK request exchange procedure initiated by an SS is executed.

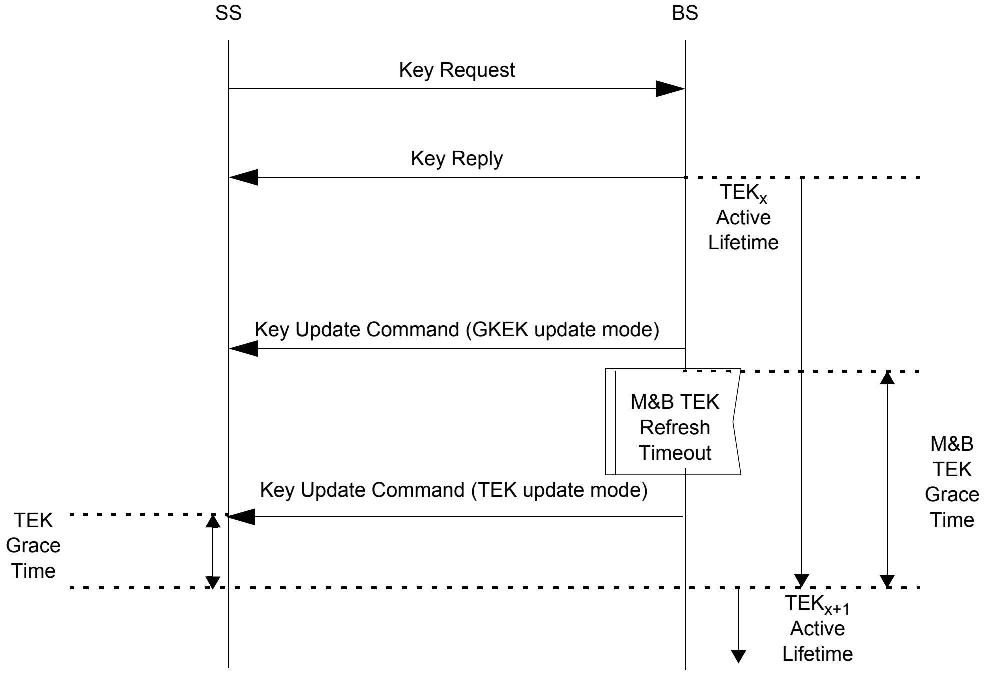


**Figure 137d—MBRA management**

### 7.9.1.1 BS usage of GTEK

An SS tries to get the GTEK before an SS is served with the specific service. The initial GTEK request exchange procedure is executed by using the Key Request and Key Reply messages that are carried on the primary management connection.

A BS shall be capable of maintaining two successive sets of traffic keying material per authorized GSAID. That is, when GKEK has been changed a BS manages the M&B (Multicast & Broadcast) TEK Grace Time for the respective GSA-ID in itself. Through operation of its M&B TEK Grace Time, a BS shall push a new set of traffic keying material. This M&B TEK Grace Time is defined only for the multicast service or the broadcast service in a BS. This parameter means time interval (in seconds) before the estimated expiration of an old distributed GTEK. That is, the M&B TEK Grace Time is longer than the TEK Grace Time managed in an SS.

A BS distributes updated GTEK by using two Key Update Command messages when the GKEK has been changed, or by using one (the second) Key Update Command message otherwise, around the M&B TEK Grace Time, before the already distributed GTEK is expired. Those messages are distinguished according to a parameter included in that message, “Key Push Modes.”

A BS transmits the first Key Update Command message to each SS served with the specific service before the M&B TEK Grace Time. The first Key Update Command message is carried on the primary management connection. A BS intermittently transmits the first Key Update Command message to each SS in order to reduce the BS’s load for key refreshment. The purpose of the first Key Update Command message is to distribute the GKEK (Group Key Encryption Key). This GKEK is needed to encrypt the updated GTEK. The GKEK is also encrypted with the SS’s KEK. The GKEK may be randomly generated in a BS or an ASA server.

A BS transmits the PKMv2 Group Key Update Command message carried on the broadcast connection after the M&B TEK Grace Time. The aim of the second Key Update Command message is to distribute the GTEK to the specific service group. This GTEK is encrypted with transmitted GKEK before the M&B TEK Grace Time.

#### 7.9.1.2 SS usage of GTEK

An SS shall be also capable of maintaining two successive sets of traffic keying material per authorized GSAID. Through operation of its GTEK state machines, an SS shall check whether it receives new traffic keying material or not. If an SS get new traffic keying material, then its TEK Grace Time is not operated. However, if it does not have that, then an SS shall request a new set of traffic keying material a configurable amount of time, the TEK Grace Time, before the SS's latest GTEK is scheduled to expire.

### 7.9.2 Messages

Messages used in the MBRA are the Key Request, Key Reply, and Key Update Command messages.

- Key Request
  An SS may request the traffic keying material with the Key Request message in the initial GTEK request exchange procedure or the GTEK refresh procedure. Refer to 6.3.2.3.9.5.

- Key Reply
  A BS responds to the Key Request message with the Key Reply message including the traffic keying material. Key Reply message includes GKEK as well as GTEK. The GTEK is the TEK for the multicast or broadcast service. GKEK and GTEK are encrypted to safely distribute to an SS. GTEK is encrypted with the GKEK for the multicast service or the broadcast service. The GKEK is encrypted with the KEK. See 7.5.4.5.2 and 7.9.3 for details. This message is carried on the primary management connection. Refer to 6.3.2.3.9.6.

- Key Update Command
  A BS transmits Key Update Command message to initiate and push newly updated GKEK and GTEK to every SSs served with the specific multicast or broadcast service.

### 7.9.3 Encryption of GKEK

The BS encrypts the value fields of the GKEK in the Key Update Command message for the GKEK update mode and sends the encrypted GKEK to each SS served with the specific multicast service or the broadcast service. This field is encrypted using several algorithms. See 7.5.4.5.2 for details.

### 7.9.4 Message authentication keys for the Key Update Command message

One of the HMAC-Digest attribute or the CMAC-Digest attribute is used for Key Update Command message authentication.

Input key used to generate HMAC authentication keys of Key Update Command message is different according to the value field of the Key Push Modes. The AK shall be used for generation of HMAC-Digest included in the Key Update Command message for the GKEK update mode and the GKEK shall be used for generation of HMAC-Digest included in the Key Update Command message for the GTEK update mode. See 7.2.2.2.9 for details. The CMAC_KEY_GD and HMAC_KEY_GD should be recomputed when a new GKEK is used.

# 8. PHY

## 8.1 WirelessMAN-SC PHY specification

### 8.1.3 Duplexing techniques and PHY Type parameter encodings

### 8.1.3.2 TDD operation

### 8.1.3.2.1 TTG

***Change the second and third sentences of the subclause as indicated:***

This gap allows time for the BS to switch from transmit to receive mode ~~and SSs to switch from receive to transmit mode~~. During this gap, the BS ~~and SS are~~is not transmitting modulated data but simply allowing the BS transmitter carrier to ramp down, the transmit/receive (Tx/Rx) antenna switch to actuate, and the BS receiver section to activate.

### 8.1.3.2.2 RTG

***Change the second and third sentences of the subclause as indicated:***

This gap allows time for the BS to switch from receive to transmit mode ~~and SSs to switch from transmit to receive mode~~. During this gap, the BS ~~and SS are~~is not transmitting modulated data but simply allowing the BS transmitter carrier to ramp up~~,~~and the Tx/Rx antenna switch to actuate~~, and the SS receiver sections to activate~~.

### 8.1.4 Downlink PHY

### 8.1.4.1 Downlink subframe

### 8.1.4.1.2 Frame control section

### 8.1.4.1.2.5 Downlink_Burst_Profile

***Change the first paragraph as indicated:***

Each Downlink_Burst_Profile in the DCD message (6.3.2.3.1) shall include the following parameters:

- Modulation type
- FEC Code Type
- Last codeword length
- ~~DIUC mandatory exit threshold~~
- ~~DIUC minimum entry threshold~~
- Preamble Presence

### 8.1.9 Channel quality measurements

### 8.1.9.2 RSSI mean and standard deviation

***Change the second paragraph as indicated:***

Mean and standard deviation statistics shall be reported in units of dBm and dB, respectively. To prepare such reports, statistics shall be quantized in 1 dB increments, ranging from –40 dBm (encoded 0x53) to –123 dBm (encoded 0x00). Values outside this range shall be assigned the closest extreme value within the scale. The standard deviation shall be quantized in 0.5 dB increments (i.e., standard deviation < 0.5 dB encoded 0x00, 0.5 dB ≤ standard deviation < 1.0dB encoded 0x01).

## 8.2 WirelessMAN-SCa PHY

### 8.2.1 Transmit processing

### 8.2.1.5 Duplex framing

### 8.2.1.5.1 FDD

### 8.2.1.5.1.3 FDD Channel and Burst Descriptor field definitions

*Change the second paragraph as indicated:*

**DL Burst Descriptor Parameters**

Each DCD message burst descriptor shall include the following TLV encodings:

Modulation type
RS information bytes
RS parity bytes
~~DIUC mandatory exit threshold~~
~~DIUC minimum entry threshold~~
CC/CTC-specific parameters

Each DCD message burst descriptor may include the following additional TLV encodings:

Block interleaver depth
BTC code selector
Spreading parameters
CID_In_DL_IE

### 8.2.1.5.2 TDD

### 8.2.1.5.2.1 TDD Channel Descriptor field definitions

*Change the second paragraph as indicated:*

**DL Burst Descriptor ~~P~~parameters**

Each DCD message burst descriptor shall include the following TLV encodings:

Modulation type
RS information bytes
RS parity bytes
~~DIUC mandatory exit threshold~~
~~DIUC minimum entry threshold~~
CC/CTC-specific parameters

Each DCD message burst descriptor may include the following additional TLV encodings:

Block interleaver depth
BTC code selector
Spreading parameters
CID_In_DL_IE

### 8.2.1.8 Compressed FCH maps

#### 8.2.1.8.2 Compressed UL-MAP

*Change the first paragraph as indicated:*

The compressed UL-MAP format is presented in Table 190. The message may only appear after a compressed DL-MAP message to which it shall be appended. The message presents the same information as the standard format ~~with one exception. The Uplink Channel ID is omitted. A value of zero shall be assigned to this parameter~~.

### 8.2.1.9 MAP message fields and IEs

#### 8.2.1.9.3 UL-MAP IE formats

*Delete the extra period above Table 202.*

*Insert new subclause 8.2.1.9.3.6:*

#### 8.2.1.9.3.6 Fast_Ranging_IE

A fast ranging extended IE may be placed in a UL-MAP message by a BS to provide an MS with a contentionless initial ranging opportunity. The value of the subcode assigned to this function is 1. The CID value in the UL-MAP_IE() shall be set to 0. The format of the extended IE is presented in Table 207a.

**Table 207a—SCa fast ranging extended IE format**

| Syntax | Size | Notes |
|---|---|---|
| Fast_Ranging_IE(){ | — | — |
| Subcode | 4 bits | FRNG=0x01 |
| Length | 4 bits | Length = 8 |
| MAC address | 48 bits | MS's MAC address as provided on the RNG-REQ message on initial system entry |
| Offset | 12 bits | Indicates the start time, in units of minislots, of the burst relative to the Allocation Start Time given in the UL-MAP message. The time instants indicated by offsets are the transmission times of the first symbol of the burst including preamble. |
| Reserved | 4 bits | — |
| } | — | — |

### 8.2.2 Channel quality measurements

#### 8.2.2.2 RSSI mean and standard deviation

*Change the second paragraph as indicated:*

Mean and standard deviation statistics shall be reported in units of dBm and dB, respectively. To prepare such reports, statistics shall be quantized in 1 dB increments, ranging from –40 dBm (encoded 0x53) to –123 dBm (encoded 0x00). Values outside this range shall be assigned the closest extreme value within the scale.

The standard deviation shall be quantized in 0.5dB increments (i.e., standard deviation < 0.5dB encoded 0x00, 0.5dB ≤ standard deviation < 1.0dB encoded 0x01).

## 8.3 WirelessMAN-OFDM PHY Layer

### 8.3.2 OFDM symbol parameters and transmitted signal

### 8.3.2.4 Parameters of transmitted signal

***Change in Table 213 "{–84,–82, –47:–45, 17: 19, 54:56}" to "{–84:–82, –47:–45, 17: 19, 54:56}".***

### 8.3.3 Channel coding

***Change the first paragraph as indicated:***

### 8.3.3.1 Randomization

Data randomization is performed on each burst of data on the downlink and uplink. The randomization is performed on each allocation (downlink or uplink), which means that for each allocation of a data block (subchannels on the frequency domain and OFDM symbols on the time domain) the randomizer shall be used independently. If the amount of data to transmit does not fit exactly the amount of data allocated, padding of 0xFF ("1" only) shall be added to the end of the transmission block for the unused integer bytes. For RS-CC and CC encoded data (see 8.3.3.2.1), padding will be added to the end of the transmission block, up to the amount of data allocated minus one byte, which shall be reserved for the introduction of a 0x00 tail byte by the FEC. For BTC (8.3.3.2.2) and CTC (8.3.3.2.3), if implemented, padding will be added to the end of the transmission block, up to the amount of data allocated.

***Change Figure 197 as indicated:***

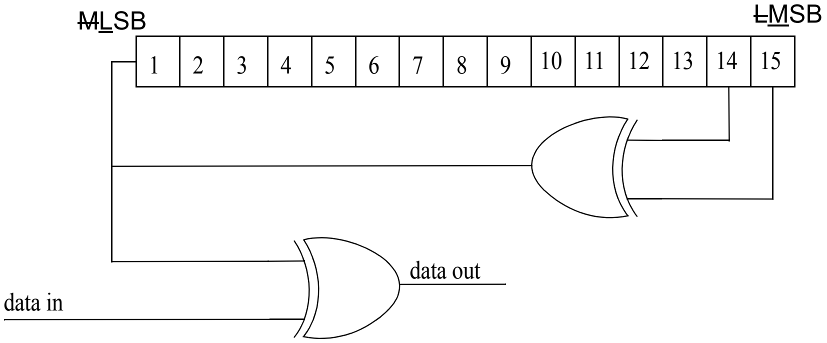


**Figure 197—PRBS generator for data randomization**

***Change the first two sentences of the second paragraph below Figure 197 as indicated:***

On the downlink, the randomizer shall be re-initialized at the start of each frame, and at the start of the STC zone only in the case a FCH-STC is present, with the sequence: 1 0 0 1 0 1 0 1 0 0 0 0 0 0 0. The randomizer shall not be reset at the start of the burst ~~#1~~immediately following FCH or FCH-STC.

***Insert new text immediately before Figure 198 in 8.3.3.1:***

For a DL subchannelization zone (refer to 8.3.5.1.1) the randomizer is initialized in an equivalent manner. At the start of the DL subchannelized zone, the randomizer shall be re-initialized to the sequence 1 0 0 1 0 1 0 1 0 0 0 0 0 0 0. The randomizer shall not be reset at the start of the first burst in the CCH. At the start of subsequent bursts, the randomizer shall be initialized with the vector shown in Figure 198. The frame number used for initialization refers to the frame in which the subchannelized burst is transmitted and can be obtained from the SBCH_DLFP (refer to Table 225b).

***Replace Figure 198 and Figure 199 with the following figures:***

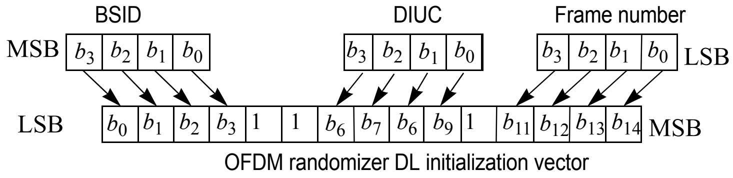

BSID
DIUC
Frame number
MSB
$b_3$ $b_2$ $b_1$ $b_0$
$b_3$ $b_2$ $b_1$ $b_0$
$b_3$ $b_2$ $b_1$ $b_0$
LSB
LSB
$b_0$ $b_1$ $b_2$ $b_3$ 1 1 $b_6$ $b_7$ $b_6$ $b_9$ 1 $b_{11}$ $b_{12}$ $b_{13}$ $b_{14}$
MSB
OFDM randomizer DL initialization vector

**Figure 198—OFDM randomizer downlink initialization vector for burst #2...N**

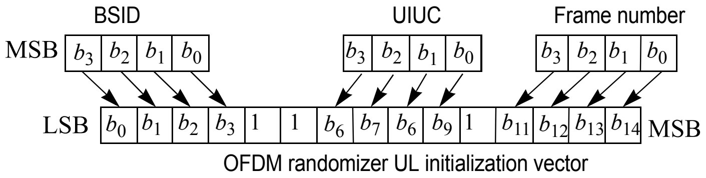

BSID
UIUC
Frame number
MSB
$b_3$ $b_2$ $b_1$ $b_0$
$b_3$ $b_2$ $b_1$ $b_0$
$b_3$ $b_2$ $b_1$ $b_0$
LSB
$b_0$ $b_1$ $b_2$ $b_3$ 1 1 $b_6$ $b_7$ $b_6$ $b_9$ 1 $b_{11}$ $b_{12}$ $b_{13}$ $b_{14}$
MSB
OFDM randomizer UL initialization vector

**Figure 199—OFDM randomizer uplink initialization vector**

### 8.3.3.2 FEC

***Change the third sentence of the first paragraph as indicated:***

The ~~Reed–Solomon-Convolutional coding rate 1/2~~most robust burst profile shall always be used as the coding mode when requesting access to the network ~~(except in subchannelization modes, which uses only convolutional coding 1/2)~~ and in the FCH burst.

### 8.3.3.2.1 Concatenated Reed–Solomon-convolutional code (RS-CC)

***Change the two paragraphs below Table 214 as indicated:***

~~RS-CC rate 1/2 shall always be used as the coding mode when requesting access to the network.~~

The encoding is performed by first passing the data in block format through the RS encoder and then passing it through a convolutional encoder. A single 0x00 tail byte is appended to the end of each burst. This tail byte shall be appended after randomization. In the RS encoder, the redundant bits are sent before the input bits, keeping the 0x00 tail byte at the end of the allocation. ~~When the total number of data bits in a burst is not an integer number of bytes, zero pad bits are added after the zero tail bits~~ To ensure that the number of bits after the convolutional encoder is divisible by $N_{cbps}$, as specified in Table 223, zero (0b0) pad bits are added after the zero tail bits before the encoder. The zero pad bits are not randomized. Note that this situation can occur only in subchannelization. In this case, the RS encoding is not employed.

***Change the second to last paragraph in 8.3.3.2.1 as indicated:***

When subchannelization is applied ~~in the uplink~~, the FEC shall bypass the RS encoder and user the Overall Coding Rate as indicated in Table 215 as CC Code Rate. The uncoded Block Size and Coded Block size may be computed by multiplying the values listed in Table 215 by the number of allocated subchannels divided by 16.

### 8.3.3.4 Modulation

### 8.3.3.4.2 Pilot modulation

***Replace Figure 204 with the following figure:***

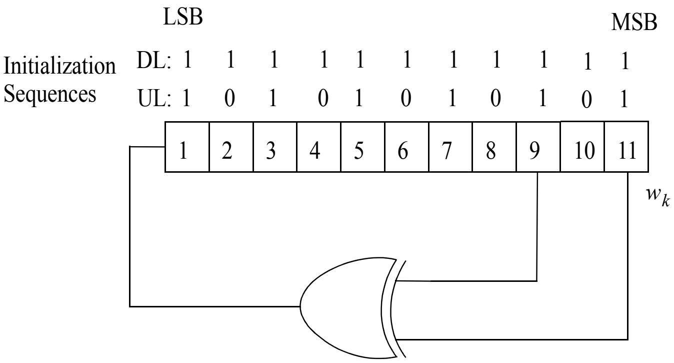


**Figure 204—PRBS generator for pilot modulation**

***Change the second paragraph in 8.3.3.4.2 as indicated:***

The value of the pilot modulation for OFDM symbol $k$ is derived from $w_k$. On the downlink the index $k$ represents the symbol index relative to the beginning of the downlink subframe. For bursts contained in the STC zone when the FCH-STC is present, index $k$ represents the symbol index relative to the beginning of the STC zone. In the DL Subchannelization Zone, the index $k$ represents the symbol index relative to the beginning of the burst. On the uplink the index $k$ represents the symbol index relative to the beginning of the burst. On both uplink and downlink, the first symbol of the preamble is denoted by $k$=0. The initialization sequences that shall be used on the downlink and uplink are shown in Figure 204. On the downlink, this shall result in the sequence 11111111111000000000110… where the 3rd 1, i.e., $w_2$ =1, shall be used in the first OFDM downlink symbol following the frame preamble. For each pilot (indicated by frequency offset index), the BPSK modulation shall be derived as follows:

### 8.3.3.5 Example OFDM uplink RS-CC encoding

### 8.3.3.5.3 Subchannelization (1 subchannel)

***Change the third paragraph as indicated:***

Randomized ~~D~~data (Hex)

D4 BA A1 12 F2 74 96 30 27 D4 00 00

NOTE—The last hex value represents two bits only.

#### 8.3.3.6 Preamble structure and modulation

***Change the first sentence of the first paragraph as indicated:***

All preambles are structured as either one ~~of~~ or two OFDM symbols.

***Change the last sentence of the paragraph below Equation (79) as indicated:***

This preamble ~~shall also precede all allocations during the AAS portion of a frame and~~ shall be used as burst preamble on the downlink bursts when indicated in the DL-MAP_IE.

### 8.3.5 Frame structure

#### 8.3.5.1 PMP

***Change the first sentence of the fifth paragraph as indicated:***

The FCH is followed by one or multiple downlink bursts~~, each transmitted with different burst profile~~.

***Change the seventh paragraph as indicated:***

The STC zone starts from a preamble. The BS can choose between the following two modes of operation:

1) No FCH-STC Present: If the regular DL-MAP describes allocations in the STC zone, then the STC zone shall start with an STC preamble that may be immediately followed by encoded PHY bursts, with no FCH-STC present.
2) FCH-STC Present: If the DL-MAP does not describe allocations in the STC zone, then the STC zone shall start with an STC preamble that is immediately followed by ~~and~~ an STC encoded FCH-STC burst, which is one symbol with the same payload format as specified in ~~Table 241~~Table 225. The FCH-STC burst is transmitted at BPSK rate ½. It is followed by one or several STC encoded PHY bursts. The first burst in the STC zone may contain a DL-MAP applicable only to the STC zone, in which the DL IEs start time refer to the beginning of the STC zone, including preamble. If DL-MAP is present, it shall be the first MAC PDU in the payload of the burst. The STC zone may also contain an UL-MAP, as well as DCD and UCD messages. The UL-MAP, if present, shall not duplicate or overlap any unicast allocations made in the regular UL-MAP, and the allocation start time shall refer to the beginning of the STC zone. The UL-MAP if present shall not contain duplicate or overlapping unicast allocations (defined within same or any other UL-MAP). Contention region allocations may be duplicated, in which case, they shall fully overlap. The randomizer and pilot modulation shall be reinitialized at the beginning of the STC zone.

The SS will be able to determine that there is no STC data allocation in frame K-1 STC Zone by determining that there has been no STC zone in the previous frame K-2.

***Add a new sentence above the eighth paragraph as indicated:***

The DL subframe may optionally contain a DL subchannelization zone as described in 8.3.5.1.1 PMP DL subchannelization zone.

***Change the eighth paragraph as indicated:***

With the OFDM PHY, a PHY burst, either a downlink PHY burst or an uplink PHY burst, consists of an integer number of OFDM symbols, carrying MAC messages, i.e., MAC PDUs. To form an integer number of OFDM symbols, unused bytes in the burst payload may be padded by the bytes 0xFF. Then the payload should be randomized, encoded, and modulated using the burst PHY parameters specified by this standard. If an SS does not have any data to be transmitted in an UL allocation, the SS shall transmit an UL PHY burst (as specified in 6.3.3.7) that may contain~~ing~~ a bandwidth request header as defined in Figure 20, with BR = 0 and its basic CID. If the allocation is large enough, an AAS enabled SS may also provide an AAS Feedback Response (AAS-FBCK-RSP) message (6.3.2.3.40). An SS shall transmit during the entirety of all of its UL allocations, using the standard padding mechanism (6.3.3.7) to fill allocations if necessary.

***Change Figure 207 as indicated:***

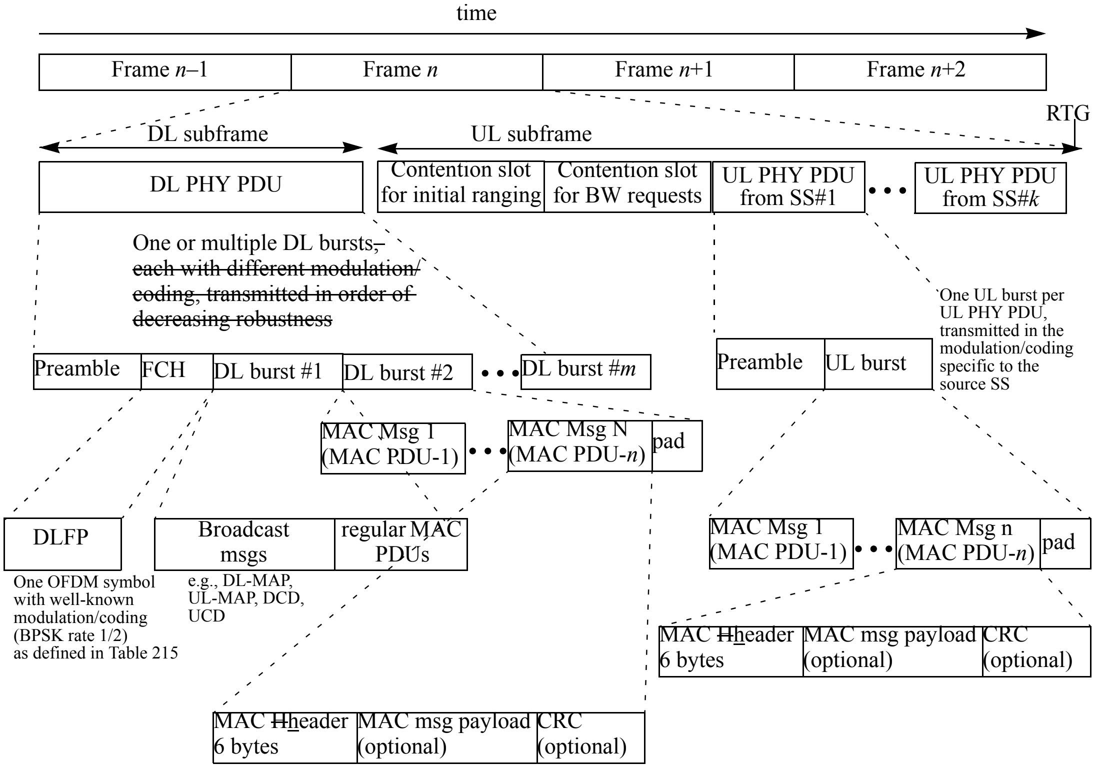

time
Frame n–1
Frame n
Frame n+1
Frame n+2
RTG
DL subframe
UL subframe
DL PHY PDU
Contention slot for initial ranging
Contention slot for BW requests
UL PHY PDU from SS#1
UL PHY PDU from SS#k
One or multiple DL bursts~~, each with different modulation/coding, transmitted in order of decreasing robustness~~
One UL burst per UL PHY PDU, transmitted in the modulation/coding specific to the source SS
Preamble
FCH
DL burst #1
DL burst #2
DL burst #m
Preamble
UL burst
MAC Msg 1 (MAC PDU-1)
MAC Msg N (MAC PDU-n)
pad
DLFP
One OFDM symbol with well-known modulation/coding (BPSK rate 1/2) as defined in Table 215
Broadcast msgs
e.g., DL-MAP, UL-MAP, DCD, UCD
regular MAC PDUs
MAC Msg 1 (MAC PDU-1)
MAC Msg n (MAC PDU-n)
pad
MAC ~~H~~header 6 bytes
MAC msg payload (optional)
CRC (optional)
MAC ~~H~~header 6 bytes
MAC msg payload (optional)
CRC (optional)

**Figure 207—Example of OFDM frame structure with TDD**

***Change the paragraph above Figure 208 as indicated:***

In TDD and H-FDD systems, subscriber station allowances must be made by a transmit-receive turnaround gap SSTTG and by a receive-transmit turnaround gap SSRTG. ~~The BS shall not transmit downlink information to a station later than (SSRTG+RTD) before its scheduled uplink allocation, and shall not transmit downlink information to it earlier than (SSTTG-RTD) after the end of scheduled uplink allocation, where RTD denotes Round-Trip Delay.~~ The BS shall transmit DL bursts intended for an SS such that the end of any DL burst shall not be transmitted to the SS later than (SSRTG+RTD) before its scheduled uplink allocation and the beginning of any DL burst to the SS shall not be transmitted to the SS earlier than (SSTTG-RTD) after the end of its scheduled uplink allocation, where RTD denotes Round-Trip Delay. The parameters SSRTG and SSTTG are capabilities provided by the SS to BS upon request during network entry (see 11.8.3.1).

***Change Figure 208 as indicated:***

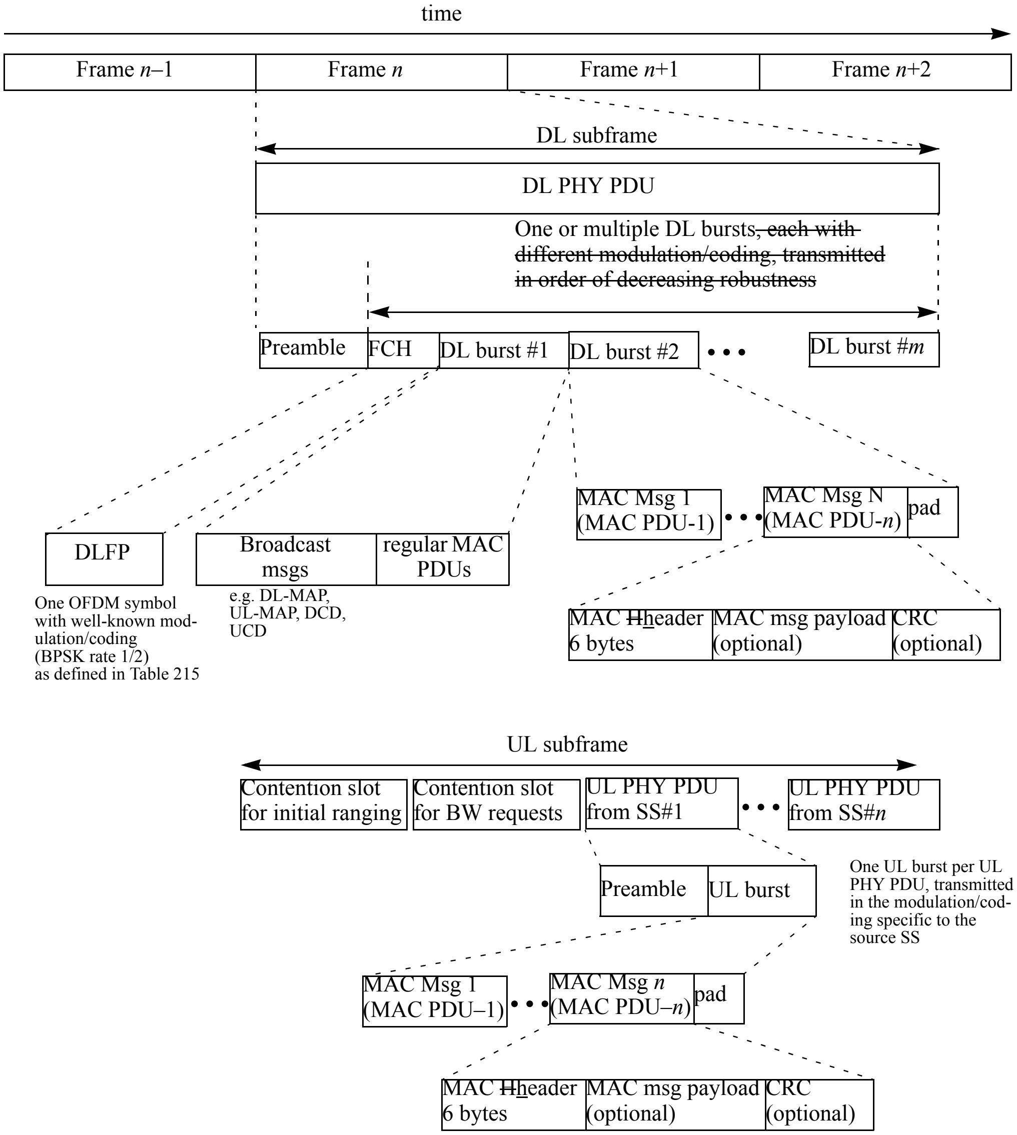

time
Frame n–1
Frame n
Frame n+1
Frame n+2
DL subframe
DL PHY PDU
One or multiple DL bursts~~, each with different modulation/coding, transmitted in order of decreasing robustness~~
Preamble
FCH
DL burst #1
DL burst #2
DL burst #m
DLFP
Broadcast msgs
regular MAC PDUs
One OFDM symbol with well-known modulation/coding (BPSK rate 1/2) as defined in Table 215
e.g. DL-MAP, UL-MAP, DCD, UCD
MAC Msg 1 (MAC PDU-1)
MAC Msg N (MAC PDU-n)
pad
MAC ~~H~~header 6 bytes
MAC msg payload (optional)
CRC (optional)
UL subframe
Contention slot for initial ranging
Contention slot for BW requests
UL PHY PDU from SS#1
UL PHY PDU from SS#n
Preamble
UL burst
One UL burst per UL PHY PDU, transmitted in the modulation/coding specific to the source SS
MAC Msg 1 (MAC PDU–1)
MAC Msg n (MAC PDU–n)
pad
MAC ~~H~~header 6 bytes
MAC msg payload (optional)
CRC (optional)

**Figure 208—Example of OFDM frame structure with FDD**

***Insert the following paragraph above Table 225:***

Because the optional STC and AAS zones may contain UL-MAPs, along with the UL-MAP transmitted in the mandatory part of the frame, and because the allocation start time for frames may vary from one frame to the next, there is a possibility that UL-MAPs from two frames, or from different zones, may describe overlapping time intervals. Where MAP IEs (contained in either a AAS-DLFP or a UL-MAP) describe overlapping time intervals with MAP IEs from another UL-MAP (or AAS-DLFP) then an SS shall interpret and use those from the most recently received map. MAP IEs that do not conflict with MAP IEs received in earlier UL-MAPs (or AAS-DLFP) shall augment the uplink map.

***Change Table 225 and the HCS field description as indicated:***

### Table 225—OFDM downlink frame prefix format

| Syntax | Size | Notes |
|---|---|---|
| DL_Frame_Prefix_Format() { | | |
| **Base_Station_ID** | 4 bits | 4 LSBs of BS ID. Prior to completion of network entry, the SS shall ignore this field and decode all bursts specified by the DLFP. Upon completion of network entry, the SS shall validate these bits with those of the BS on which it is registered. The burst specified by the DLFP shall not be decoded if these bits do not match those of the BS on which it is registered. |
| **Frame_Number** | 4 bits | 4 LSB of the Frame Number of current frame ~~DCD Channel Encoding as specified in Table 358.~~ |
| **Configuration_Change_Count** | 4 bits | 4 LSB of Change Count value as specified in 6.3.2.3.1. |
| *Reserved* | 4 bits | Shall be set to zero. |
| **Rate_ID** | 4 bits | Encoded according to the Table 224. |
| *Reserved* | 1 bit | Shall be set to zero. |
| **Length** | 11 bits | Number of OFDM symbols in the first burst. |
| for (n=0; n < ~~4~~3; n++) { | | |
| DL_Frame_Prefix_IE() { | | |
| **~~Rate_ID/~~ DIUC** | 4 bits | ~~For the first information element it shall be Rate_ID encoded according to the Table 224. For following IEs this field is DIUC that d~~Defines the burst profile of the corresponding burst. |
| if (DIUC != 0){ | | |
| **Preamble present** | 1 bits | If "1," preamble is placed ~~before~~ as the first symbol in the burst. |
| **Length** | 11 bits | Number of OFDM symbols in the burst~~.~~, including preamble if present. |
| } else { | | |
| **Start Time** | 12 bits | Start time of STC zone in units of symbol duration counted from the beginning of the frame. |
| } | | |
| } | | |
| } | | |
| **HCS** | 8 bits | An 8-bit Header Check Sequence; calculated as specified in Table 5. |
| } | | |

**HCS**

An 8-bit Header Check Sequence used to detect errors in the DL Frame Prefix. The generator polynomial is $g(D)= D^8 + D^2 + D + 1$. The transmitter shall take all the bytes in the DL Frame Prefix except the byte reserved for the HCS and divide them by g(x) and use the remainder as HCS code. At the receiver, dividing the DL_Frame_Prefix by g(x) then gives the remainder 0 if correct. (Example: BS_ID=0x0319B812A9B8 (4LSB=0x8), Frame_Number=187662 (4LSB=0xE), Configuration_Change_Count=159 (4LSB=0xF), Reserved=0x~~F~~0, Rate_ID=1 (0x1), Length=204 (0x0CC), DLFP_IE(1) DIUC=1 (0x1), DLFP_IE(1) Midamble Present = 1 / Burst_Length=50 (0x832), all following DLFP_IEs=0 (~~8~~2 times 0x0000). Encode byte sequence [0x8EF~~F~~010CC183200000000] and obtain 0x~~99~~30 as the HCS byte.)

*Insert new subclause 8.3.5.1.1:*

### 8.3.5.1.1 PMP DL subchannelization zone

The DL subframe may optionally contain a DL subchannelization zone. This zone is marked by a DL_SUBCH_IE in the DL Map.

The DL subchannelization zone is shown in Figure 208a.

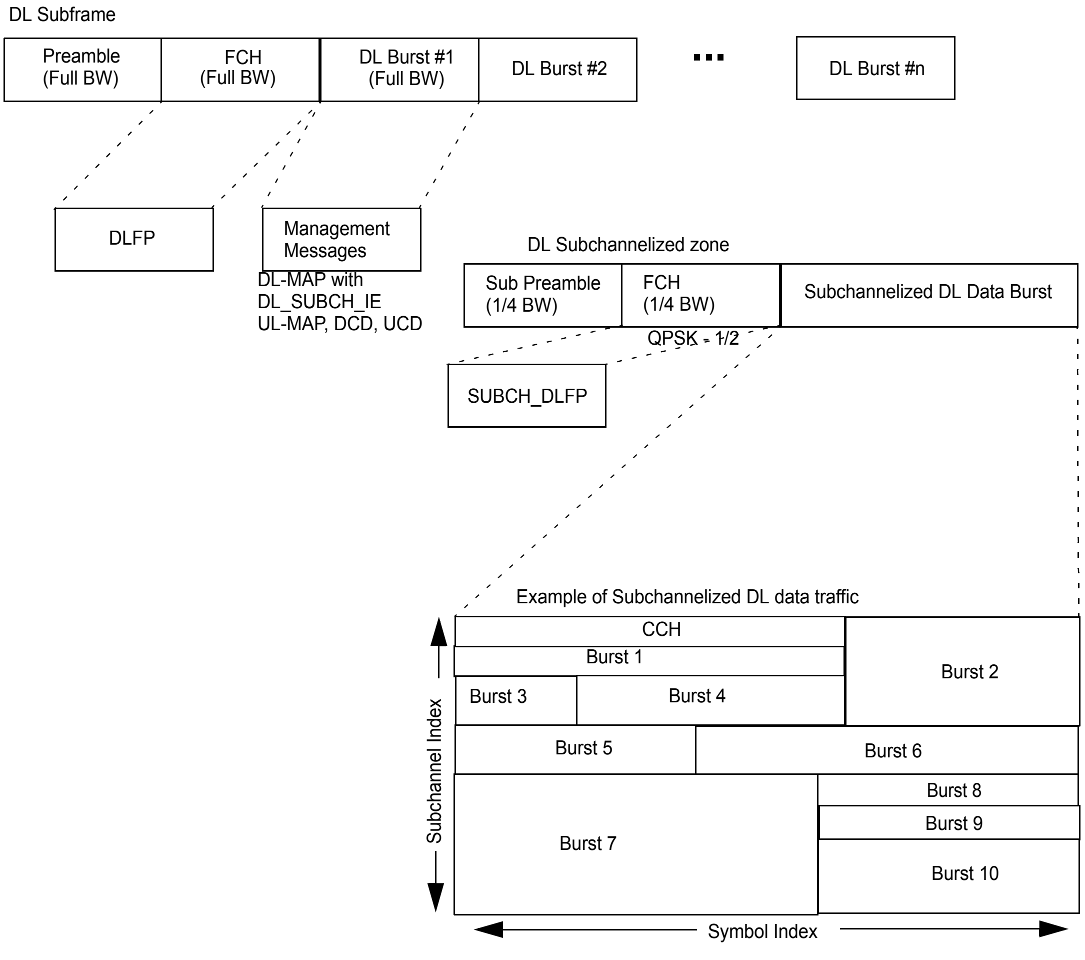

DL Subframe
Preamble (Full BW)
FCH (Full BW)
DL Burst #1 (Full BW)
DL Burst #2
...
DL Burst #n
DLFP
Management Messages
DL-MAP with DL_SUBCH_IE UL-MAP, DCD, UCD
DL Subchannelized zone
Sub Preamble (1/4 BW)
FCH (1/4 BW)
Subchannelized DL Data Burst
QPSK - 1/2
SUBCH_DLFP
Example of Subchannelized DL data traffic
CCH
Burst 1
Burst 2
Burst 3
Burst 4
Burst 5
Burst 6
Burst 7
Burst 8
Burst 9
Burst 10
Subchannel Index
Symbol Index

**Figure 208a—Format of DL subchannelization zone**

The zone commences with a subchannelized preamble followed by a subchannelized FCH burst. The FCH is transmitted using QPSK ½. The FCH is transmitted over 1/4 of the bandwidth. The carrier allocation is as given in Table 211 (OFDM symbol parameters).

The subchannel index of the FCH shall be one of the codes 0b00100, 0b01100, 0b10100, or 0b11100. The subchannel index should preferably be provisioned by the operator to avoid illumination of an area by base stations using the same frequency channel with the same subchannel index. If not provisioned, the subchannel index shall, by default, be derived from the 2 LSBs of the BSID as in Table 225a.

Table 225a—DL Subchannel index table

| 2 LSBs of BSID (binary) | Subchannel index according to Table 211 (binary) |
|---|---|
| 00 | 00100 |
| 01 | 01100 |
| 10 | 10100 |
| 11 | 11100 |

The FCH contains the SBCH_DLFP, which points to the control subchannel (CCH), and contains the profile and length of the first burst in it. The SBCH_DLFP is shown in Table 225b.

Table 225b—SBCH_DLFP

| Field | Size | Comments |
|---|---|---|
| SBCH_DL_Frame_Prefix_format() { | — | — |
| **Base_Station_ID** | 4 bits | 4 LSBs of BS ID. The burst specified by the DFLP shall not be decoded if these bits do not match those of the BS on which it is registered. |
| **Frame_Number** | 4 bits | 4 LSBs of Frame Number field as specified in Table 214. |
| **Configuration_Change_Count** | 4 bits | 4 LSBs of Change Count value as specified in 6.3.2.3.1. |
| **CCH_Rate ID** | 4 bits | The Rate ID, according to Table 222 of the first burst of the CCH. |
| **CCH duration** | 8 bits | The duration of the first burst in the CCH. |
| **Reserved** | 1 bit | Shall be set to zero. |
| **CCH subchannel index** | 5 bits | The subchannel index in which the CCH is transmitted. See Table 211. |
| **CCH midamble repetition** | 2 bits | The midamble repetition rate of the first burst of the CCH:<br>0b00: Preamble only<br>0b01: Midamble after every 4 data symbols<br>0b10: Midamble after every 8 data symbols<br>0b11: Midamble after every 16 data symbols |

### Table 225b—SBCH_DLFP *(continued)*

| Field | Size | Comments |
|---|---|---|
| **HCS** | 8 bits | An 8-bit header Check Sequence; calculated as specified in Table 5. |
| } | — | — |

The FCH is followed by subchannelized traffic on allocated subchannels. The subcarrier allocation of the subchannels is given in Table 211. Bursts in the DL subchannelized zone shall contain midambles when indicated in the midamble repetition field.

The CCH may carry UL and DL maps. UL maps shall use the format of UL-MAP_IE as in Table 243 (UL map IE). DL maps shall use the format if SBCH_DL_MAP_IE as in Table 225c.

### Table 225c—SBCH_DL_MAP_IE

| Syntax | Size | Notes |
|---|---|---|
| SBCH_DL_MAP_IE() { | — | — |
| **CID** | 16 bits | — |
| **Start Time** | 11 bits | — |
| **Subchannel Index** | 5 bits | — |
| **DIUC** | 4 bits | — |
| **Duration** | 10 bits | In OFDM symbols |
| **Midamble repetition interval** | 2 bits | 0b00: Preamble only<br>0b01: Midamble after every 4 data symbols<br>0b10: Midamble after every 8 data symbols<br>0b11: Midamble after every 16 data symbols |
| } | — | — |

**Start Time**

This field indicates the start time in units of symbol duration, relative to the beginning of the subsequent DL subchannelized zone (including preamble).

A BS shall assume that the MS is not capable of receiving more than one burst in a single frame. Therefore downlink allocations contained in SBCH_DL_MAP_IEs in the CCH shall point to future frames. When an allocation is present for a given MS, the BS shall assume that the MS may not be capable of demodulating the CCH in that frame, and therefore not include any SBCH_DL_MAP_IEs or UL-MAP_IEs for that MS.

### 8.3.5.2 PMP-AAS Zone

***Change all instances to FCH to AAS-FCH.***

***Change the second sentence of the first paragraph as indicated:***

The first fraction of the transmission consists of one or several repetitions of a short preamble followed by AAS-FCH symbol (Figure ~~3~~209).

***Insert the following text below the first paragraph:***

The randomizer shall be reinitialized with the sequence 1 0 0 1 0 1 0 1 0 0 0 0 0 0 0 for all the AAS-FCH bursts, and not initialized for the first burst of the body. It is then reinitialized as specified in Figure 198 for subsequent bursts.

***Change the third paragraph as indicated:***

AAS_DLFP contains information (DL IEs or UL IEs) on location and transmission rate of PHY bursts. There is a possibility of more than one concatenated DL PHY bursts, each one described by a DL IE. UL IEs specify either UL PHY burst (a single burst per SS) or contention region for initial ranging or bandwidth requesting. The DL IEs and UL IEs in each AAS_DLFP shall appear in the same order as the allocations to which they refer. The DL IEs and UL IEs described in the AAS portion of the zone shall not be described in the broadcast DL-MAP and UL-MAP.

***Change the fifth paragraph as indicated:***

Alternatively, AAS_DLFP may contain UL IEs. There are two options as follows:

1) A single UL IE.
2) “Compressed” UL IE, which contains a network entry allocation and a regular allocation.

The minimum time between an UL IE and the corresponding UL burst shall be equal to the relevance time of an UL-MAP as described in subclause 6.3.7.5.

***Replace Figure 209 with the following figure:***

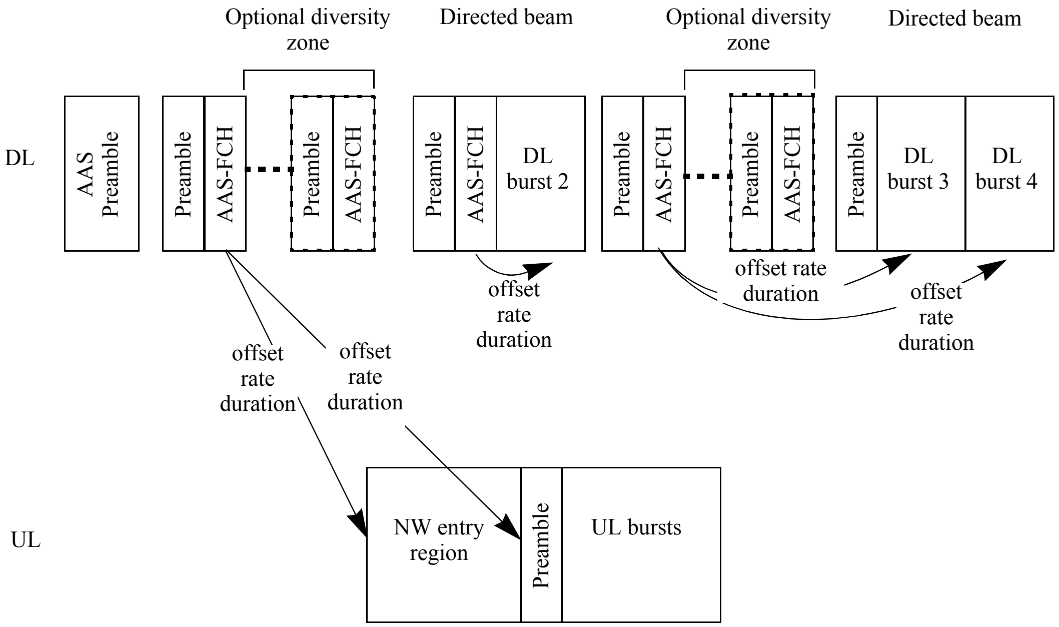

Optional diversity zone
Directed beam
Optional diversity zone
Directed beam
DL
AAS Preamble
Preamble
AAS-FCH
Preamble
AAS-FCH
Preamble
AAS-FCH
DL burst 2
Preamble
AAS-FCH
Preamble
AAS-FCH
Preamble
DL burst 3
DL burst 4
offset rate duration
offset rate duration
offset rate duration
offset rate duration
offset rate duration
UL
NW entry region
Preamble
UL bursts

**Figure 209—Structure of AAS Zone**

***Change the relevant fields in Table 228 as indicated:***

| | | |
|---|---|---|
| } else If (**UIUC** == ~~3~~4) { | | |
| **Midamble repetition interval** | 2 bits | 0b00: Preamble only<br>0b01: Interval 5: Midamble after every ~~8~~4 data symbols<br>0b10: Interval 9: Midamble after every ~~16~~8 data symbols<br>0b11: Interval 17: Midamble after every ~~32~~16 data symbols |
| **Duration** | ~~9~~12 bits | In OFDM symbols. |

***Change the relevant fields in Table 229 as indicated:***

| | | |
|---|---|---|
| } else If (**UIUC** == ~~3~~4) { | | |
| **Duration** | ~~12~~9 bits | Duration of regular allocation in OFDM symbols. |

***In Table 230, replace "Burst Profiles" by "Burst Profiles (Data Grant Burst Type)"***

***Change the title of subclause 8.3.5.5 as indicated:***

### 8.3.5.5 Burst ~~P~~profile format

***Change the second sentence of the first paragraph as indicated:***

The DIUC field is associated with the Downlink Burst Profile ~~and Thresholds~~.

***Change the third sentence of the paragraph below Table 233 as indicated:***

The UIUC field is associated with the Uplink Burst Profile ~~and Thresholds~~.

### 8.3.6 MAP message fields and IEs

### 8.3.6.2 DL-MAP IE format

***Change 8.3.6.2 as indicated:***

**Connection Identifier (CID)**

Represents the assignment of the IE to a broadcast, multicast or unicast address.
If the broadcast or multicast CID is used then it is possible to concatenate unicast MAC PDUs (with different CIDs) into a single DL burst. During a broadcast or multicast DL burst it is the responsibility of the BS to ensure that any ~~MAC PDUs~~bursts sent to an HFDD SS do not overlap (in time; taking SSTTG and SSRTG into account) any UL allocations for that SS. An HFDD SS for which a DL MAP IE and UL MAP IE overlap in time shall use the UL allocation and discard DL traffic during the overlapping period.

**Start Time**

If transmitted in a private map (for compressed private map see 8.3.6.6, for reduced private map see 8.3.6.7) within an AAS zone, this field ~~I~~indicates the start time, in units of symbol duration, relative to the ~~start of the first symbol of the PHY PDU~~ beginning of the subsequent AAS zone (including preamble) where the DL-MAP message is transmitted. If transmitted in a compressed private map (see 8.3.6.6), this field indicates the start time, in units of symbol duration, relative to the beginning of the subsequent downlink frame (including preamble). For a DL-MAP in the STC zone, indicates the start time in units of symbol duration, relative to the start of the first symbol of the STC zone (including preamble). The end of the last allocated burst is indicated by allocating ~~a~~ an End of Map burst (DIUC = 14) with zero duration. The time instants indicated by the Start Time values are the transmission times of the first symbol of the burst including ~~preamble~~ (if present) any preamble.

### 8.3.6.2.1 DIUC allocations

***Insert the following text below Table 237:***

The Gap Downlink Burst Profile (DIUC = 13) indicates that the Base Station does not transmit (a silent interval in downlink transmission) and the SS shall ignore the received signal.

### 8.3.6.2.3 Channel measurement IE format

***Change the first sentence of the first paragraph as indicated:***

An extended IE with an extended DIUC value of 0x00 is issued by the BS to request a channel measurement ~~report~~ (see 6.3.2.3.33).

### 8.3.6.2.8 DL-MAP dummy IE format

***Change Table 244 as indicated:***

**Table 244—OFDM DL-MAP dummy IE format**

| Syntax | Size | Notes |
|---|---|---|
| Dummy_IE() { | — | — |
| **Extended DIUC** | 4 bits | 0x~~05~~06 .. 0x0F |
| **Length** | 4 bits | 0..15 |
| **Unspecified data** | *variable* | The “Length” field specifies the size of this field in bytes. |
| } | — | — |

***Insert new subclause 8.3.6.2.9:***

### 8.3.6.2.9 DL SUBCH_IE format

In the DL-MAP a DL subchannelization enabled BS (see 8.3.5.3) may transmit an extended IE with a DUIC value of 0x05 to indicate that subsequent allocations use DL subchannelization. The extended IE conforms to the structure in Table 244a.

**Table 244a—DL SUBCH_IE format**

| Syntax | Size | Comments |
|---|---|---|
| DL_SUBCH_IE { | — | — |
| **Extended DIUC** | 4 bits | DL SUBCH = 0x05 |
| **Length** | 4 bits | Length = 0x00 |
| } | — | — |

### 8.3.6.3 UL-MAP IE format

***Change the 'Midamble repetition interval' in Table 245 as indicated:***

| | | |
|---|---|---|
| **Midamble repetition interval** | 2 bits | 0b00: Preamble only<br>0b01: Interval 5: Midamble after every ~~8~~4 data symbols<br>0b10: Interval 9: Midamble after every ~~16~~8 data symbols<br>0b11: Interval 17: Midamble after every ~~32~~16 data symbols |

***Change the description of the 'Midamble Repetition Interval' field below Table 245 as indicated:***

**Midamble Repetition Interval**

Indicates the preamble repetition interval in OFDM symbols. When the last section of ~~symbol~~burst after the last preamble\midamble is higher than half the midamble repetition interval (i.e., more than ~~4~~2, ~~8~~4, ~~16~~8 for 0b01, 0b~~0~~10, 0b11) a postamble shall be added at the end of the ~~allocation~~burst.

### 8.3.6.3.1 UIUC allocations

***In Table 246, replace "Burst Profiles" by "Burst Profiles (Data Grant Burst Type)".***

### 8.3.6.3.3 Subchannelized network entry IE

***Change the last sentence of first paragraph as indicated:***

An SS responding to a bandwidth allocation using the Subchannelized Network entry IE shall start its burst with a ~~short~~subchannelization preamble (see 8.3.3.6) and use only the most robust mandatory burst profile in that burst.

***Insert the following sentence to the definition of the 'Transmit opportunity index' field below Table 248:***

The transmit opportunities are numbered from 0x00 to 0x0F, where transmit opportunity 0x00 indicates the first transmit opportunity in the frame pointed by the frame number index.

#### 8.3.6.3.5 UL-MAP power control IE format

***Change the first paragraph as indicated:***

When a power change for the SS is needed, UIUC = 15 is used with extended UIUC set to 0x00 and with 8-bit Power control value as shown in Table 250. The power control value is an 8-bit signed integer expressing the change in power level (in 0.25 dB units) that the SS ~~should~~shall apply to correct ~~it's~~its current transmission power. If the SS cannot apply the commanded power correction (SS is already at maximum or minimum power) the SS shall send a RNG-REQ message with "Ranging Anomalies" parameter.

#### 8.3.6.3.7 UL-MAP Physical Modifier IE

***Change the second paragraph as indicated:***

Cyclically delaying the preambles and midambles is an optional feature. The PHYMOD_UL_IE can appear anywhere in the UL map, and it shall remain in effect until another PHYMOD_UL_IE is encountered, or until the end of the UL map.

#### 8.3.6.3.8 UL-MAP dummy IE format

***Change Table 253 as follows:***

**Table 253—OFDM UL-MAP dummy IE format**

| Syntax | Size | Notes |
|---|---|---|
| Dummy_IE() { | — | — |
| **Extended UIUC** | 4 bits | 0x0~~3~~4..0x0F |
| **Length** | 4 bits | 0..15 |
| **Unspecified data** | *variable* | The "Length" field specifies the size of this field in bytes |
| } | — | — |

***Insert new subclause 8.3.6.3.9:***

### 8.3.6.3.9 Fast_Ranging_IE

A Fast_Ranging_IE may be placed in the UL-MAP message by a BS to provide a non-contention-based initial-ranging opportunity. The Fast_Ranging_IE shall be placed in the extend UIUC (extension code = 0x03) within a UL-MAP IE. The Fast_Ranging_IE shall be assigned to the initial ranging CID=0x0000.

**Table 253a—OFDM Fast_Ranging_IE format**

| Syntax | Size | Notes |
|---|---|---|
| Fast_Ranging_IE { | — | — |
| **Extended UIUC** | 4 bits | = 0x03 |
| **Length** | 4 bits | = 0x8 |
| **MAC address** | 48 bits | MS’s MAC address as provided on the RNG-REQ message on initial system entry |
| **UIUC** | 4 bits | UIUC ≠ 15. UIUC ≠ 4. A code used to define the type of uplink access and the burst type associated with that access. |
| **Duration** | 12 bits | The length, in units of OFDM symbols, of the allocation. The start time of the first allocation shall be the Allocation Start Time given in the UL-MAP message. |
| } | — | — |

BS may assign subchannel indices other than 0b10000, only to the MS that entered the network using the subchannelized network entry (see 8.3.6.3.3).

***Insert new subclause 8.3.6.3.10:***

### 8.3.6.3.10 UL-MAP Fast tracking information element

The UL-MAP Fast tracking information element in an UL-MAP entry is used to provide fast power, time and frequency indications/corrections to MS’s that have transmitted in the previous frame.

The extended UIUC=15 shall be used for this IE with sub-code 0x04.

The CID used in the Information Element shall be a broadcast CID.

Table 253b—UL fast tracking information element

| Syntax | Size | Notes |
|---|---|---|
| UL_Fast_tracking_IE() | — | — |
| **extended UIUC** | 4 bits | Fast-Indication = 0x04 |
| **Number of Length** | 4 bits | Variable |
| for (i=1; i<*n*; i++) { | — | For each Fast Indication bytes 1 to *n* (*n* = Length) |
| **Power correction** | 2 bits | Power correction indication:<br>0b00: no change;<br>0b01: +2 dB;<br>0b10: –1 dB;<br>0b11: –2 dB; |
| **Frequency correction** | 4 bits | The correction is 0.1% of the carrier spacing multiplied by the 4-bit number interpreted as a signed integer (i.e., 0b1000: –8; … 0b0000: 0; … 0b0111: 7) |
| **Time correction** | 2 bits | The correction is floor(2 / Fs) multiplied by: 0b00: 0; 0b01: 1; 0b10: –1; 0b11: Not used |
| } | — | — |
| } | — | — |

The UL Fast tracking IE is an optional field in the UL-MAP. When this IE is sent, it provides an indication about corrections that should be applied by MS's that have transmitted in the previous UL frame. Each indication byte shall correspond to one unicast allocation-IE that has indicated an UL burst allocation in the previous UL-MAP. The order of the indication bytes shall be the same as the order of the unicast allocation-IE in the UL-MAP.

The response time for corrections following receipt of this IE shall be equal to "Ranging Response Processing Time" as defined in 10.1.

***Insert new subclause 8.3.6.6:***

### 8.3.6.6 Compressed private maps

The presence of the compressed private DL-MAP format is indicated by the contents of the most significant two bits of the first data byte. These bits overlay the HT and EC bits of a generic MAC header. When these bits are both set to 1 (an invalid combination for a standard header), the compressed private DL-MAP format is present. A compressed private UL-MAP shall only appear immediately after a compressed private DL-MAP. The presence of a compressed private UL-MAP is indicated by a bit in the compressed private DL-MAP data structure.

A broadcast map, an AAS-DLFP message, a SBCH_DL_MAP_IE, or another private map in a previous frame can point to the compressed private map. Other restrictions of compressed private maps include:

- The private map must be the first message in a PHY burst.

- Private maps shall only be used in the AAS portion of the subframe or within the DL subchannelization zone.
- Private maps are only allowed to use unicast CID values.
- Private maps shall only describe allocations within the AAS portion of the subframe or within the DL subchannelization zone.
- Both UL and DL allocations included in the private map are relative to the next frame.

A modification to the 'Preamble Time Shift' (as defined in 8.3.6.2.7 and 8.3.6.3.7) shall also apply to allocations in subsequent private maps in the private map chain, until modified again or until the end of the private map chain.

The compressed private map is an optional feature that can be negotiated between the SS and BS.

***Insert new subclause 8.3.6.6.1:***

### 8.3.6.6.1 Compressed private DL-MAP

The compressed private DL-MAP format is presented in Table 258a. The message presents the same information as the standard format with one exception. In place of the DL-MAP's 48-bit Base Station ID, the compressed format provides a subset of the full value. When the compressed format is used, the full 48-bit Base Station ID shall be present in the DCD.

**Table 258a—Compressed Private DL-MAP message format**

| Syntax | Size | Notes |
|---|---|---|
| Compressed_Private_DL-MAP() { | — | — |
| **Compressed map indicator** | 2 bits | Set to 0b11 for compressed format |
| *Reserved* | 1 bit | Shall be set to zero |
| **UL-MAP appended** | 1 bit | — |
| **Compressed Map Type** | 1 bit | Shall be set to 0 for compressed private map |
| **Map message length** | 11 bits | — |
| **DCD Count** | 8 bits | — |
| **Base Station ID** | 4 bits | 4 LSBs of BSID. The burst specified by the DLFP shall not be decoded if these bits do not match those of the BS on which it is registered |
| **DL IE Count** | 8 bits | — |
| for (i=1;i<=DL IE count;i++){ | — | — |
| **SBCH_DLP_MAP_IE()** | *variable* | — |
| } | — | — |
| if !(bypte boundary) { | — | — |
| **Padding Nibble** | 4 bits | Padding to reach byte boundary |
| } | — | — |
| if (UL-MAP appended) { | — | — |
| **Compressed_Private_UL-MAP( )** | *variable* | |

**Table 258a—Compressed Private DL-MAP message format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| } | | |
| **HCS** | 8 bits | — |
| } | — | — |

**Compressed map indicator**

A value of 0b11 in this field indicates the map message conforms to the compressed format described here. A value of 0b00 in this field indicates the map message conforms to the standard format described in 6.3.2.3.2. Any other value is in error.

**UL-MAP appended**

A value of 1 indicates a compressed UL-MAP (see 8.3.6.6.2) is appended to the current compressed DL-MAP data structure.

**Map message length**

This value specifies the length of the compressed map message(s) beginning with the byte containing the Compressed map indicator and ending with the last byte of the compressed DL-MAP message if the UL-MAP appended bit is not set or the lasts byte of the UL-MAP compressed message if the UL-MAP appended bit is set. The length includes the computed 8-bit HCS value.

**DCD Count**

Matches the value of the configuration change count of the DCD, which describes the downlink burst profiles that apply to this map.

**DL IE count**

A field that holds the number of CID entries in the following list of DL-MAP IEs.

**HCS**

A HCS value, as defined in 6.3.2.1.1, is appended to the compressed private DL-MAP.

The HCS is computed across all bytes of the compressed map(s) starting with the byte containing the Compressed map indicator and including appended Compressed Private UL-MAP, if present.

***Insert new subclause 8.3.6.6.2:***

### 8.3.6.6.2 Compressed Private UL-MAP

The compressed private UL-MAP format is presented in Table 258b. The message may only appear after a compressed private DL-MAP message to which it shall be appended. The message presents the same information as the standard format with the exception that the Generic MAC header and the Uplink Channel ID are omitted. The HCS is computed across all bytes of the compressed map(s) starting with the byte containing the Compressed map indicator and including appended UL-MAP, if present.

### Table 258b —Compressed Private UL-MAP message format

| Syntax | Size | Notes |
|---|---|---|
| Compressed_Private _UL-MAP() { | — | — |
| **UCD Count** | 8 bits | — |
| **Allocation Start Time** | 32 bits | — |
| while (map data remains) { | — | — |
| **UL-MAP_IE()** | *variable* | — |
| } | — | — |
| if !(byte boundary) { | — | — |
| **Padding Nibble** | 4 bits | Padding to reach byte boundary |
| } | — | — |
| } | — | — |

**UCD Count**
Matches the value of the Configuration Change Count of the UCD, which describes the uplink burst profiles that apply to this map.

**Allocation Start Time**
Effective start time of the uplink allocation defined by the UL-MAP.

***Insert new subclause 8.3.6.7:***

### 8.3.6.7 Reduced private maps

Reduced private maps are based upon the compressed map format; however, they are specifically designed to support a single unicast ID per map. Their use is identical to standard compressed private maps. However, fields have been removed that are not required to support a single ID. The reduced private map will be pointed to by a broadcast map or private compressed map, which will define the values of several fields that will be constant for the duration of the private map chain. The behavior of the compressed map fields that are not present in the reduced private map are described in the following list:

1) DCD Count—Optionally included. Only required if DCD count changes.
2) Base Station ID—Acquired by the map that initiated the private map chain. Assumed constant for the duration of the private map chain.
3) CID—Only required in first map of private map chain.
4) UCD Count—Optionally included. Only required in first UL map of private map chain.
5) Allocation Start Time—UL start time relative to TTG plus an integer number of symbol times.

***Insert new subclause 8.3.6.7.1:***

### 8.3.6.7.1 Reduced private DL-MAP

The Reduced private DL-MAP format is presented in Table 258c. The reduced private DL-MAP message eliminates the fields that are not relevant since the message is targeted to a single CID.

**Table 258c—Reduced private DL-MAP message format**

| Syntax | Size | Notes |
|---|---|---|
| Reduced Private DL_MAP() | — | — |
| **Compressed map indicator** | 2 bits | Set to 0b11 for compressed format |
| *Reserved* | 1 bit | Shall be set to zero |
| **UL-MAP appended** | 1 bit | — |
| **Compressed Map Type** | 1 bit | Shall be set to 1 for reduced private map |
| **CID Included** | 1 bit | 1 = CID included.<br>The CID shall be included in the first compressed private MAP if it was pointed to by a DL-MAP IE with a multicast CID |
| **DCD Count Included** | 1 bit | 1 = DCD Count included.<br>The DCD count is expected to be the same as in the broadcast map that initiated the private map chain. The DCD count can be included in the private map if it changes |
| **PHY modification Included** | 1 bit | 1 = included. |
| *Reserved* | 1 bit | Shall be set to zero |
| Map message length | 11 bits | — |
| if (CID Included) { | — | — |
| **CID** | 16 bits | — |
| } | — | — |
| if (DCD Count Included) { | — | — |
| **DCD Count** | 8 bits | — |
| } | — | — |
| if (PHY modification Included) { | — | — |
| **Preamble Time Shift** | 8 bits | Updated preamble time shift to be used starting with the next frame |
| } | — | — |
| **Preamble Present** | 1 bit | — |
| **Start Time** | 11 bits | — |
| **Duration** | 10 bits | — |
| **Subchannel Index** | 5 bits | |
| *Reserved* | 1 bit | Shall be set to zero |
| If (UL-MAP appended) { | — | For the AMC permutation (2 x 3 type) |

### Table 258c—Reduced private DL-MAP message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Reduced Private UL-MAP()** | *variable* | — |
| } | — | — |
| **HCS** | 8 bits | |
| } | — | — |

**Map message length**

Specifies the length of the reduced map message(s) beginning with the byte containing the Compressed map indicator, including the Reduced Private UL maps if present, and ending with the last byte of the Reduced Private DL-MAP message, the computed 8-bit HCS value.

**Compressed map indicator**

A value of 0b11 in this field indicates the presence of a compressed map.

**UL-MAP appended**

A value of 1 indicates a reduced compressed private UL-MAP (see 8.3.6.7.2) is appended to the current private DL-MAP data structure.

**CID Included**

Specifies if a CID is included. The CID shall be included in the first compressed private MAP if it was pointed to by a DL-MAP IE with a multicast CID.

**DCD Count Included**

Specifies if a DCD count is included. DCD Count is only required if the DCD count is changed.

**PHY Modification Included**

Indicates if a preamble modifier is included.

**Connection Identifier (CID)**

Represents the assignment of the IE to a unicast address.

**Preamble Time Shift**

The preamble time shift for subsequent DL allocations, as defined in 8.6.3.3.7.

**DCD Count**

Matches the value of the configuration change count of the DCD, which describes the downlink burst profiles that apply to this map.

**DIUC**

DIUC used for the burst.

**Preamble Present**

If set, the indicated burst shall start with the short preamble.

**Start Time**

Indicates the start time, in units of symbol duration, relative to the beginning of the next downlink frame (including preamble). The time instants indicated by the Start Time values are the transmission times of the first symbol of the burst including preamble (if present).

**Duration**

Indicates the duration, in units of OFDM symbols, of the allocation. The duration is inclusive of the preamble contained in the allocation.

**HCS**

An HCS value, as defined in 6.3.2.1.1, is appended to the end of the reduced map(s) data. The HCS is computed across all bytes of the reduced map(s) starting with the byte containing the Compressed map indicator and including appended Reduced Private UL-MAP(s), if present.

***Insert new subclause 8.3.6.7.2:***

### 8.3.6.7.2 Reduced private UL-MAP

The Reduced private UL-MAP format is presented in Table 258d. The message may only appear after a Reduced private DL-MAP message to which it shall be appended.

**Table 258d—Reduced private UL-MAP message format**

| Syntax | Size | Notes |
|---|---|---|
| Reduced Private UL-MAP() | — | — |
| **UCD Count Included** | 1 bit | 1 = UCD Count Included.<br>The UCS count should be included in the first allocation of a private map chain. |
| **PHY modification Included** | 1 bit | 1 = Preamble time shift included. |
| **Power Control Included** | 1 bit | 1 = Power control value included. |
| if (UCD Count Included) { | — | — |
| **UCD Count** | 8 bits | — |
| } | — | — |
| if (PHY modification Included) { | — | — |
| **Preamble Time Shift** | 8 bits | Updated preamble time shift to be used starting with the next frame. |
| } | — | — |
| if (Power Control Included) { | — | — |
| **Power Control** | 8 bits | Signed integer in 0.25 dB units. |
| } | — | — |
| **UIUC** | 4 bits | — |
| **Start Time** | 11 bits | — |
| **Duration** | 10 bits | — |
| **Subchannel Index** | 5 bits | — |
| **Midamble Repetition Interval** | 2 bits | — |
| *Reserved* | 5 bits | Set to zero. |
| } | — | |

**UCD Count Included**

Indicates if UCD Count is included. This should be included in the first UL map of a private map chain.

**Phy Modification Included**

Indicates if a preamble modifier is included.

**Power Control Included**
Indicates if an SS power control byte is included.

**Preamble Time Shift**
The preamble time shift for subsequent UL allocations, as defined in 8.6.3.3.7.

**Power Control**
The change in transmit power level that the SS should apply starting on the next frame.

**UCD Count**
Matches the value of the configuration change count of the UCD, which describes the uplink burst profiles that apply to this map.

**UIUC**
UIUC used for the burst.

**Start Time**
Indicates the start time of the allocation, in units of symbol duration, referenced to the beginning of the next frame and consists of an integer symbol offset specified here, as well as the addition of the TTG known from DCD messages. If TTG is not present in the DCD (for FDD) it is assume to be zero.

**Duration**
Indicates the duration, in units of OFDM symbols, of the allocation. The duration is inclusive of the preamble contained in the allocation.

**Subchannel Index**
See Table 211.

**Midamble Repetition Interval**
Indicates the preamble repetition interval in OFDM symbols, as defined in 8.3.6.3.

### 8.3.7 Control mechanisms

### 8.3.7.2 Ranging

***Change the fifth paragraph as indicated:***

SSs that compute their $P_{TX\_IR\_max}$ to exceed their maximum power level and SSs that have attempted initial ranging with the maximum power level using RNG-REQ may, if the BS supports subchannelization, attempt initial ranging in an initial ranging slot using the following burst format, to be referred to as the Subchannelized Initial Ranging Signal and as indicated in Figure 210a and Figure 210b.

***Insert the following new figures (Figure 210a and Figure 210b) into the subclause:***

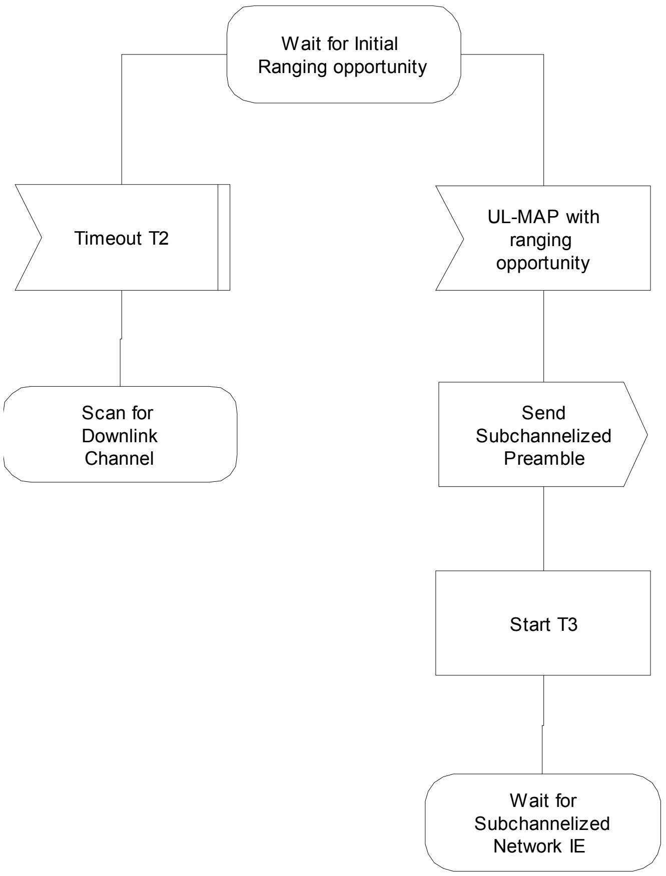

Wait for Initial Ranging opportunity
Timeout T2
UL-MAP with ranging opportunity
Scan for Downlink Channel
Send Subchannelized Preamble
Start T3
Wait for Subchannelized Network IE

**Figure 210a—Subchannelized Initial Ranging—SS (part 1a)**

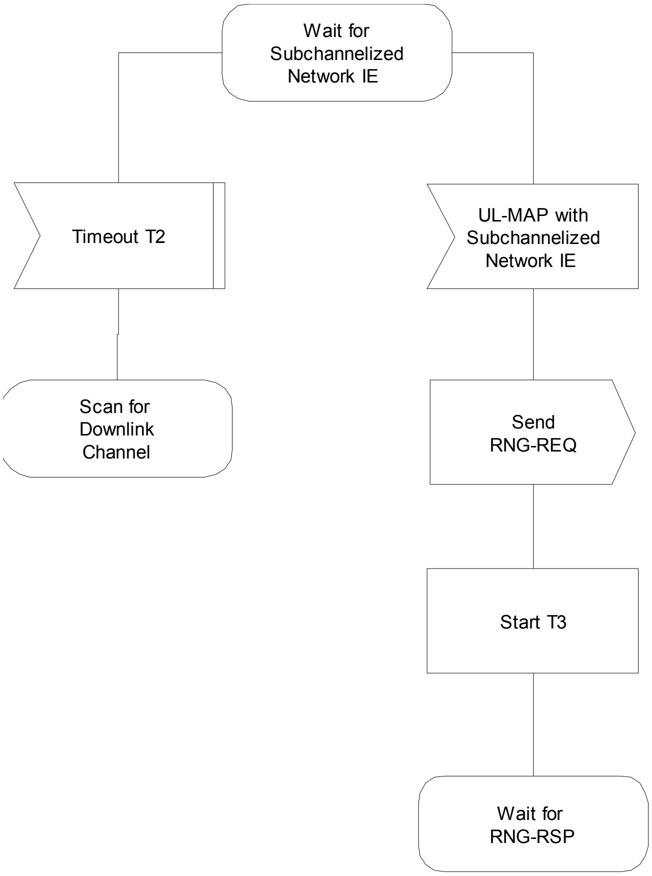

Wait for Subchannelized Network IE
Timeout T2
UL-MAP with Subchannelized Network IE
Scan for Downlink Channel
Send RNG-REQ
Start T3
Wait for RNG-RSP

Figure 210b—Subchannelized Initial Ranging —SS (part 1b)

*Change the eighth paragraph as indicated:*

The BS need only detect that energy is sent on a single subchannel and may respond by allocating a single subchannel identifying the SS by the Transmit Opportunity, Frame Number and ranging subchannel in which the transmission was received. The allocation is accomplished by sending an UL-MAP IE containing a Subchannelized_Network_Entry_IE (see 8.3.6.3.3) and transmitted using the Initial Ranging CID, as shown in Figure 210b. The allocated bandwidth shall be big enough as to contain at least one RNG-REQ message.

### 8.3.7.2.1 Initial Ranging in AAS systems

*Change the last sentence of the first paragraph as indicated:*

This burst shall use the most robust mandatory ~~rate~~coding method (BPSK-1/2).

*Insert the following sentence under the Notes column for the HCS field in Table 259:*

An 8-bit Header Check Sequence, calculated as specified in Table 5.

*Change Table 260 as indicated:*

### Table 260—OFDM SBCH_AAS_NW_ENTRY_REQ format

| Syntax | Size | Notes |
|---|---|---|
| SBCH_AAS_NW_ENTRY_REQ(){ | | |
| **Network entry code** | 4 bits | A randomly selected code. |
| **Phase offset 1** | 4 bits | The mean phase offset of beam 1 relative to beam 0. 4-bit signed number, in units of 360°/16. |
| **Phase offset 2** | 4 bits | The mean phase offset of beam 2 relative to beam 0. 4-bit signed number, in units of 360°/16. |
| **Phase offset 3** | 4 bits | The mean phase offset of beam 3 relative to beam 0. 4-bit signed number, in units of 360°/16. |
| **Measurement frame index** | 1 bit | 0: Phase information corresponds to beams in previous frame<br>1: Phase information corresponds to beams in one before previous frame. |
| **RSSI mean value** | 5 bits | |
| ***Reserved*** | 2 bits | Shall be set to zero |
| **HCS** | 8 bits | An 8-bit Header Check Sequence; calculated as specified in Table 5. |
| } | | |

### 8.3.7.3 Bandwidth requesting

*Change the first sentence of the second paragraph as indicated:*

In a REQ Region-Full, when subchannelization is not active, each Transmit Opportunity shall consist of a short preamble and one OFDM symbol using the most robust mandatory ~~burst profile~~coding method (BPSK-1/2).

*Change the last sentence of the second paragraph as indicated:*

The transmission of an SS shall contain a subchannelized preamble corresponding to the TO chosen, followed by data OFDM symbols using the most robust mandatory ~~burst profile~~coding method (BPSK-1/2).

### 8.3.7.3.2 Full Contention transmission

*Change the second paragraph as indicated:*

If the Full Contention allocation appears in subchannelized region, the allocation is partitioned into transmission opportunities (TOs) both in frequency and in time. The width (in subchannels) and length (in OFDM symbols) of each transmission opportunity is defined in the UCD message ~~defining UIUC = 2~~. The transmission of an SS shall contain a subchannelized preamble corresponding to the TO chosen, followed by data OFDM symbols using the most robust mandatory ~~burst profile~~coding method (BPSK-1/2).

### 8.3.7.4 Power control

***Change the last sentence of the second paragraph as indicated:***

Subscriber stations shall report the maximum available power, and the ~~normalized~~current average transmitted power.

Explicitly, let PSDref be the reference level of power spectrum density of the SS. This can only be changed by power control messages. The transmit power of the SS is defined as current tx power = min((number used subchannels) × PSDref, maximum available power). Thus, in the case of saturation, the reference level of power spectrum density shall not be changed.

***Insert a new subheading 8.3.7.4.1 Closed loop power control mode:***

#### 8.3.7.4.1 Closed loop power control mode

***Change the second paragraph in 8.3.7.4 as indicated:***

When subchannelization is employed in the uplink, the SS shall maintain the same transmitted power density unless the maximum power level is reached. That is, when the number of active subchannels allocated to a user is reduced, the total transmitted power shall be reduced proportionally by the SS, without additional power control messages. When the number of subchannels is increased the total transmitted power shall also be increased proportionally. However, the transmitted power level shall not exceed the maximum levels dictated by signal integrity considerations and regulatory requirements. Subscriber stations shall report the maximum available power, and the normalized transmitted power.

***Insert the following text between the second and third paragraph in 8.3.7.4:***

When subchannelization is employed in the downlink, the BS may vary the power of individual subchannelized allocations to improve the link budget to particular MS's. The transmitted power level shall not exceed the maximum levels dictated by signal integrity considerations and regulatory requirements. Within a given DL subchannelized allocation the spectral flatness requirement as specified in 8.3.10.1.1 applies to all the energized subcarriers.

***Insert a new subclause 8.3.7.4.2:***

#### 8.3.7.4.2 Open Loop Power Control Mode (Optional)

When the open loop power control is supported and the uplink power control mode is changed to open loop power control by PMC_RSP, the power per a subcarrier shall be maintained for the UL transmission as follows.

This open loop power control shall be applied for all the uplink bursts.

$$P_{EIRP}(dBm) = PL + CNR + R + (N+I) + 10log_{10}(BW_{sch}) + Offset\_SS_{perSS} + Offset\_BS_{perSS} \tag{84a}$$

where

$P_{EIRP}$ is the Tx effective isotropic radiated power (EIRP) level, expressed in dBm, per subcarrier for the current transmission. It includes the MS Tx antenna gain and its related coupling losses.

***PL*** is the estimated average current UL path loss.

***CNR*** is the normalized Carrier to Noise Ratio (per subcarrier) for the given modulation, FEC and the related Convolutional Coding scheme used for the current transmission as presented in Table 262a. The normalized Carrier to Noise Ratio can be modified by UCD (Normalized C/N override).

***R*** is the number of repetitive sequences used by the receiving circuitry employed to determine the path losses.

$BW_{sch}$ is the bandwidth occupied by an OFDM subcarrier, expressed in Hz.

***N+I*** is the estimated normalized average power level (dBm) of the noise and interference per subcarrier at the Rx antenna port of the receiving side (BS), for BW=1 Hz. It does not include the equivalent gain of the Rx antenna and its related coupling losses.

***OffsetMS_UL*** represents the correction term for SS-specific power offset. Practically it amounts to the desired Fade Margin for the respective UL link. It is controlled by the MS and initially is set to zero.

***OffsetBS_UL*** represents the MS-specific power offset, controlled by the BS through the power control messages. When OffsetBS_UL is set through the PMC_RSP message, it shall include the equivalent BS Rx antenna gain, including its related coupling losses, measured at the antenna port of the equipment.

**Table 262a—Normalized CINR per modulation (BER = 1e-6)**

| Modulation/FEC-CC Rate | Normalized CNR (dB) |
|---|---|
| BPSK 1/2 | 13.9 |
| QPSK 1/2 | 16.9 |
| QPSK 3/4 | 18.65 |
| 16QAM 1/2 | 23.7 |
| 16QAM 3/4 | 25.45 |
| QAM64 1/2 | 29.7 |
| QAM64 3/4 | 31.45 |

The normalized CNR is calculated based on Noise Figure = 7 dB and MIL (Modulation Implementation Losses = 5 dB).

The estimated average current UL propagation loss, $PL_{UL}$, shall be calculated based on the total power received on the active subcarriers of the frame preamble, referenced to the *BS_EIRP* parameter sent by the BS.

Table 262a returns the default normalized CNR values per modulation. The operating parameters *BS_EIRP* and *NI* are signaled by a DCD message (Table 358—DCD channel encoding).

Additionally, the BS controls the $Offset\_BS_{perSS}$ using PMC_RSP message (6.3.2.3.58) to override the $Offset\_BS_{perSS}$ value or using RNG-RSP (6.3.2.3.6), Fast Power Control (FPC) message (6.3.2.3.34), Power Control IE (8.3.6.3.5) to adjust the $Offset\_BS_{perSS}$ value. The accumulated power control value shall be used for $Offset\_BS_{perSS}$.

The $Offset\_BS_{perSS}$ can be updated using relative or fixed form (as a function of the relevant adjustment commands used). Fixed form is used when the parameter is obtained from a PMC_RSP message. In this case, the MS should replace the old $Offset\_SS_{perSS}$ value by the new $Offset\_SS_{perSS}$ sent by the BS. With all other messages mentioned in the previous paragraph, relative form is used. In this case, MS should increase and decrease the $Offset\_SS_{perSS}$ according to the offset value sent by BS.

The actual power setting shall be quantized to the nearest implementable value, subject to the specification. For each transmission, the SS shall limit the power, as required to satisfy the spectral masks and EVM requirements.

**Passive Uplink open loop power control**

In passive Uplink open loop power control the MS will set $Offset\_SS_{perSS}$ to zero and modify the TX power value using Equation (84a).

**Active Uplink open loop power control**

An alternative way is that the SS may adjust $Offset\_SS_{perSS}$ value within a range.

$$Offset\_Bound_{lower} \le Offset_{perSS} \le Offset\_Bound_{upper}, \tag{84b}$$

where

$Offset\_Bound_{upper}$ is the upper bound of $Offset\_SS_{perSS}$
$Offset\_Bound_{lower}$ is the lower bound of $Offset\_SS_{perSS}$

***Change the title of subclause 8.3.8 as indicated:***

### 8.3.8 Transmit diversity: ~~S~~space-~~T~~time ~~C~~coding (optional)

***Change the first paragraph as indicated:***

STC (~~see~~ Alamouti [B1]), (in some cases also termed STTD), may be used on the downlink to provide ~~second~~higher order (Space) transmit diversity.

### 8.3.9 Channel quality measurements

#### 8.3.9.2 RSSI mean and standard deviation

***Change the first sentence of first paragraph as indicated:***

When collection of RSSI measurements is mandated by the BS, an SS shall obtain an RSSI measurement from the OFDM downlink long preambles.

***Change the first sentence of the third paragraph as indicated:***

The method used to estimate ~~the~~ a single RSSI ~~of a single message~~ measurement is left to individual implementation, but the relative accuracy of a single signal strength measurement, taken from a single message, shall be ± 2 dB, with an absolute accuracy of ± 4 dB.

***Replace Equation (90) and Equation (91) with the following equations:***

$$\hat{x}^2_{RSSI}[k] = \begin{cases} |R[0]|^2 & k = 0 \\ (1-\alpha_{avg})\hat{x}^2_{RSSI}[k-1] + \alpha_{avg}|R[k]|^2 & k > 0 \end{cases} \qquad (mW)^2 \tag{90}$$

$$\hat{\sigma}_{RSSI\ dB} = 5\log\left(\left|\hat{x}^2_{RSSI}[k] - (\hat{\mu}_{RSSI}[k])^2\right|\right) \quad dBm \tag{91}$$

### 8.3.9.3 CINR mean and standard deviation

***Change the second sentence of the third paragraph as indicated:***

The specified accuracy shall apply to the range of CINR values starting from ~~3 dB below~~the SNR of the most robust rate, to ~~10~~3 dB above the SNR of the least robust rate.

### 8.3.10 Transmitter requirements

***Insert the following paragraph:***

All requirements on the transmitter apply to the RF output connector of the equipment. For equipment with integral antenna only, a reference antenna with 0 dBi gain shall be assumed.

### 8.3.10.1 Transmit power level control

***Change the subclause as indicated:***

For an SS not supporting subchannelization, the transmitter shall support a monotonic power level control of 30 dB minimum. For an SS supporting subchannelization, the transmitter shall support a monotonic power level control of 50 dB minimum. The minimum step size shall be no more than 1 dB. The relative accuracy of the power control mechanism is ±1.5 dB for step sizes not exceeding ~~30~~15 dB, ~~and~~ ±3 dB for step sizes from 15 dB to 30 dB and ±5 dB for step size greater than 30 dB. For a BS, the transmitter shall support a monotonic power level control of 10 dB minimum.

***Renumber subclause 8.3.10.1.1 as 8.3.10.2***

### 8.3.10.2 Transmitter spectral flatness

***Insert the following sentence after Table 263:***

The power transmitted at spectral line 0 shall not exceed –15 dB relative to total transmitted power.

***Renumber subclause 8.3.10.1.2 as 8.3.10.3***

***Change Table 264 as indicated:***.

**Table 263—Allowed relative constellation error versus data rate**

| Burst type | Relative constellation error for SS (dB) | Relative constellation error for BS (dB) |
|---|---|---|
| BPSK-1/2 | –13.0 | –13.0 |
| QPSK-1/2 | –16.0 | –16.0 |
| QPSK-3/4 | –18.5 | –18.5 |
| 16-QAM-1/2 | –21.5 | –21.5 |

**Table 263—Allowed relative constellation error versus data rate *(continued)***

| Burst type | Relative constellation error for SS (dB) | Relative constellation error for BS (dB) |
|---|---|---|
| 16-QAM-3/4 | –25.0 | –25.0 |
| 64-QAM-2/3 | ~~–28.5~~ –29.0 | –29.0 |
| 64-QAM-3/4 | ~~–31.0~~ –30.0 | –31.0 |

***Renumber subclause 8.3.10.2 as 8.3.10.4***

### 8.3.11 Receiver requirements

***Insert the following paragraph:***

All requirements on the receiver apply to the RF input connector of the equipment. For equipment with integral antenna only, a reference antenna with 0 dBi gain shall be assumed.

### 8.3.11.1 Receiver sensitivity

***Delete the first bullet of the first paragraph:***

— ~~At the antenna connector or through a calibrated radiated test environment,~~

***Change the second paragraph as indicated:***

The receiver minimum input level sensitivity ($R_{SS}$) shall be (assuming a 5 dB implementation margin and a ~~7~~ 8 dB Noise Figure):

***Replace Equation (98) with the following equation:***

$$R_{SS} = -101 + SNR_{Rx} + 10 \cdot \log\left(F_S \cdot \frac{N_{used}}{N_{FFT}} \cdot \frac{N_{subchannels}}{16}\right) \quad (98)$$

where

| | |
|---|---|
| $SNR_{Rx}$ | the receiver SNR as per Table 266 in dB, |
| $F_S$ | sampling frequency in MHz as defined in 8.3.2.2, |
| $N_{\text{subchannels}}$ | the number of allocated subchannels (default 16 if no subchannelization is used). |

***Change Table 266 as indicated:***

**Table 266—Receiver SNR assumptions**

| **Modulation** | **Coding rate** | **Receiver SNR (dB)** |
|---|---|---|
| BPSK | 1/2 | ~~6.4~~ 3.0 |
| QPSK | 1/2 | ~~9.4~~ 6.0 |
| | 3/4 | ~~11.2~~ 8.5 |
| 16-QAM | 1/2 | ~~16.4~~ 11.5 |
| | 3/4 | ~~18.2~~ 15.0 |
| 64-QAM | 2/3 | ~~22.7~~ 19.0 |
| | 3/4 | ~~24.4~~ 21.0 |

***Change the paragraph below Table 266 as indicated:***

Note that these SNR values are derived in an AWGN environment, and assume that Reed-Solomon convolutional coding (RS-CC) is used.

Test messages for measuring Receiver Sensitivity shall be based on a continuous stream of MAC PDUs, each with a payload ~~consisting of~~ containing an ***R*** times repeated sequence $\boldsymbol{S}_{\boldsymbol{modulation}}$. For each modulation, a different sequence applies:

***Change the second paragraph below Table 266 as indicated:***

For each mandatory test message, the ($\boldsymbol{R}$,$\boldsymbol{S}_{\boldsymbol{modulation}}$) tuples that shall apply are:

> Short length test message payload (288 data bytes): (144,$S_{BPSK}$), (72,$S_{QPSK}$), (36,$S_{16QAM}$), (6,$S_{64QAM}$)
> Mid length test message payload (864 data bytes): (432,$S_{BPSK}$), (216,$S_{QPSK}$), (108,$S_{16QAM}$), (18,$S_{64QAM}$)
> Long length test message payload (~~1536~~1488 data bytes): (~~768~~744,$S_{BPSK}$), (~~384~~372,$S_{QPSK}$), (~~192~~186,$S_{16QAM}$), (~~32~~31,$S_{64QAM}$)

### 8.3.11.2 Receiver adjacent and alternate channel rejection

***In the second paragraph, change the reference 8.3.10.3 to 8.3.11.3.***

### 8.3.12 Frequency and timing requirements

***Change the second paragraph as indicated:***

At the SS, both the transmitted center frequency and the ~~symbol~~sampling clock frequency shall be synchronized and locked to the BS with a tolerance of maximum 2% of the subcarrier spacing for the transmitted center frequency, and 5 ppm for the sampling clock frequency. In the case of subchannelization, the tolerance for transmitted center frequency shall be maximum 1% of the subcarrier spacing.

## 8.4 WirelessMAN-OFDMA PHY layer

### 8.4.1 Introduction

***Insert the following text at the end of 8.4.1***

The OFDMA PHY mode based on at least one of the FFT sizes 2048 (backward compatible to IEEE Std 802.16-2004), 1024, 512 and 128 shall be supported. This facilitates support of the various channel bandwidths.

The MS may implement a scanning and search mechanism to detect the DL signal when performing initial network entry and this may include dynamic detection of the FFT size and the channel bandwidth employed by the BS.

### 8.4.2 OFDMA symbol description, symbol parameters and transmitted signal

### 8.4.2.3 Primitive parameters

***Change this subclause as indicated:***

The following four primitive parameters characterize the OFDMA symbol:

— *BW: This* is the nominal channel bandwidth.
— $N_{\text{used}}$: Number of used subcarriers (which includes the DC subcarrier).
— $n$: Sampling factor. This parameter, in conjunction with $BW$ and $N_{\text{used}}$ determines the subcarrier spacing, and the useful symbol time. This value is set ~~to 8/7~~ as follows: for channel bandwidths that are a multiple of 1.75 MHz then $n = 8/7$ else for channel bandwidths that are a multiple of any of 1.25, 1.5, 2 or 2.75 MHz then $n = 28/25$ else for channel bandwidths not otherwise specified then $n = 8/7$.
— $G$: This is the ratio of CP time to “useful” time. The following values shall be supported: 1/32, 1/16, 1/8, and 1/4.

### 8.4.3 OFDMA basic terms definition

***Change the title of subclause 8.4.3.1 as indicated:***

### 8.4.3.1 Slot and ~~D~~data ~~R~~region

***Change the text in 8.4.3.1 as indicated:***

The definition of an OFDMA slot depends on the OFDMA symbol structure, which varies for uplink and downlink, for FUSC and PUSC, and for the distributed subcarrier permutations and the adjacent subcarrier permutation.

— For downlink FUSC (defined in 8.4.6.1.2.2) and downlink optional FUSC (defined in 8.4.6.1.2.3) using the distributed subcarrier permutation ~~(defined in 8.4.6.1.2.2 and 8.4.6.1.2.3)~~, one slot is one subchannel by one OFDMA symbol.
— For downlink PUSC using the distributed subcarrier permutation (defined in 8.4.6.1.2.1), one slot is one subchannel by two OFDMA symbols.
— For uplink PUSC using either of the distributed subcarrier permutations (defined in 8.4.6.2.1 and 8.4.6.2.5), and for downlink TUSC1 and TUSC2 (defined in 8.4.6.1.2.4 and 8.4.6.1.2.5), one slot is one subchannel by three OFDMA symbols.
— For ~~uplink and downlink using~~ the adjacent subcarrier permutation (defined in 8.4.6.3), one slot is one subchannel by ~~one~~two, three, or six OFDMA symbols.

***Change the paragraph above Figure 215 as indicated:***

In OFDMA, a Data Region is a two-dimensional allocation of a group of contiguous subchannels, in a group of contiguous OFDMA symbols. All the allocations refer to logical subchannels. ~~This~~A two dimensional allocation may be visualized as a rectangle, such as the 4 × 3 rectangle shown in Figure 215.

### 8.4.3.4 OFDMA data mapping

***Change the second and third paragraphs as indicated:***

Downlink:

1) Segment the data after the modulation block into blocks sized to fit into one OFDMA slot.
2) Each slot shall span one ~~or more~~ subchannel~~s~~ in the subchannel axis and ~~two~~ one or more OFDMA symbols in the time axis, as per the slot definition in 8.4.3.1 (see Figure 21~~6~~7 for an example). Map the slots such that the lowest numbered slot occupies the lowest numbered subchannel in the lowest numbered OFDMA symbol.
3) Continue the mapping such that the OFDMA ~~symbol~~subchannel index is increased. When the edge of the Data Region is reached, continue the mapping from the lowest numbered OFDMA ~~symbol~~subchannel in the next ~~subchannel~~available symbol.

Uplink:

The UL mapping consists of two steps. In the first step, the OFDMA slots allocated to each burst are selected. In the second step, the allocated slots are mapped.

Step 1—Allocate OFDMA slots to bursts

1) Segment the data into blocks sized to fit into one OFDMA slot.
2) Each slot shall span one or more subchannels in the subchannel axis and ~~three~~one or more OFDMA symbols in the time axis, as per the slot definition in 8.4.3.1 (see Figure 217 for an example). Map the slots such that the lowest numbered slot occupies the lowest numbered subchannel in the lowest numbered OFDMA symbol.
3) Continue the mapping such that the OFDMA symbol index is increased (skipping allocations made with UIUC=0,12,13, see 8.4.5.4). When the edge of the UL zone (which is marked with Zone~~_switch~~_IE) is reached, continue the mapping from the lowest numbered OFDMA symbol in the next available subchannel.
4) An UL allocation is created by selecting an integer number of contiguous slots, according to the ordering of steps 1–3. This results in the general Burst structure shown by the gray area in Figure 217.

Step 2—Map OFDMA slots within the UL allocation.

1) Map the slots such that the lowest numbered slot occupies the lowest numbered subchannel in the lowest numbered OFDMA symbol.
2) Continue the mapping such that the Subchannel index is increased. When the last subchannel is reached, continue the mapping from the lowest numbered subchannel in the next OFDMA symbol that belongs to the UL allocation. The resulting order is shown by the arrows in Figure 217.

The subchannels referred to in this subclause are logical subchannels, before subchannel renumbering in the downlink, and before applying the rotation scheme (8.4.6.2.6) and the mapping indicated by UL allocated subchannels bitmap in UCD for the uplink.

***Replace Figure 216 and Figure 217 with the following figures:***

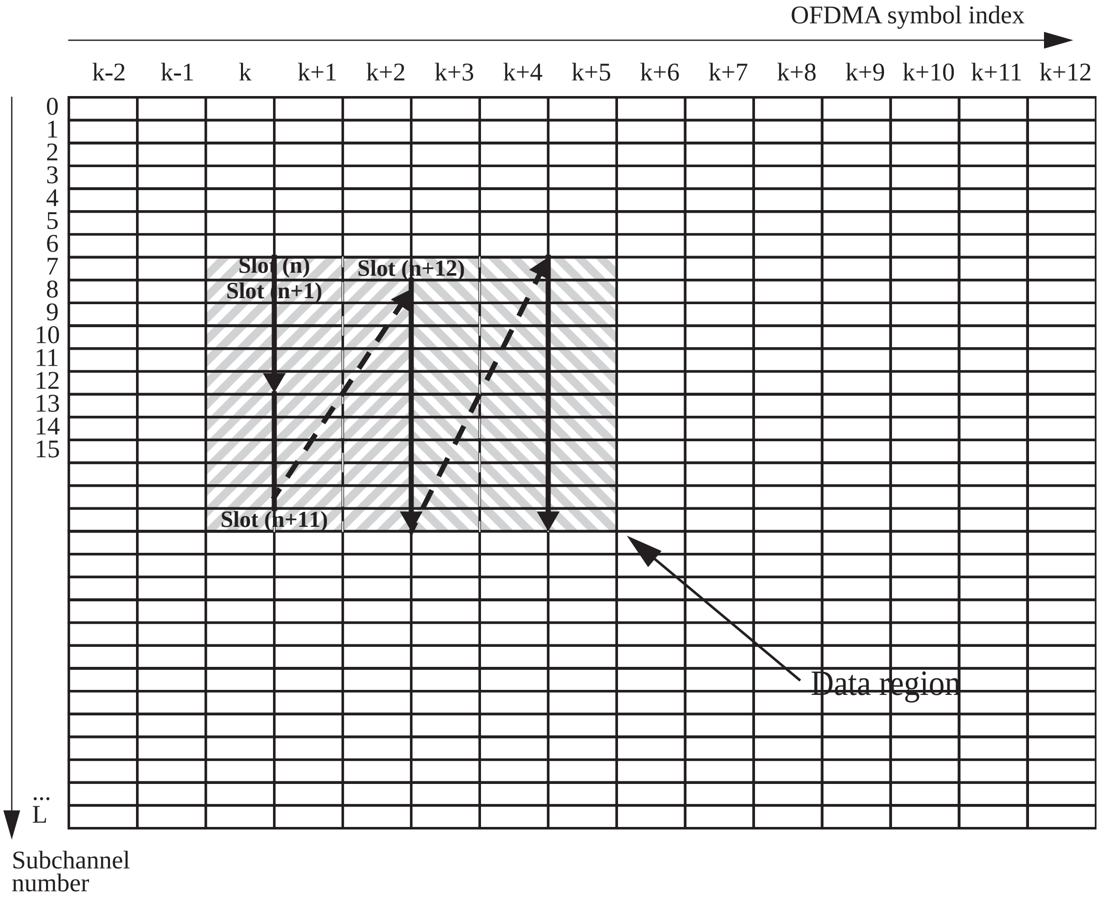

OFDMA symbol index
k-2
k-1
k
k+1
k+2
k+3
k+4
k+5
k+6
k+7
k+8
k+9
k+10
k+11
k+12
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
...
L
Subchannel number
Slot (n)
Slot (n+1)
Slot (n+12)
Slot (n+11)
Data region

**Figure 216—Example of mapping OFDMA slots to subchannels and symbols in the downlink (in PUSC mode)**

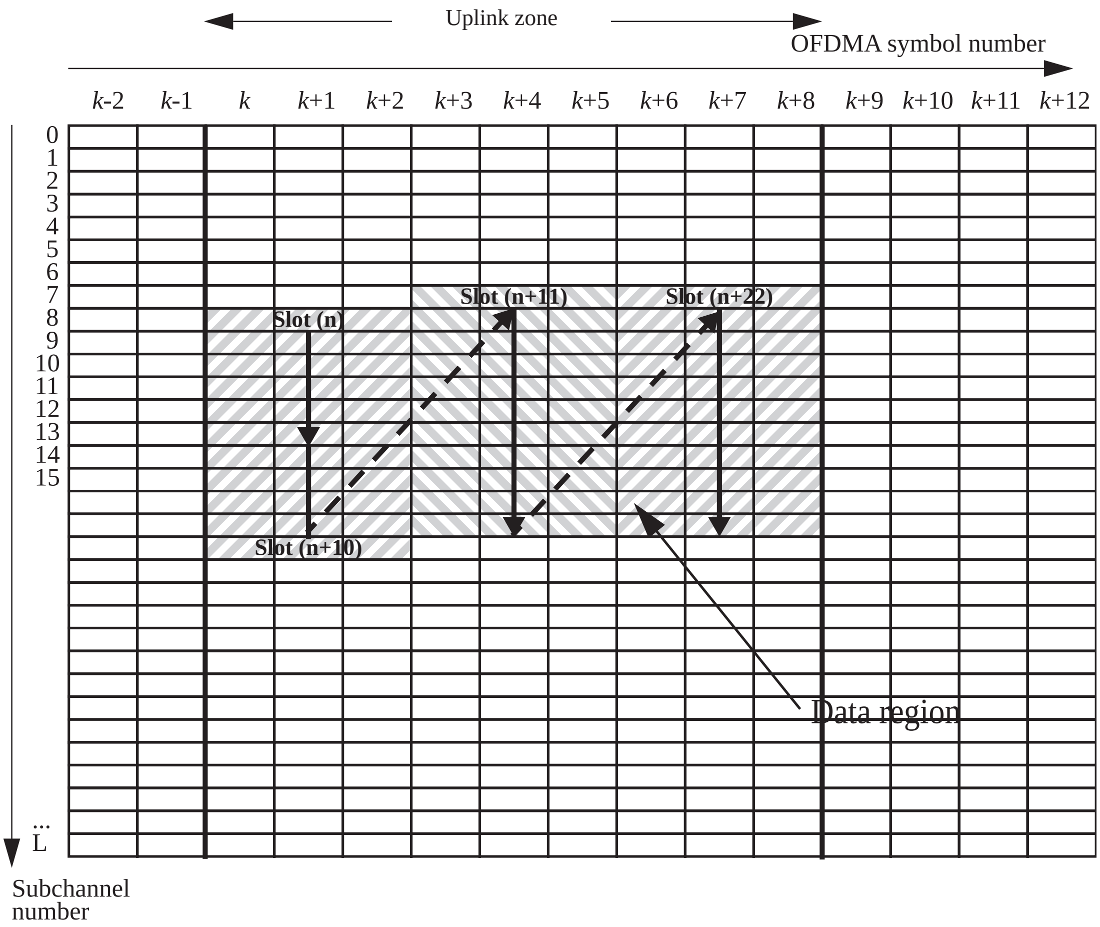

Uplink zone
OFDMA symbol number
k-2
k-1
k
k+1
k+2
k+3
k+4
k+5
k+6
k+7
k+8
k+9
k+10
k+11
k+12
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
...
L
Slot (n)
Slot (n+11)
Slot (n+22)
Slot (n+10)
Data region
Subchannel number

Figure 217—Example of mapping OFDMA slots to subchannels and symbols in the uplink

### 8.4.4 Frame structure

### 8.4.4.2 PMP frame structure

***Change the second paragraph as indicated:***

In TDD and H-FDD systems, subscriber station allowances must be made by a SSRTG and by a SSTTG. The BS shall not transmit downlink information to a station later than (SSRTG+RTD) before the beginning of its first scheduled uplink allocation in any UL-subframe, and shall not transmit downlink information to it earlier than (SSTTG-RTD) after the end of the last scheduled uplink allocation, where RTD denotes Round-Trip Delay. In addition the SS should be allowed to receive the downlink preamble for each frame that contains DL data for it, by assuring the period specified above does not overlap with the preamble. The parameters SSRTG and SSTTG are capabilities provided by the SS to BS upon request during network entry (see 11.8.3.1).

***Replace Figure 218 with the following figure:***

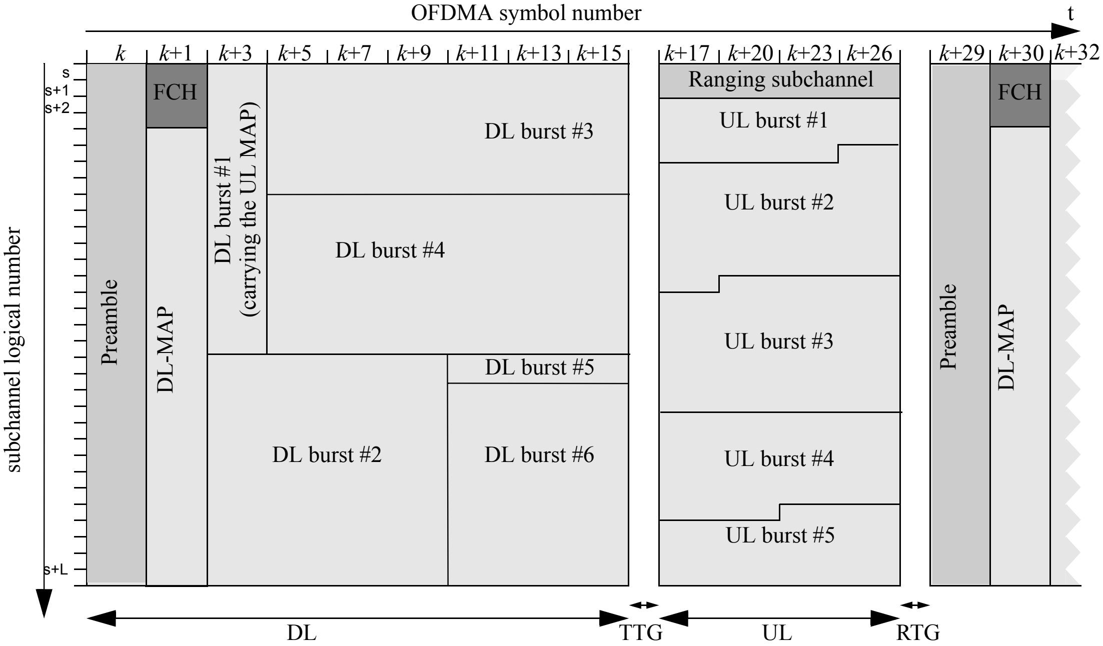

OFDMA symbol number
t
k
k+1
k+3
k+5
k+7
k+9
k+11
k+13
k+15
k+17
k+20
k+23
k+26
k+29
k+30
k+32
s
s+1
s+2
s+L
subchannel logical number
Preamble
FCH
DL-MAP
DL burst #1 (carrying the UL MAP)
DL burst #3
DL burst #4
DL burst #5
DL burst #2
DL burst #6
Ranging subchannel
UL burst #1
UL burst #2
UL burst #3
UL burst #4
UL burst #5
Preamble
FCH
DL-MAP
DL
TTG
UL
RTG

**Figure 218—Example of an OFDMA frame (with only mandatory zone) in TDD mode**

***Change the third through fifth paragraphs as indicated:***

Subchannel allocation in the downlink may be performed in the following ways: partial usage of subchannels (PUSC) where some of the subchannels are allocated to the transmitter, and full usage of the subchannels (FUSC) where all subchannels are allocated to the transmitter. ~~The first two transmitted subchannels in the first data symbol of the downlink is called FCH~~. The FCH shall be transmitted using QPSK rate 1/2 with four repetitions using the mandatory coding scheme (~~e.g.~~i.e., the FCH information will be sent on four ~~adjacent~~ subchannels with successive logical subchannel numbers) in a PUSC zone. The FCH contains the DL_Frame Prefix as described in 8.4.4.3, and specifies the length of the DL-MAP message that immediately follows the DL_Frame_Prefix and the repetition coding used for the DL-MAP message.

The transitions between modulations and coding take place on ~~OFDMA symbol~~slot boundaries in time domain (except in AAS zone) and on subchannels within an OFDMA symbol in frequency domain.

The OFDMA frame may include multiple zones (such as PUSC, FUSC, PUSC with all subchannels, optional FUSC, AMC, TUSC1, and TUSC2 ~~and optional FUSC with all subchannels~~), the transition between zones is indicated in the DL-Map by the STC_DL_Zone ~~Zone_switch~~ IE (see 8.4.5.3.4) or AAS_DL_IE (see 8.4.5.3.3). No DL-MAP or UL-MAP allocations can span over multiple zones. Figure 219 depicts the OFDMA frame with multiple zones.

The PHY parameters (such as channel state and interference levels) may change from one zone to the next.

*Replace Figure 219 with the following figure:*

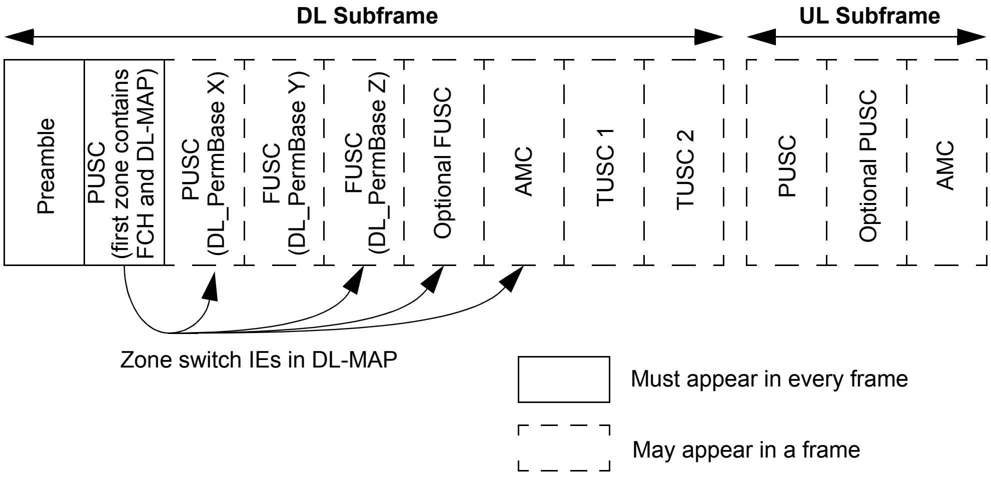

DL Subframe
UL Subframe
Preamble
PUSC (first zone contains FCH and DL-MAP)
PUSC (DL_PermBase X)
FUSC (DL_PermBase Y)
FUSC (DL_PermBase Z)
Optional FUSC
AMC
TUSC 1
TUSC 2
PUSC
Optional PUSC
AMC
Zone switch IEs in DL-MAP
Must appear in every frame
May appear in a frame

**Figure 219—Illustration of OFDMA frame with multiple zones**

*Insert the following text in 8.4.4.2 after Figure 219:*

The following restrictions apply to downlink allocations:

a) The maximum number of downlink zones is 8 in one downlink subframe.

b) For each SS, the maximum number of bursts to decode in one downlink subframe is 64. This includes all bursts without CID or with CIDs matching the SS's CIDs.

c) For each MS, the maximum number of bursts transmitted concurrently and directed to the MS is limited by the value specified in Max_Num_Bursts TLV (including all bursts without CID or with CIDs matching the MSs CIDs). Bursts transmitted concurrently are bursts that share the same OFDMA symbol. Before the MS completed capability exchange BS shall transmit data to the MS in the first concurrent data burst per symbol.

If the BS allocates more bursts or zones, then the SS is required to decode the first bursts/zones until the limit is reached.

*Change the title of subclause 8.4.4.3 as indicated:*

### 8.4.4.3 DL ~~F~~frame ~~P~~prefix

***Change Table 268 as indicated:***

**Table 268—OFDMA downlink Frame Prefix format for all FFT sizes except 128**

| Syntax | Size | Notes |
|---|---|---|
| DL_Frame_Prefix_~~F~~format() { | — | — |
| **Used subchannel bitmap** | 6 bits | Bit #0: ~~Subchannels 0-11 are used~~ Subchannel group 0<br>Bit #1: ~~Subchannels 12-19 are used~~ Subchannel group 1<br>Bit #2: ~~Subchannels 20-31 are used~~ Subchannel group 2<br>Bit #3: ~~Subchannels 32-39 are used~~ Subchannel group 3<br>Bit #4: ~~Subchannels 40-51 are used~~ Subchannel group 4<br>Bit #5: ~~Subchannels 52-59 are used~~ Subchannel group 5 |
| ~~**Ranging_Change_Indication**~~ *Reserved* | 1 bit | Shall be set to zero |
| **Repetition_Coding_Indication** | 2 bits | 0b00: No repetition coding on DL-MAP<br>0b01: Repetition coding of 2 used on DL-MAP<br>0b10: Repetition coding of 4 used on DL-MAP<br>0b11: Repetition coding of 6 used on DL-MAP |
| **Coding_Indication** | 3 bits | 0b000: CC encoding used on DL-MAP<br>0b001: BTC encoding used on DL-MAP<br>0b010: CTC encoding used on DL-MAP<br>0b011: ZT CC encoding used on DL-MAP<br>0b100: CC encoding with optional interleaver<br>0b101: LDPC encoding used on DL-MAP<br>~~0b101~~ 0b110 to 0b111 -*Reserved* |
| **DL-MAP_Length** | 8 bits | — |
| *Reserved* | 4 bits | Shall be set to zero. |
| } | — | — |

***Change paragraph below Table 268 as indicated:***

**Used subchannel bitmap**

A bitmap indicating which groups of subchannel are used on the first PUSC zone and on PUSC zones in which 'use all SC' indicator is set to '0' in STC_DL_Zone_IE(). Value of '1' means used by this segment and '0' means not used by this segment.

~~**Ranging_Change_Indication**~~

~~A flag that indicates whether this frame contains a change of the allocation of Periodic Ranging/BW Request uplink regions comparing to the previous frame. A value of "1" means that a change has occurred, and value of "0" means that the allocations of Periodic Ranging/BW Request regions in the current frame are the same as in the previous frame.~~

**Repetition_Coding_Indication**

Indicates the repetition code used for the DL-MAP. Repetition code may be 0 (no additional repetition), 1 (one additional repetition), 2 (three additional repetitions) or 3 (five additional repetitions).

**Coding_Indication**

Indicates the FEC encoding code used for the DL-MAP. The DL-MAP shall be transmitted with QPSK modulation at FEC rate 1/2. ~~Note that t~~ The BS ~~must~~shall ensure that DL-MAP (and other MAC messages required for SS operation) are sent with the mandatory coding scheme often enough to ensure uninterrupted operation of SS supporting only the mandatory coding scheme.

**DL-Map_Length**

Defines the length in slots of the DL-MAP message that follows immediately the DL_Frame_Prefix, after repetition code is applied.

***Insert new Table 268a following Table 268:***

### Table 268a—Subchannel index of the six subchannel groups

| FFT size | Subchannel group | # Subchannel range | FFT size | Subchannel group | # Subchannel range |
|---|---|---|---|---|---|
| 2048 | 0 | 0-11 | 512 | 0 | 0-4 |
| | 1 | 12-19 | | 1 | N/A |
| | 2 | 20-31 | | 2 | 5-9 |
| | 3 | 32-39 | | 3 | N/A |
| | 4 | 40-51 | | 4 | 10-14 |
| | 5 | 52-59 | | 5 | N/A |
| 1024 | 0 | 0-5 | 128 | 0 | 0 |
| | 1 | 6-9 | | 1 | N/A |
| | 2 | 10-15 | | 2 | 1 |
| | 3 | 16-19 | | 3 | N/A |
| | 4 | 20-25 | | 4 | 2 |
| | 5 | 26-29 | | 5 | N/A |

***Insert new text and table:***

For the case of 128 FFT, the following compressed format shall be used for FCH.

### Table 268b—OFDMA downlink frame prefix format for 128 FFT

| Syntax | Size | Notes |
|---|---|---|
| DL_Frame_Prefix_format() { | — | — |
| **Used subchannel indicator** | 1 bit | 0: Subchannel 0 is used for segment 0,<br>Subchannel 1 is used for segment 1,<br>Subchannel 2 is used for segment 2,<br>1: Use all subchannels |
| *Reserved* | 1 bit | Shall be set to zero |
| **Repetition_Coding_Indication** | 2 bits | 0b00 - No repetition coding on DL-MAP<br>0b01 - Repetition coding of 2 used on DL-MAP<br>0b10 - Repetition coding of 4 used on DL-MAP<br>0b11 - Repetition coding of 6 used on DL-MAP |
| **Coding_Indication** | 3 bits | 0b000 - CC encoding used on DL-MAP<br>0b001 - BTC encoding used on DL-MAP<br>0b010 - CTC encoding used on DL-MAP<br>0b011 - ZT CC encoding used on DL-MAP<br>0b100 - LDPC encoding used on DL-MAP<br>0b101 ~ 0b111 - *Reserved* |
| **DL-Map_Length** | 5 bits | — |
| } | — | — |

Before being mapped to the FCH, the 12-bit DL Frame Prefix shall be repeated four times to form a 48-bit block, which is the minimal FEC block size.

***Change the title of 8.4.4.4 to read:***

### 8.4.4.4 Allocation of subchannels for FCH and DL-MAP, and logical subchannel numbering

***Change the first paragraph of 8.4.4.4 as indicated:***

In PUSC, any segment used shall be allocated at least ~~12 subchannels~~the same number of subchannels as in subchannel group #0. For FFT sizes other than 128, t~~T~~he first 4 slots in the downlink part of the segment contain the FCH as defined in 8.4.4.2. These slots contain 48 bits modulated by QPSK with coding rate 1/2 and repetition coding of 4. For FFT-128, the first slot in the downlink part of the segment is dedicated to FCH and repetition is not applied. The basic allocated subchannel sets for Segments 0, 1, and 2 are Subchannel Group #0, #2, #4 ~~Subchannel Group #0, #2, #4~~ respectively. Figure 220 depicts this structure.

***Change the paragraph below Figure 220 as indicated:***

After decoding the DL_Frame_Prefix message within the FCH, the SS has the knowledge of how many and which subchannels are allocated to the PUSC segment. In order to observe the allocation of the subchannels in the downlink as a contiguous allocation block, the subchannels shall be renumbered. The renumbering, for the first PUSC zone, shall start from the FCH subchannels (renumbered to values 0…11), then continue numbering the subchannels in a cyclic manner to the last allocated subchannel and from the first allocated subchannel to the FCH subchannels. Figure 221 gives an example of such renumbering for segment 1. For other PUSC zones, in which use all SC indicator is set to '1' or which are defined by AAS_DL_IE(), renumbering shall be performed starting from subchannel ($N_{subchannels}$/3)*PRBS_ID, where PRBS_ID is specified in the STC_DL_Zone_IE or AAS_DL_IE(). For other PUSC zones, in which use all SC indicator is set to ‘0’, the renumbering shall be the same as in the first PUSC zone.

For uplink, in order to observe the allocation of the subchannels as a contiguous allocation block, the subchannels shall be renumbered, the renumbering shall start from the lowest numbered allocated subchannel (renumbered to value 0), up to the highest numbered allocated subchannel, skipping non-allocated subchannels. Figure 222 gives an example of such renumbering for segment 1.

***Insert the following text at the end of the subclause:***

The DL-MAP of each segment shall be mapped to the slots allocated to the segment in a frequency first order, starting from the slot after the FCH (subchannel 4 in the first symbol, after renumbering), and continuing to the next symbols if necessary. The FCH of segments that have no subchannels allocated (unused segments) will not be transmitted, and the respective slots may be used for transmission of MAP/data of other segments.

### 8.4.4.5 Uplink transmission allocations

***Change 8.4.4.5 as follows:***

The allocation for a user uplink transmission is a number of subchannels over a number of OFDMA symbols. ~~The number of symbols shall be equal to 3*$N$, where $N$ is a positive integer.~~ The basic allocation structure is a slot, as defined in 8.4.3.1.

~~The basic allocation structure is one subchannel for a duration of 3 times the OFDMA symbol duration $T_S$, (N = 1). Larger allocation are repetitions of the basic structure ($N = k$, for a positive integer $k$).~~

The framing structure used for the uplink includes an allocation for ranging and an allocation for data transmission. The MAC layer sets the length of the uplink framing and the uplink mapping.

***Insert the following text at the end of the subclause:***

In the uplink, the BS shall not allocate to any SS more than one UL-MAP_IE with data burst profile UIUC (1-10) in a single frame. In the uplink, the BS shall not allocate to any MS more than one Mini-subchannel allocation in a single frame. These limitations do not apply to HARQ data allocation regions.

The BS shall not allocate more than three ranging allocation IEs (UIUC 12) per frame, one for initial ranging/handover ranging (Dedicated ranging indicator bit in UL-MAP IE is set to 0 and Ranging Method is set to 0b00 or 0b01), one for bandwidth request/periodic ranging (Dedicated ranging indicator bit in UL-MAP IE is set to 0 and Ranging Method is set to 0b10 or 0b11), and one for initial ranging for the paged MS and/ or coordinated association (Dedicated ranging indicator bit in UL-MAP IE is set to 1).

Rectangular allocations made with UIUC = 0,12,13 shall not break the UL tile structure, shall not span over multiple zones and conform to the following rules:

1) In each subchannel, the size of each continuous group of OFDMA symbols remaining after allocation of UIUC = 0,12,13 regions shall be a multiple of 3 OFDMA symbols.
2) The slot boundaries in all subchannels shall be aligned, i.e., if a slot starts in symbol k in any subchannel, then no slots are allowed to start at symbols $k + 1$, $k + 2$ at any other subchannel.
3) The number of UL symbols (excluding AAS preambles) per zone shall be an integer multiple of slot duration. Data symbols shall always start on a slot boundary.

Figure 222a depicts examples of correct and incorrect allocations of regions with UIUC = 0,12,13. Each rectangle is an UL-subframe (or zone). Regions 1,2,3 are correct allocations, while 4 and 5 are incorrect allocations.

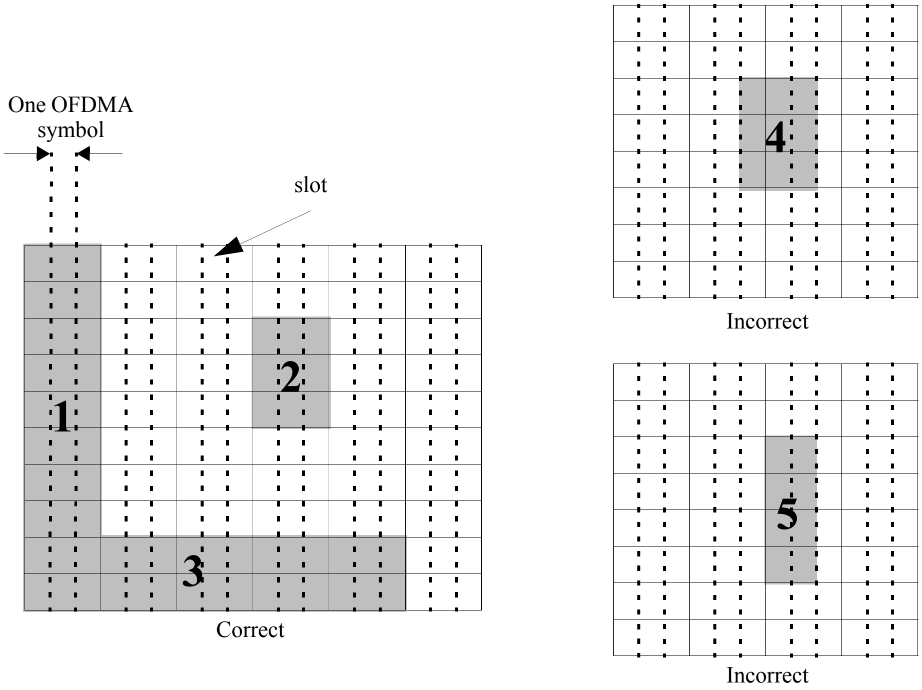


Figure 222a—Example of rectangular allocation rules

***Change the title of subclause 8.4.4.6 as indicated:***

### 8.4.4.6 Optional ~~Diversity-Map Scan~~AAS support

#### 8.4.4.6.1 AAS frame structure

***Change the subclause as indicated:***

An AAS DL Zone begins on the specified symbol boundary and consists of all subchannels until the start of the next Zone or end of frame. The two highest numbered subchannels of the DL frame may be dedicated at the discretion of the BS for the AAS Diversity-Map Zone in PUSC, FUSC, and optional FUSC permutation.

The AAS Diversity-Map Zone shall only be used with FFT sizes greater than or equal to 512.

In the AMC permutation, the ~~fourth and ($N$-4)th subchannels of the total $N$ subchannels~~first and last subchannels of the ~~DL frame~~ AAS DL Zone may be dedicated at the discretion of the BS for the AAS Diversity-Map Zone. ~~For AMC permutation, each subchannel for the AAS diversity MAP consists of 3 bins by 2 symbols.~~ When ~~these~~ subchannels are used for ~~this purpose~~a Diversity-Map zone, they shall not be allocated in the normal DL-MAP message ~~and shall be used only on the AAS portion of the DL subframe~~. These subchannels will be used to transmit the AAS-DLFP() whose physical construction is shown in Figure 223. In the case that the AAS Diversity-Map zone is not included in the AAS zone, these subchannels may be used for ordinary traffic and may be allocated in DL_MAP messages.

A 2 bin by 3 symbol tile structure shall be used for all AMC permutations in an AAS zone, including the optional AAS Diversity-Map zone.

In the AAS zone, the same antenna beam pattern shall be used for all pilot subcarriers and data subcarriers in a given AMC subchannel.

In an AAS zone defined with the PUSC permutation, the SS may assume that the entire major group is beamformed such that the channel may vary slowly within the major group over the entire duration of the zone.

***Change the caption of Figure 223 as indicated:***

Example of allocation for ~~AAS_DL_Scan IE~~AAS-DLFP

***Replace Figure 224 with the following figure:***

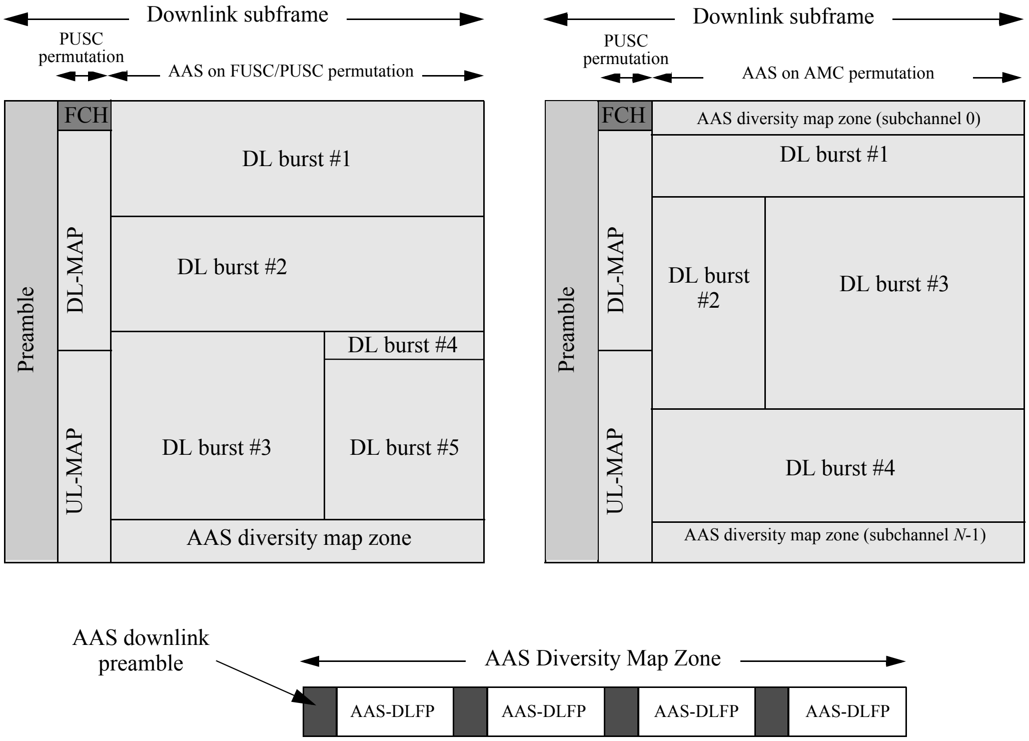

Downlink subframe
PUSC permutation
AAS on FUSC/PUSC permutation
Preamble
FCH
DL-MAP
UL-MAP
DL burst #1
DL burst #2
DL burst #3
DL burst #4
DL burst #5
AAS diversity map zone
Downlink subframe
PUSC permutation
AAS on AMC permutation
Preamble
FCH
DL-MAP
UL-MAP
AAS diversity map zone (subchannel 0)
DL burst #1
DL burst #2
DL burst #3
DL burst #4
AAS diversity map zone (subchannel N-1)
AAS downlink preamble
AAS Diversity Map Zone
AAS-DLFP
AAS-DLFP
AAS-DLFP
AAS-DLFP

**Figure 224—AAS Diversity Map Frame Structure**

***Change the title of subclause 8.4.4.6.2 as indicated:***

### 8.4.4.6.2 ~~AAS-DLFP Format~~ Optional Diversity-Map scan

***Change the subclause as indicated:***

The purpose of the AAS-DLFP is to provide a robust transmission of the required base station parameters to enable SS initial ranging, as well as SS paging and access allocation. This is achieved through using a highly robust form of modulation and coding (namely QPSK-1/2 rate with 2 repetitions). The start of an AAS-DLFP is marked by an AAS DL preamble. The AAS-DLFPs transmitted within the AAS Diversity Map Zone may, but need not carry the same information. Different beams may be used within the AAS Diversity Map Zone; however, each AAS Downlink Preamble and associated AAS-DLFP must be transmitted on the same beam.

The UL and DL AAS Zones are defined by the uplink and downlink extended AAS-IE in the broadcast map. In the case that an SS cannot successfully decode the broadcast maps, the SS will scan for the DLFP messages and utilize private maps within the AAS zone. It is assumed that all AAS subscribers will be able to determine the IDcell used in the selection of the DL preamble at the beginning of the DL frame. This IDcell shall be used as the DL_PermBase for the AAS zone. The UL_PermBase for the UL zone referred to by the initial ranging allocation in the AAS-DLFP shall be that provided in the UCD message. For AAS subscribers that cannot detect the AAS_DL_IE transmitted in the DL-MAP, which specifies the boundaries and permutation of AAS DL zones, they must search over the possible permutations (PUSC/FUSC/AMC) and starting symbol to detect the AAS-DLFP. The permutation for the AAS UL Zone is specified by a field in the AAS-DLFP.

The AAS-DLFP supports the ability to transmit a ~~MAP IE that carries a~~ compressed DL-MAP IE. This allocation message can point to a broadcast DL-MAP that is beamformed or can be used to “page” a specific SS that cannot receive the normal DL-MAP. Once the initial allocations are provided to the user, private DL-MAPs and UL-MAPs can be sent on a beamformed transmission to the user at the highest modulation and ~~lowest~~highest coding rate that can be supported by the link. The AAS-DLFP also has an uplink initial ranging allocation for AAS subscribers. The AAS-DLFP is not randomized.

The preamble length specified by the Downlink_preamble_config field should be limited to an integer number of slot durations for the DL PUSC permutation. Further, this field determines the preamble duration for the allocation pointed to by the DL Comp IE in the AAS-DLFP, and must be consistent with the preamble lengths described in the AAS_DL_IE messages.

The contents of the AAS-DLFP() payload is described by Table 269.

### Table 269—AAS-DLFP ~~S~~structure, Diversity-Map ~~S~~scan

| Syntax | Size | Notes |
|---|---|---|
| AAS-DLFP() { | | |
| **AAS beam index** | ~~6~~4 bits | This index is the index referred to by the AAS_Beam_Select message (see 6.3.2.3.41).<br>This field also defines the preamble frequency/time shift. For frequency shifted preambles, this value is used for the value of $K$ in Equation (103). For time shifted preambles, the value of $K$ in Equation (102) is given by:<br>For PUSC,<br>$K$ = [AAS_beam_index (mod14)]*$N_{fft}$/14<br>For AMC,<br>$K$ = [AAS_beam_index (mod 9)]*$N_{fft}$/9 |
| **Preamble select** | 1 bit | 0 – Frequency shifted Preamble<br>1 – Time shifted Preamble |
| **Uplink_Preamble_Config** | 2 bits | 0b00 – 0 symbols<br>0b01 – 1 symbols<br>0b10 – 2 symbols<br>0b11 – 3 symbols |
| **Downlink_Preamble_Config** | 2 bits | 0b00 – 0 symbols<br>0b01 – 1 symbols<br>0b10 – 2 symbols<br>0b11 – 3 symbols |
| **AAS_UL_Zone_Permutation** | 2 bits | This field describes the permutation used by the allocation pointed to by the AAS_ranging_allocation_IE.<br>0b00 = PUSC permutation<br>0b01 = Optional PUSC permutation<br>0b10 = adjacent-subcarrier permutation<br>0b11 = *Reserved* |
| ~~Initial~~AAS_Ranging_Allocation_IE(){ | | |

## Table 269—AAS-DLFP ~~S~~structure, Diversity-Map ~~S~~scan *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **OFDMA Symbol Offset** | 8 bits | The offset to the starting location of the ranging allocation is referenced to the DL preamble of the subsequent frame, and consists of an integer symbol offset specified here, as well as the addition of the TTG known from DCD messages. If TTG is not present in the DCD (for FDD) it is assumed to be zero. |
| **Subchannel offset** | ~~6~~7 bits | |
| **No of OFDMA Symbols** | ~~7~~4 bits | |
| **No of Subchannels** | ~~6~~4 bits | |
| **Ranging Method** | 2 bits | 0b00 – Initial Ranging over two symbols<br>0b01 – Initial Ranging over four symbols<br>0b10 – BW Request/Periodic Ranging over one symbol<br>0b11 – BW Request/Periodic Ranging over three symbols |
| } | | |
| **AAS_Comp_DL_IE()** | 5~~0~~2 bits | |
| **HCS** | 8 bits | |
| } | | |

## Table 270—Structure of AAS_COMP_DL_IE ()

| Syntax | Size | Notes |
|---|---|---|
| AAS_COMP_DL_IE() | | |
| **CID** | 16 bits | |
| **DIUC** | 4 bits | Set DIUC =15 to indicate the well known modulation of QPSK, encoded with the mandatory CC at rate ½ |
| **OFDMA Symbol Offset** | 8 bits | Referenced to the DL frame start preamble of the next frame. |
| **Subchannel offset** | ~~6~~8 bits | |
| **No of OFDMA Symbols** | 7 bits | |
| **No of Subchannels** | 6 bits | |
| ~~**Boosting**~~ | ~~3 bits~~ | |
| **Repetition Coding Indication** | 2 bits | As specified in 8.4.5.3 |
| *Reserved* | 1 bit | Shall be set to zero |
| } | | |

***Insert a new subclause 8.4.4.6.3 and renumber all subsequent subclauses accordingly:***

### 8.4.4.6.3 AAS Diversity-Scan Map network entry procedure

The AAS network entry utilizing the DLFP involves the following procedure:

- The AAS-SS synchronizes frame timing and frequency to the frame-start DL preamble.
- For AAS-SS at cell edge, which cannot decode the FCH or broadcast DL-MAP and UL-MAP messages, they will search for the AAS-DLFP on the AAS Diversity Map Zone. This search will need to span the possible subchannel permutations.
- The AAS-SS may receive necessary messages such as the DCD and UCD pointed to by allocations made from the AAS-DLFP using the broadcast CID. These messages may be transmitted using beam-pattern diversity to increase the link budget.
- Once the AAS-SS decodes the DCD and UCD it should perform initial ranging on the interval pointed to by the best-received AAS-DLFP.
- The AAS-SS may receive a ranging response message through a DL-MAP allocation pointed to by an AAS-DLFP with the broadcast CID.
- The AAS-SS may receive initial downlink allocations through a DL-MAP allocation pointed to by the AAS-DLFP with either broadcast CID or specific CID.
- Subsequent allocations can be managed with private DL-MAP and UL-MAP allocations.

***Replace subclauses 8.4.4.6.3 and 8.4.4.6.4 with the following subclauses and renumber them from 8.4.4.6.4:***

### 8.4.4.6.4 AAS preambles

AAS preambles are used to provide training information in both UL and DL AAS zones. All data allocations (UIUC 1-10, DIUC 0-12) and the optional AAS DLFP in an AAS zone are preceded by an AAS preamble.

UL and DL allocations are made exclusive of the AAS preamble. In the DL, a 2D allocation burst is preceded by the appropriate DL AAS preamble. In the UL, a 1D allocation is preceded by the appropriate AAS preamble. The absolute slot offset for the UL AAS allocation indicates the first data slot, which is preceded by the appropriate AAS preamble. If an UL allocation wraps at the end of the AAS zone, the data allocation does not include the symbols required for the initial AAS zone preambles.

In case the UL AAS zone length is equal to the number of symbols assigned to the AAS preamble, then no data slots are transmitted in the zone. In this case, the 'slot offset' field in the UL_MAP_IE shall be interpreted as the logical subchannel from which to start transmitting preambles. The 'duration' field in the UL_MAP_IE shall be interpreted as the number of subchannels on which to send the preamble.

The optional AAS -DLFP is preceded by an AAS downlink preamble of one symbol duration. All other DL bursts with DIUC 0-12 within an AAS DL zone have a preamble whose duration is specified by the "Downlink_preamble_config" fields of the AAS_DL_IE. This field shall be consistent with the same field of the AAS_DLFP if present. In the case the AAS DL Zone is using the PUSC permutation, the "Downlink_preamble_config" shall always be set to an integer number of slot durations (i.e., 0 or 2 symbols).

An UL preamble is inserted at the start of an UL data allocation with UIUC 1–10 and whenever such an UL allocation wraps from the end of an AAS zone to the beginning. The first Uplink_preamble_config symbols of the UL AAS zone are reserved for UL AAS preambles. On a given subchannel, an UL AAS preamble will be inserted into these symbols by the SS devices who is allocated the slot following the preamble (or following a UIUC 0,12,13 region if it directly follows the preamble). Any UL preamble inserted in an AAS zone in a location other than the first Uplink_preamble_config symbols shall be 3 symbols in duration.

The absolute slot offset field in the UL map IE corresponds to the first data slot of an allocation, which is preceded by the appropriate number of symbols for the UL AAS preamble. The absolute slot offset will count from the first subchannel slot, counting all slots in an AAS zone including any UIUC 0,12,13 regions. The slot offset will not include the first "Uplink_preamble_config" preamble symbols at the start of the AAS zone.

The duration of an UL AAS zone minus the reserved uplink preamble symbols and any UIUC 0,12,13 allocations shall be an integer number of slots. To insure that UL tile structures are not broken due to an allocation wrapping, the following restrictions hold:

— When used in an AAS zone, a UIUC 0,12,13 region shall be a multiple of three symbols in duration.
— An UL AAS Zone shall consist of an integer number of slots plus the number of UL AAS preamble symbols as defined in by the "Uplink_preamble_config" field of the UL_AAS_IE and AAS_DLFP.
— UL AAS Zone Duration = $N$*3 + Uplink_preamble_config symbols.
— Fast-feedback channels shall be allocated an integer number of slots.

Figure 224a shows a legal UL AAS zone with an UIUC 12,13 allocation that is an integer number of slots in duration.

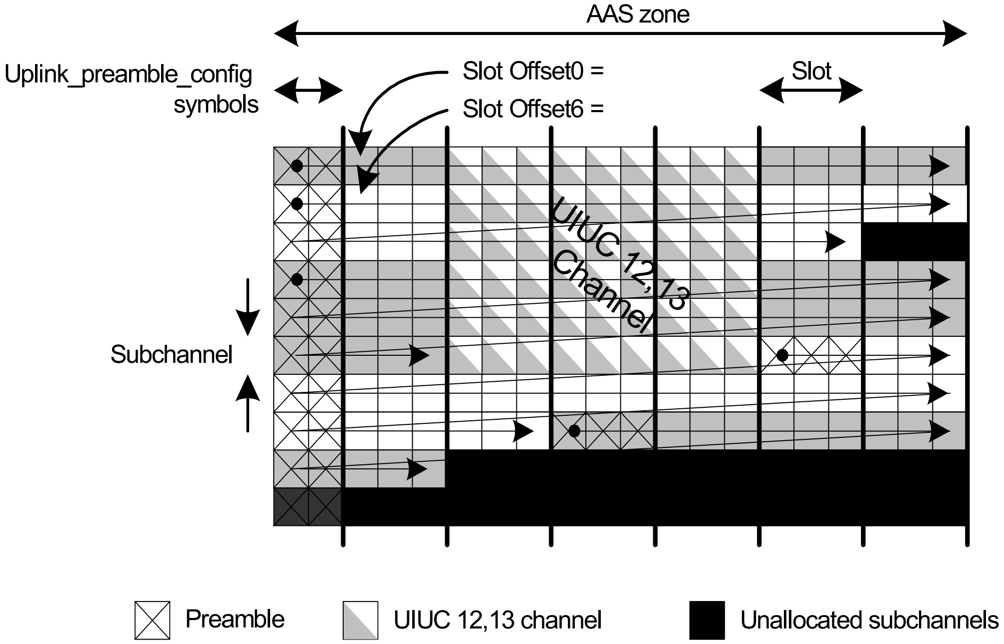


**Figure 224a—Example of UL AAS allocation with integer number of slots in duration**

The structure of the preambles is as specified in 8.4.4.6.4.1 and 8.4.4.6.4.2 for the downlink and uplink, respectively. The preamble may be either time or frequency shifted according to a preamble shift index as defined in 8.4.5.3.11 and 8.4.5.4.14. The preamble shift index shall be set by the PHY_MOD_DL_IE and PHY_MOD_UL_IE, for downlink and uplink, respectively. The preamble shift index shall also be set by the AAS beam index carried by the AAS -DLFP(), in which case it shall apply to all subsequent downlink allocations until a PHY_MOD_DL_IE is received. The BS shall ensure that all shift index specifications for an allocation (in private maps, AAS -DLFP, broadcast maps, etc.) are consistent. When using the cyclic time / frequency shifted preamble defined in 8.4.5.3.11 and 8.4.5.4.14, beams that use the same subchannels at the same time instance shall be configured to use a different preamble shift index.

### 8.4.4.6.4.1 AAS Downlink Preamble

A basic AAS downlink preamble is formed by concatenating the sequences from the three carrier sets defined in 8.4.6.1.1. Let the PN sequence for the *m*-th preamble carrier set ($m = 0,1,2$) defined in 8.4.6.1.1 have length *N* bits. The *k*-th bit of the basic AAS preamble sequence P is given by:

$$P_k = W_n(m \ mod \ 3) \tag{100a}$$

where

$m \quad = \left\lfloor \frac{k}{N} \right\rfloor mod \ 3$ ,
$n \quad = k \bmod N$,
$W_n(m)$ is the *n*-th bit of the PN sequence for the *m*-th preamble carrier-set defined in 8.4.6.1.1.

The preamble sequence will correspond to a IDcell equal to ($ID_c$ + 16) mod 32 (where $ID_c$ is the IDcell determined from the DL preamble). The bits $P_k$ shall be mapped to values consistent with the specification in 8.4.6.1.1 (0 mapped to +1, 1 mapped to –1).

The AAS preamble sequence length is $N_{used}$ bits and it shall be mapped starting from the first usable subcarrier, according to the permutation. The DC carrier shall not be modulated and the corresponding bit in the constructed preamble sequence shall be discarded.

The AAS preamble used for the burst shall be a subset of this basic preamble sequence corresponding to the subcarriers used by the burst's subchannels. In the AMC allocation, the basic AAS preamble occupies nine subcarriers in each bin of the subchannels. The number of symbols occupied by the preamble is set by the 'Downlink preamble_config' field in the AAS_DL_IE(). The AAS preamble is formed by copying the basic preamble onto the consecutive preamble symbols. The AAS preamble shall be placed, for each subchannel, starting from the first OFDMA symbol for that subchannel that belongs to the burst.

Downlink pilot locations are shifted forward with the burst allocation in time in the AMC zone with the following rules: pilot index = $9k + 3m + 1$ where *k* is a bin index and *m* = symbol index mod 3. The symbol index starts at zero for each AAS zone and corresponds to the first symbol in the AAS zone (If AAS preamble is not present) or the first symbol following the AAS preamble (if AAS preamble is present).

### 8.4.4.6.4.2 AAS uplink preamble

The basic AAS uplink preamble is formed by the method defined in 8.4.4.6.4.1 using the IDcell (as determined from the preamble). This subset shall correspond to the subcarriers used by the burst's subchannels. In the AMC allocation, the basic AAS preamble occupies nine subcarriers in each bin of the subchannels. The number of symbols occupied by the preamble is set by the 'Uplink preamble_config' field in the AAS_UL_IE(). The AAS preamble is formed by copying the basic preamble onto the consecutive preamble symbols. The AAS preamble shall be placed, for each subchannel, starting from the first OFDMA symbol for that subchannel that belongs to the burst.

Any UL allocation that wraps from the last OFDMA symbol of the AAS zone to the first OFDMA symbol shall have a preamble inserted in the first *N* OFDMA symbols of the AAS zone, where *N* is the number of AAS preamble symbols for the burst defined by the Uplink_Preamble_Config field of either the AAS_UL_IE or the AAS_DLFP.

The transmit power level of uplink AAS preamble is equal to that of data subcarrier determined by Equation (135) in 8.4.10.3 when the required (C/N) value of the current transmission, excluding code repetition factor, is between the predefined lower bound and the predetermined upper bound. Otherwise, the transmit power level of uplink AAS preamble is boosted or reduced. The predefined LowerBound$_{AAS\_PREAMBLE}$ and UpperBound$_{AAS\_PREAMBLE}$ are broadcast in the UCD TLV. Thus, transmit power level of AAS preamble can be determined as follows:

$$\begin{cases} P_{AAS\_PREAMBLE} = P_{Data} - (C/N) + 10 \cdot \log 10(R) + LowerBound_{AAS\_PREAMBLE}, \\ \quad if\,(C/N) - 10 \cdot \log 10(R) < LowerBound_{AAS\_PREAMBLE} \\ P_{AAS\_PREAMBLE} = P_{Data} - (C/N) + 10 \cdot \log 10(R) + UpperBound_{AAS\_PREAMBLE}, \\ \quad if\,(C/N) - 10 \cdot \log(10(R) \geq UpperBound_{AAS\_PREAMBLE}) \\ P_{AAS\_PREAMBLE} = P_{Data}, \\ \quad elsewhere \end{cases} \tag{100b}$$

where

**PData**
Tx power level (dBm) per subcarrier for current data transmission determined by Equation (135) in 8.4.10.3.
**(C/N)**
Required normalized C/N of the modulation/FEC rate for the current transmission in Table 332.
**R**
Number of repetitions for the modulation/FEC rate.

When SS does not have enough power to boost up AAS preamble, the power of AAS preamble is set equal to data symbol power. The power control of the uplink AAS preamble is normally disabled by setting the initial values of LowerBound$_{AAS\_PREAMBLE}$ and UpperBound$_{AAS\_PREAMBLE}$ equal to –32 dB, 31.75 dB, respectively. The SS that does not support preamble power control set the AAS preamble power equal to that of data symbols.

### 8.4.4.7 Optional Direct Signaling Method

***Delete 8.4.4.7 and all of its subclauses.***

### 8.4.5 Map message fields and IEs

### 8.4.5.3 DL-MAP IE format

***Change Table 275 as indicated:***

**Table 275—OFDMA DL-MAP_IE format**

| Syntax | Size | Notes |
|---|---|---|
| DL_MAP_IE() { | — | — |
| **DIUC** | 4 bits | — |
| if (DIUC == 14) { | — | — |
| **Extended-2 DIUC dependent IE** | — | — |
| } Else if (DIUC == 15) { | — | — |
| **Extended DIUC dependent IE** | *variable* | See subclauses following 8.4.5.3.1. |
| } else { | — | — |

### Table 275—OFDMA DL-MAP_IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| if (INC_CID == 1) { | — | The DL-MAP starts with INC_CID =0. INC_CID is toggled between 0 and 1 by the CID-SWITCH_IE() (8.4.5.3.7) |
| **N_CID** | 8 bits | Number of CIDs assigned for this IE |
| for (*n*=0; *n*< N_CID; *n*++) { | — | — |
| If ( included in SUB-DL-UL-MAP) { | — | — |
| **RCID_IE()** | — | For SUB-DL-UL-MAP, reduced CID format is used |
| } else { | — | — |
| **CID** | 16 bits | — |
| } | — | — |
| } | | |
| **OFDMA Symbol offset** | 8 bits | |
| if (Permutation = 0b11 and (AMC type is 2x3 or 1x6)) { | | |
| **Subchannel offset** | 8 bits | |
| **Boosting** | 3 bits | 000: normal (not boosted); 001: +6dB; 010: -6dB; 011: +9dB; 100: +3dB; 101: -3dB; 110: -9dB; 111: -12dB; |
| **No. OFDMA triple symbol** | 5 bits | Number of OFDMA symbols is given in multiples of 3 symbols |
| **No. Subchannels** | 6 bits | |
| } else { | | |
| **Subchannel offset** | 6 bits | |
| **Boosting** | 3 bits | 000: normal (not boosted); 001: +6dB; 010: -6dB; 011: +9dB; 100: +3dB; 101: -3dB; 110: -9dB; 111: -12dB; |
| **No. OFDMA Symbols** | 7 bits | |
| **No. Subchannels** | 6 bits | |
| } | | |
| **Repetition Coding Indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| } | | |
| } | | |

***Change the following text in 8.4.5.3***

**OFDMA Symbol offset**

The offset of the OFDMA symbol in which the burst starts, measured in OFDMA symbols from ~~beginning of~~ the downlink ~~frame~~symbol in which the ~~DL-MAP~~preamble is transmitted with the symbol immediately following the preamble being offset 1. The symbol offset shall follow the normal slot allocation within a zone so that difference between OFDMA Symbol offsets for all bursts within a zone is a multiple of the slot length in symbols.

**Boosting**

Power boost applied to the allocation's data subcarriers. ~~Indication whether the subcarriers for this allocation are power boosted.~~ The field shall be zero in AAS zone with AMC permutation, or in a zone with AMC or PUSC-ASCA permutation using 'Dedicated Pilots'.

**Repetition coding Indication**

Indicates the repetition code used inside the allocated burst. Repetition shall be used only for DIUC indicating QPSK modulation.

**No. OFDMA Symbols**

The number of OFDMA symbols that are used (fully or partially) to carry the downlink PHY Burst. The value of the field shall be a multiple of the slot length in symbols.

***Insert the following sentence at the end of the subclause:***

The subchannels offsets referred to in all formats of DL-MAP_IE are logical subchannels, before subchannel renumbering in the downlink.

### 8.4.5.3.1 DIUC allocation

***Change Table 276 as indicated:***

**Table 276—OFDMA DIUC values**

| DIUC | Usage |
|---|---|
| 0–12 | Different burst profiles |
| 13 | Gap/PAPR reduction |
| 14 | ~~End of map~~<br>Extended-2 DIUC IE |
| 15 | Extended DIUC |

***Insert the following sentence at the end of the subclause:***

The SS shall ignore the received signal in the GAP/PAPR reduction region.

#### 8.4.5.3.2 DL-MAP extended IE format

***Insert new subclause 8.4.5.3.2.1:***

##### 8.4.5.3.2.1 DL-MAP extended IE format

Table 277a defines the encoding for Extended DIUC that shall be used by DL-MAP Extended IEs.

**Table 277a—Extended DIUC Code Assignment for DIUC=15**

| Extended DIUC (hexadecimal) | Usage |
|---|---|
| 00 | Channel_Measurement_IE |
| 01 | STC_Zone_IE |
| 02 | AAS_DL_IE |
| 03 | Data_location_in_another_BS_IE |
| 04 | CID_Switch_IE |
| 05 | MIMO_DL_Basic_IE |
| 06 | MIMO_DL_Enhanced_IE |
| 07 | HARQ_Map_Pointer_IE |
| 08 | PHYMOD_DL_IE |
| 09-0A | *Reserved* |
| 0B | DL PUSC Burst Allocation in Other Segment |
| 0C-0E | *Reserved* |
| 0F | UL_interference_and_noise_level_IE |

***Insert new subclause 8.4.5.3.2.2:***

##### 8.4.5.3.2.2 DL-MAP extended-2 IE format

A DL-MAP IE entry with a DIUC value of 14, indicates that the IE carries special information and conforms to the structure shown in Table 277b. A station shall ignore an extended-2 IE entry with an extended-2 DIUC value for which the station has no knowledge. In the case of a known extended-2 DIUC value but with a length field longer than expected, the station shall process information up to the known length and ignore the remainder of the IE.

**Table 277b—OFDMA DL-MAP extended-2 IE format**

| Syntax | Size | Notes |
|---|---|---|
| DL_extended-2_IE { | — | — |
| **Extended-2 DIUC** | 4 bits | 0x00 … 0x0F |
| **Length** | 8 bits | Length in bytes of Unspecified data field |
| **Unspecified data** | *variable* | — |
| } | — | — |

Table 277c defines the encoding for Extended-2 DIUC that shall be used by DL-MAP extended-2 IEs.

**Table 277c—Extended-2 DIUC code assignment for DIUC=14**

| Extended-2 DIUC (hexadecimal) | Usage |
|---|---|
| 00 | MBS_MAP_IE |
| 01 | HO_Anchor_Active_DL_MAP_IE |
| 02 | HO_Active_Anchor_DL_MAP_IE |
| 03 | HO_CID_Translation_MAP_IE |
| 04 | MIMO_in_another_BS_IE |
| 05 | Macro-MIMO_DL_Basic_IE |
| 06 | Skip_IE |
| 07 | HARQ DL MAP IE |
| 08 | HARQ ACK IE |
| 09 | Enhanced DL MAP IE |
| 0A | Closed-loop MIMO DL Enhanced IE |
| 0B-0D | *Reserved* |
| 0E | AAS_SDMA_DL_IE |
| 0F | *Reserved* |

***Change the title of subclause 8.4.5.3.3 as indicated:***

### 8.4.5.3.3 AAS downlink IE format

***Change the subclause as indicated:***

Within a frame, the switch from non-AAS to AAS-enabled traffic is marked by using the extended DIUC = 15 with the AAS_DL_IE()~~ to indicate that the subsequent allocations, until the start of the first UL-MAP allocation using TDD, and until the end of the frame using FDD shall be for AAS traffic~~. The AAS_DL_IE defines a DL AAS Zone that spans continuous OFDMA symbols until terminated by a Zone Switch IE, another AAS_DL_IE or the end of the DL frame. Multiple AAS zones can exist within the same frame. For the HARQ MAP, the last AAS_IE is relevant until the beginning of the broadcast region if defined in HARQ format configuration IE. When used, the CID in the DL-MAP_IE() shall be set to the broadcast CID. All DL bursts in the AAS portion of the frame may be preceded by an AAS preamble based on the ~~indication~~ “Downlink_preamble_config” field in the AAS_DL_IE(). The preamble is defined in 8.4.4.6.4.1. ~~The preamble is defined in 8.4.6.1.1, and shall be selected to have the same segment number as the DL frame preamble, and the cell ID shall equal to *(DL-Preamble IDcell + 16) mod 32*. The preamble shall exist only on those subchannels used by the DL burst.~~

**Table 278—OFDMA ~~downlink~~ AAS downlink IE**

| Syntax | Size | Notes |
|---|---|---|
| AAS_DL_IE() { | | |
| **Extended DIUC** | 4 bits | AAS = 0x02 |
| **Length** | 4 bits | Length = 0x03 |
| **OFDMA symbol offset** | 8 bits | Denotes the start of the zone (counting from the frame preamble and starting from 0) |
| **Permutation** | ~~2~~3 bits | 0b000 = PUSC permutation<br>0b001 = FUSC permutation<br>0b010 = Optional FUSC permutation<br>~~0b011 = adjacent-subcarrier permutation~~<br>0b011 = AMC<br>0b100 = TUSC1<br>0b101 = TUSC2<br>~~0b100-0b111 = *Reserved*~~<br>0b110-0b111 = *Reserved* |
| **DL_PermBase** | 6 bits | |
| ~~**Preamble indication**~~<br>**Downlink_preamble_config** | 2 bits | ~~0b00 = No preamble~~<br>~~0b01 = Preamble used~~<br>~~0b10-0b11 = *Reserved*~~<br>0b00 - 0 symbols<br>0b01 - 1 symbols<br>0b10 - 2 symbols<br>0b11 - 3 symbols |
| ~~**First bin index**~~ | ~~6 bits~~ | ~~When Permutation=0b10, this indicates the index of the first band allocated to this AMC segment~~ |
| ~~**Last bin index**~~ | ~~6 bits~~ | ~~When Permutation=0b10, this indicates the index of the last band allocated to this AMC segment~~ |
| **Preamble type** | 1 bit | 0 – Frequency shifted preamble is used in this DL AAS zone<br>1 – Time shifted preamble is used in this DL AAS zone |
| **PRBS_ID** | 2 bits | Values: 0...2. Refer to 8.4.9.4.1 |
| **Diversity Map** | 1 bit | 0: Not Supported in this AAS zone<br>1: Supported in this AAS zone |
| *Reserved* | 1 bit | Shall be set to zero |
| } | | |

**Permutation**

Defines the permutation used within the DL AAS Zone.

**DL_PermBase**

Permutation Base for specified DL AAS Zone.

**OFDMA Symbol offset**

The offset of the OFDMA symbol in which the AAS Zone starts, measured in OFDMA symbols from beginning of the current downlink frame.

**Downlink_preamble_config**
Defines the number of DL AAS preambles to be used before each DL burst in the AAS Zone.

Following AAS_IE indicating AMC permutation the AMC type shall be 2x3 (2 bins by 3 symbols).

*Insert new Figure 229a:*

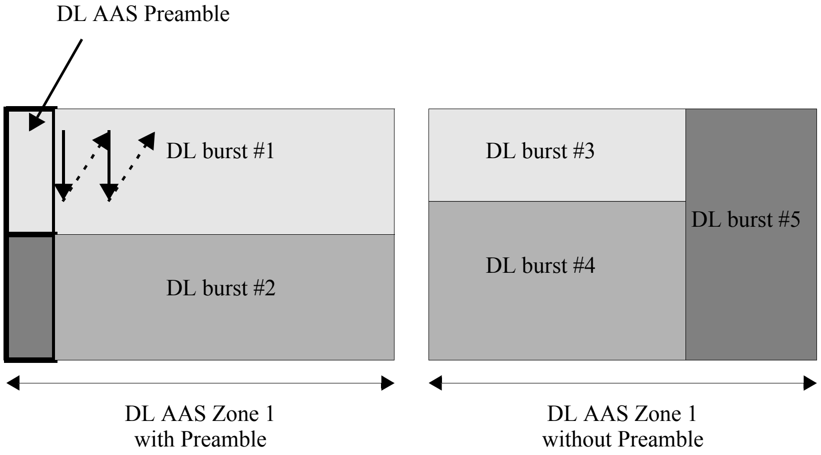


**Figure 229a—Burst allocations in DL AAS Zone**

*Change the title of subclause 8.4.5.3.4*

### 8.4.5.3.4 ~~Transmit diversity (TD)~~Space-Time Coding (STC)/DL_Zone switch IE format

*Change 8.4.5.3.4 as indicated:*

In the DL-MAP, a BS may transmit DIUC=15 with the STC_DL ~~TD~~_ZONE_IE() to indicate that the subsequent allocations shall use a specific permutation, and/or ~~be STCtransmit diversity encoded~~ use a specific transmit diversity mode. The downlink frame shall start in PUSC mode with ~~IDcell=0 and~~ no transmit diversity. Allocations subsequent to this IE shall use the permutation and transmit diversity mode it instructs, until the next STC_DL Zone IE or AAS_DL_IE. Allocation for a STC capable SS shall be done through either DL_MAP_IE() or any one of MIMO related IEs (MIMO_DL_Basic_IE() or MIMO_DL_Enhanced_IE()). If DL_MAP_IE() is used, the matrix indicator in STC_DL_Zone_IE() shall be used for the allocation. If any one of MIMO related IEs is used, the matrix indicator in these IEs shall override the matrix indicator in STC_DL_Zone_IE().

***Replace Table 279 with the following table:***

### Table 279—OFDMA downlink STC_DL_Zone~~TD_ZONE~~ IE format

| Syntax | Size | Notes |
|---|---|---|
| STC_DL_ZONE_IE() { | — | — |
| **Extended DIUC** | 4 bits | STC/DL_ZONE_SWITCH = 0x01 |
| **Length** | 4 bits | Length = 0x04 |
| **OFDMA symbol offset** | 8 bits | Denotes the start of the zone (counting from the frame preamble and starting from 0) |
| **Permutation** | 2 bits | 0b00 = PUSC permutation<br>0b01 = FUSC permutation<br>0b10 = Optional FUSC permutation<br>0b11 = Optional adjacent subcarrier permutation |
| **Use All SC indicator** | 1 bit | 0 = Do not use all subchannels<br>1 = Use all subchannels |
| **STC** | 2 bits | 0b00 = No STC<br>0b01 = STC using 2/3antennas<br>0b10 = STC using 4 antennas<br>0b11 = FHDC using 2 antennas |
| **Matrix indicator** | 2 bits | STC matrix (see 8.4.8.1.4)<br>if (STC == 0b01 or STC == 0b10)<br>{<br>0b00 = Matrix A<br>0b01 = Matrix B<br>0b10 = Matrix C<br>0b11 = *Reserved*<br>}<br>else if (STC == 0b11)<br>{<br>0b00 = Matrix A<br>0b01 = Matrix B<br>0b10-11 = *Reserved*<br>} |
| **DL_PermBase** | 5 bits | — |
| **PRBS_ID** | 2 bits | Values: 0..2. Refer to 8.4.9.4.1 |
| **AMC type** | 2 bits | Indicates the AMC type in case permutation type = 0b11, otherwise shall be set to 0.<br>AMC type (NxM = N bins by M symbols):<br>0b00 - 1x6<br>0b01 - 2x3<br>0b10 - 3x2<br>0b11 - *Reserved*<br>Note that only 2x3 Band AMC subchannel type (AMC Type = 0b01) is supported by MS. |
| **Midamble presence** | 1 bit | 0 = not present<br>1 = present at the first symbol in STC zone |
| **Midamble boosting** | 1 bit | 0 = no boost<br>1 = Boosting (3 dB) |

### Table 279—OFDMA downlink STC_DL_Zone~~TD_ZONE~~ IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **2/3 antennas select** | 1 bit | 0 = STC using 2 antennas<br>1 = STC using 3 antennas<br>Selects 2/3 antennas when STC = 0b01 |
| **Dedicated Pilots** | 1 bit | 0 = Pilot symbols are broadcast<br>1 = Pilot symbols are dedicated. An MS should use only pilots specific to its burst for channel estimation |
| *Reserved* | ~~8~~4 bits | Shall be set to zero |
| } | — | — |

***Change the text in subclause 8.4.5.3.4 as indicated:***

**STC~~Transmit Diversity~~**

Indicates the STC~~Transmit Diversity~~ mode that shall be used by the transmitter for allocations following this IE (see 8.4.8). All allocations ~~without STCTransmit Diversity~~ with STC='0b00' shall be transmitted ~~only from one antenna (antenna 0)~~with non-STC pilot pattern. All allocations with STC-~~Transmit Diversity~~ ~~the BS shall transmit from both its antennas~~ not setting to '0b00' shall be transmitted with the corresponding pilot pattern in 8.4.8. The STC mode change is allowed only on a zone boundary.

**Dedicated Pilots**

The optional fields Dedicated Pilots are used to support the use of open loop precoding or closed-loop transmissions in which the MS has no knowledge of the precoding/beamforming matrix. When the data allocations are precoded/beamformed, then setting the Dedicated Pilots bit to 1 means the pilot symbols are precoded/beamformed in the same way as are the corresponding data subcarriers. In this case, an MS should use only the pilots that are specific to its allocation for channel estimations.

For the PUSC permutation, the pilot symbols belonging to a major group must be precoded/beamformed along with all of the data allocations made within the major group. For the FUSC or Optional FUSC permutation, all of the pilot symbols and data subcarriers within an OFDM symbol shall be precoded/beamformed.

For backward compatibility, for the FUSC or Optional FUSC permutation, multiple legacy (revD) SS units must not be allocated in TD Zones in which pilots are dedicated. However, a single legacy SS unit can be allocated to a TD Zone in which the pilots are dedicated as long as no other SS units are also allocated to that TD Zone. For the PUSC permutation, only a single legacy SS can be allocated to one or more major groups and only when the major groups extend~~s~~ across the entire zone.

This IE should not be used within SUB-DL-UL-MAP.

### 8.4.5.3.6 Data location in another BS IE

***Change the text in 8.4.5.3.6 as indicated:***

In the DL-MAP, a BS may transmit DIUC=15 with the Data_location_in_another_BS_IE() to indicate that data is transmitted to the SS through another BS. This IE shall be sent right after the IE defining the same data received in the current BS, but it may be sent alone without the IE defining the same data received in the current BS only if the data is to be transmitted in the current frame.

**Table 281—OFDMA Data location in another BS IE**

| Syntax | Size | Notes |
|---|---|---|
| Data_location_in_another_BS_IE() { | | |
| **Extended DIUC** | 4 bits | Data_location_in_another_BS = 0x3 |
| **Length** | 4 bits | Length = 0x0~~A~~9 |
| ~~*Reserved*~~ | ~~6 bits~~ | ~~Shall be set to zero~~ |
| **Segment** | 2 bits | Segment number |
| **Used subchannels** | 6 bits | Used subchannels groups at other BS<br>Bit #0: ~~0-11~~ Subchannel group 0<br>Bit #1: ~~12-19~~ Subchannel group 1<br>Bit #2: ~~20-31~~ Subchannel group 2<br>Bit #3: ~~32-39~~ Subchannel group 3<br>Bit #4: ~~40-51~~ Subchannel group 4<br>Bit #5: ~~52-59~~ Subchannel group 5 |
| ~~**IDcell**~~ | ~~5 bits~~ | ~~Cell ID of other BS~~ |
| **DIUC** | 4 bits | DIUC used for the burst in the other BS |
| **Frame Advance** | 3 bits | The number of frames offset from the ~~current~~next frame where the data will be transmitted (0 = Next frame) |
| *Reserved* | 1 bit | Shall be set to zero |
| **OFDMA Symbol offset** | 8 bits | |
| **Subchannel offset** | 6 bits | |
| **Boosting** | 3 bits | 000: normal (not boosted);<br>001: +6dB;<br>010: –6dB;<br>011: +9dB;<br>100: +3dB;<br>101: –3dB;<br>110: –9dB;<br>111: –12dB; |
| **Preamble index** | 7 bits | Preamble index of the other BS |
| **No. OFDM Symbols** | 8 bits | |
| **No. Subchannels** | 6 bits | |

**Table 281—OFDMA Data location in another BS IE *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **Repetition Coding Indication** | 2 bits | 00 – No repetition coding<br>01 – Repetition coding of 2 used<br>10 – Repetition coding of 4 used<br>11 – Repetition coding of 6 used |
| **CID** | 16 bits | |
| } | | |

### 8.4.5.3.7 CID Switch IE

***Change 8.4.5.3.7 as indicated:***

In the DL-MAP, a BS may transmit DIUC=15 with the CID-Switch_IE() to toggle the inclusion of the CID parameter in DL-MAP allocations. The DL-MAP and Sub-DL-UL-MAP shall begin in the mode where CIDs are not included. The first appearance of the CID-Switch_IE() shall toggle the DL-MAP mode to include CIDs. Any subsequent appearance of the CID-Switch_IE() shall toggle the DL-MAP CID inclusion mode.

### 8.4.5.3.8 MIMO DL basic IE format

***Change the first paragraph of 8.4.5.3.8 as indicated:***

In the DL-MAP, a MIMO-enabled BS may transmit DIUC = 15 with the MIMO_DL_Basic_IE() to ~~indicate the MIMO configuration of the subsequent downlink allocation to a specific MIMO-enabled SS CID~~describe downlink allocations assigned to MIMO-enabled SSs. The MIMO mode indicated in the MIMO_DL_Basic_IE() shall only apply to the ~~subsequent downlink~~ allocations~~ until the end of frame~~s indicated in the IE. The allowed combinations of number of antennas, matrices, number of encoded streams, and CIDs are listed in Table 283a.

***Change Table 283 as indicated:***

**Table 283—MIMO DL basic IE format**

| Syntax | Size | Notes |
|---|---|---|
| MIMO_DL_Basic_IE () { | | |
| **Extended DIUC** | 4 bits | MIMO = 0x05 |
| **Length** | 4 bits | ~~Length of the message in bytes (~~variable~~)~~ |
| **Num_Region** | 4 bits | |
| for ( *i* = 0; *i*< Num_Region; *i*++) { | | |
| **OFDMA Symbol offset** | ~~10~~8 bits | |
| If (Permutation = 0b11 and (AMC type is 2x3 or 1x6)) { | | |
| **Subchannel offset** | 8 bits | |

**Table 283—MIMO DL basic IE format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **Boosting** | 3 bits | |
| **No. OFDMA Symbols** | 5 bits | |
| **No. subchannels** | 6 bits | |
| Else { | | |
| **Subchannel offset** | ~~5~~6 bits | |
| **Boosting** | 3 bits | |
| **No. OFDMA Symbols** | ~~9~~7 bits | |
| **No. subchannels** | ~~5~~6 bits | |
| } | | |
| **Matrix_indicator** | 2 bits | ~~STC matrix (see 8.4.8)~~<br>~~STC = STC mode indicated in the latest STC_DL_Zone_IE().~~<br>~~if (STC == 0b01)~~<br>~~{~~<br>~~00 = Matrix A~~<br>~~01 = Matrix B~~<br>~~10 -11 = Reserved~~<br>~~}~~<br>~~else if (STC == 0b10)~~<br>~~{~~<br>~~00 = Matrix A~~<br>~~01 = Matrix B~~<br>~~10 = Matrix C~~<br>~~11 = Reserved~~<br>~~}~~<br>STC matrix (see 8.4.8.1.4)<br>if (STC == 0b01 or STC == 0b10)<br>{<br>0b00 = Matrix A<br>0b01 = Matrix B<br>0b10 = Matrix C<br>0b11 = *Reserved*<br>}<br>else if (STC == 0b11)<br>{<br>0b00 = Matrix A<br>0b01 = Matrix B<br>0b10-11 = Reserved<br>} |
| **Num_layers** | 2 bits | |
| *Reserved* | 1 bit | Shall be set to zero |
| for ( *j* = 0; *j*< Num_layers; *j*++) { | | |
| if (INC_CID == 1) { | | |
| **CID** | 16 bits | |
| } | | |

**Table 283—MIMO DL basic IE format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **Layer_index** | 2 bits | |
| **DIUC** | 4 bits | |
| } | | |
| } | | |
| *padding* | *variable* | Number of bits required to align to byte length, shall be set to zero. |
| } | | |

***Change the following text below Table 283:***

**Num_layers**

~~The value of these 2 bits plus one indicate the number of MIMO transmission layers.~~ Number of individually encoded streams allocated in the region. The layer is defined as a separate coding/ modulation path.

***Insert the following text at the end of the subclause:***

Table 283a defines the modes of operation specified by MIMO_DL_Basic_IE() and MIMO_DL_Enhanced_IE(). For each it details: the number of antennas (as indicated by the latest STC_DL_ZONE_IE()), the type of matrix, the number of encoded streams, (i.e., the number of different CIDs stated in the Num_layers 'for' loop in Table 283); the implicit type and rate of coding. The cases of either broadcast CID or (INC_CID == 0), correspond to 'Single CID' rows, but should be decoded by all SSs on a best effort basis. An SS that does not support decoding of multiple overlapping bursts shall attempt to decode the first burst relevant to it, according to the stream ordering.

**Table 283a—DL MIMO operation modes**

| Number of transmit antennas | Matrix indicator | Num_ layers | Number of different SSs | Encoding type | Rate | Mapping of encoded stream to matrix entries | Remark |
|---|---|---|---|---|---|---|---|
| 2 | A | 1 | 1 | STTD | 1 | Encoded stream #0: S1, S2 | |
| 2 | B | 1 | 1 | Vertical encoding | 2 | Encoded stream #0: S1, S2 | |
| 2 | B | 2 | 1 | Horizontal encoding for a single SS | 2 | Encoded stream #0: S1<br>Encoded stream #1: S2 | Two overlapping layers |
| 2 | B | 2 | 2 | Horizontal encoding for two different SSs | 2 | Encoded stream #0: S1<br>Encoded stream #1: S2 | Two overlapping layers |

**Table 283a—DL MIMO operation modes *(continued)***

| Number of transmit antennas | Matrix indicator | Num_ layers | Number of different SSs | Encoding type | Rate | Mapping of encoded stream to matrix entries | Remark |
|---|---|---|---|---|---|---|---|
| 4 | A | 1 | 1 | STTD | 1 | Encoded stream #0: S1, S2, S3, S4 | |
| 4 | B | 1 | 1 | Vertical encoding | 2 | Encoded stream #0: S1, S2, S3, S4 | |
| 4 | B | 2 | 1 | Horizontal encoding for a single SS | 2 | Encoded stream #0: S1, S2, S5, S7<br>Encoded stream #1: S3, S4, S6, S8 | Two overlapping layers |
| 4 | B | 2 | 2 | Horizontal encoding for two different SSs | 2 | Encoded stream #0: S1, S2, S5, S7<br>Encoded stream #1: S3, S4, S6, S8 | Two overlapping layers |
| 4 | C | 1 | 1 | Vertical encoding | 4 | Encoded stream #0: S1, S2, S3, S4 | |
| 4 | C | 4 | 1 | Horizontal encoding for a single SS | 2 | Encoded stream #0: S1<br>Encoded stream #1: S2<br>Encoded stream #2: S3<br>Encoded stream #3: S4 | Four overlapping layers |
| 4 | C | 4 | > 1 | Horizontal encoding for two or more different SSs | 4 | Encoded stream #0: S1<br>Encoded stream #1: S2<br>Encoded stream #2: S3<br>Encoded stream #3: S4 | Four overlapping layers |

**Vertical encoding**

Indicates transmitting a single FEC encoded stream over multiple antennas. The number of encoded streams is always 1.

**Horizontal encoding**

Indicates transmitting multiple separately FEC encoded streams over multiple antennas. The number of encoded streams is more than 1.

**Rate**

The number of QAM symbols signaled per array channel use.

### 8.4.5.3.9 MIMO DL ~~E~~enhanced IE format

*Change the subclause as indicated:*

In the DL-MAP, a MIMO-enabled BS may transmit DIUC = 15 with the MIMO_DL_Enhanced_IE(), as shown in Table 284, to ~~indicate the MIMO mode of the subsequent downlink allocation to a specific MIMO-enabled SS~~ describe downlink allocations assigned to MIMO-enabled SSs, each identified by the CQICH_ID previously assigned to the SS. The MIMO mode indicated in the MIMO_DL_Enhanced_IE() shall only apply to the ~~subsequent downlink~~ allocations~~ until the end of frame~~s indicated in the IE. The allowed combinations of number of antennas, matrices, number of encoded streams, and CIDs are listed in Table 283a.

**Table 284—MIMO DL enhanced IE format**

| Syntax | Size | Notes |
|---|---|---|
| MIMO_DL_Enhanced_IE() { | | |
| **Extended DIUC** | 4 bits | EN_MIMO = 0x06 |
| **Length** | 4 bits | ~~Length of the message in bytes (variable)~~ |
| **Num_Region** | 4 bits | |
| for ( *i* = 0; *i*< Num_Region; *i*++) { | | |
| **OFDMA Symbol offset** | ~~10~~8 bits | |
| If (Permutation = 0b11 and (AMC type is 2x3 or 1x6)) { | | |
| **Subchannel offset** | 8 bits | |
| **Boosting** | 3 bits | |
| **No. OFDMA Symbols** | 5 bits | |
| **No. subchannels** | 6 bits | |
| Else { | | |
| **Subchannel offset** | ~~5~~6 bits | |
| **Boosting** | 3 bits | |
| **No. OFDMA Symbols** | ~~9~~7 bits | |
| **No. subchannels** | ~~5~~6 bits | |
| } | | |

### Table 284—MIMO DL enhanced IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Matrix_indicator** | 2 bits | ~~STC matrix (see 8.4.8)~~<br>~~STC = STC mode indicated in the latest STC_DL_Zone_IE().~~<br>~~if (STC == 0b01)~~<br>~~{~~<br>~~00 = Matrix A~~<br>~~01 = Matrix B~~<br>~~10 -11 = Reserved~~<br>~~}~~<br>~~else if (STC == 0b10)~~<br>~~{~~<br>~~00 = Matrix A~~<br>~~01 = Matrix B~~<br>~~10 = Matrix C~~<br>~~11 = Reserved~~<br>~~}~~<br>STC matrix (see 8.4.8.1.4)<br>if (STC == 0b01 or STC == 0b10)<br>{<br>0b00 = Matrix A<br>0b01 = Matrix B<br>0b10 = Matrix C<br>0b11 = *Reserved*<br>}<br>else if (STC == 0b11)<br>{<br>0b00 = Matrix A<br>0b01 = Matrix B<br>0b10-11 = Reserved<br>} |
| **Num_layers** | 2 bits | |
| *Reserved* | 1 bit | Shall be set to zero |
| for ( *j* = 0; *j*< Num_layers; *j*++) { | | |
| if (INC_CID == 1) { | | |
| **CQICH_ID** | *variable* | Index to uniquely identify the CQICH resource assigned to the SS.<br>The size of this field is dependent on system parameter defined in ~~D~~UCD (see Table 353). |
| } | | |
| **Layer_index** | 2 bits | |
| **DIUC** | 4 bits | |
| } | | |
| } | | |
| *padding* | *variable* | Number of bits required to align to byte length, shall be set to zero. |
| } | | |

**Num_Region**
This field indicates the number of the regions defined by OFDMA_Symbol_offset, Subchannel_offset, Boosting, No._OFDMA_Symbols and No._subchannels in this IE.

**Matrix_indicator**
The values of these two bits indicate the STC matrix (see 8.4.8.1.4).

**CQICH_ID**
This is the CQICH_ID assigned to an SS in the CQICH_Alloc_IE(). The CQICH_ID is used to uniquely identify an SS that is assigned a CQICH.

**Num_layers**
~~The value of these 2 bits plus one indicate the number of MIMO transmission layers.~~Number of individually encoded streams allocated in the region. The layer is defined as a separate coding/ modulation path.

**~~Layer~~Burst_index**
This field specifies the ~~layer~~burst index.

*Change 8.4.5.3.10 as indicated:*

### 8.4.5.3.10 ~~H-ARQ~~ HARQ and Sub-MAP Pointer IE

*Change the first paragraph as indicated:*

This IE shall only be used by a BS supporting ~~H-ARQ~~HARQ, for M~~S~~S supporting ~~H-ARQ~~HARQ. There shall be at most 4 HARQ MAP Pointer IE in the DL-MAP.

*Change Table 285 as indicated:*

**Table 285—~~H-ARQ~~ HARQ ~~MAP~~ and Sub-MAP pointer IE format**

| Syntax | Size | Notes |
|---|---|---|
| ~~H-ARQ_MAP_Pointer_IE() {~~<br>HARQ and Sub-MAP_Pointer_IE() { | — | — |
| **Extended DIUC** | 4 bits | HARQ_P = 0x07 |
| **Length** | 4 bits | ~~Length = 0x02~~ |
| While (data remains) { | — | — |
| **DIUC** | 4 bits | Indicates the AMC level of the burst containing an HARQ MAP message. |
| **No. Slots** | 8 bits | The number of slots allocated for the burst containing an HARQ MAP message. |
| ~~*Reserved*~~ | ~~4 bits~~ | ~~Shall be set to zero~~ |
| **Repetition Coding Indication** | 2 bits | 0b00 - No repetition coding<br>0b01 - Repetition coding of 2 used<br>0b10 - Repetition coding of 4 used<br>0b10 - Repetition coding of 6 used |
| **MAP Version** | 2 bits | 0b00 - HARQ MAPv1<br>0b01 - Sub-MAP<br>0b10 – Sub-MAP with CID Mask included<br>0b11 - *Reserved* |
| If (MAP Version == 0b10) { | — | — |
| **Idle users** | 1 bit | Bursts for Idle users included in the Sub MAP |
| **Sleep users** | 1 bit | Bursts for Sleep users included in the Sub MAP |

**Table 285~~—H-ARQ~~ HARQ ~~MAP~~ and Sub-MAP pointer IE format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **CID Mask Length** | 2 bits | 0b00: 12 bits<br>0b01: 20 bits<br>0b10: 36 bits<br>0b11: 52 bits |
| **CID mask** | *n* bits | *n* = The number of bits of CID mask is determined by CID Mask Length. When the MAP message pointed by this pointer IE includes any MAP IE for an awake mode MS, the bit index corresponding to ((Basic CID of the MS) MOD *n*) in this CID mask field shall be set to 1. Otherwise, it may be set to 0. |
| } | — | — |
| *Reserved* | 0 or 4 bits | For a byte alignment of IE. Shall be set to zero |
| } | — | — |

***Insert the following text to the end of the subclause:***

**Repetition coding Indication**
Indicates the repetition code used inside the allocated burst.

**MAP Version**
Indicates the version the HARQ MAP.

### 8.4.5.3.11 DL-MAP Physical modifier IE

***Change the first two paragraphs as indicated:***

The Physical Modifier Information Element indicates that the subsequent allocations shall utilize a preamble, which is either cyclically delayed in time or cyclically rotated in frequency. This IE applies to operation in AAS mode.

In the case when the preamble is cyclically delayed in time by ~~k~~K samples, the preamble will contribute a component s'(t) to the transmitted waveform as defined in Equation (104). This IE applies to operation in AAS mode.

***Replace Equation (104) with the following equation:***

$$s'(t) = Re\left\{ e^{2j\pi f_c t} \left( \sum_{m = -(N_{used} - 1)/2}^{(N_{used} - 1)/2} c_m \times e^{2j\pi m \Delta f (t - T_g - K/F_s)} \right) \right\} \tag{104}$$

***Change the first sentence of the paragraph below Equation (104) as indicated:***

where $c_{\cancel{k}m}$ are the preamble tone values, and $t$ is the time, elapsed since the beginning of the OFDMA symbol, with $0 < t < T_s$.

***Replace Equation (105) with the following equation:***

$$C_{New,K} = (C_{Original} + 5 \cdot K) \ mod \ N_{Used} \tag{105}$$

***Change the first sentence of the paragraph below Equation (105) as indicated:***

~~W~~where $C_{New,K}$ is the new subcarrier index and $C_{Original}$ is the original subcarrier index, and $K$ is the frequency shift index indicated in the PHYMOD_DL_IE.

***Change Table 286 as indicated:***

**Table 286—OFDMA DL-MAP Physical Modifier IE format**

| Syntax | Size | Notes |
|---|---|---|
| PHYMOD_DL_IE() { | | |
| **Extended DIUC** | 4 bits | PHYMOD = 0x08 |
| **Length** | 4 bits | Length = 0x03 |
| **Preamble Modifier Type** | 1 bit | 0 – ~~Randomized preamble~~frequency shifted preamble<br>1 – ~~Cyclically shifted Preamble~~time shifted Preamble |
| if (Preamble Modifier Type == 0) { | | |
| **Preamble frequency shift index** | 4 bits | Indicates the value of $K$ in Equation (105) |
| } else { | | |
| ~~**Time index shift type**~~ | ~~1 bit~~ | ~~0 – Rounded down shift~~<br>~~1 – Exact shift~~ |
| ~~if (Time index shift type ==0) {~~ | | |
| **Preamble Time Shift Index** | 4 bits | Specifies the cyclic time shift in Equation (104):<br>For PUSC,<br>0 – 0 sample cyclic shift<br>1 – ~~floor(~~$N_{FFT}$/14~~)~~ sample cyclic shift<br>….<br>13 – ~~floor(~~$N_{FFT}$/14*13~~)~~ sample cyclic shift<br>14-15 – Reserved<br><br>For AMC permutation,<br>0 – 0 sample cyclic shift<br>1 – ~~floor(~~$N_{FFT}$/9~~)~~ sample cyclic shift<br>….<br>8 – ~~floor(~~$N_{FFT}$/9*8~~)~~ sample cyclic shift<br>9–15 – Reserved |
| ~~} else {~~ | | |

**Table 286—OFDMA DL-MAP Physical Modifier IE format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| ~~**Preamble Time Shift Index**~~ | ~~4 bits~~ | ~~For PUSC,~~<br>~~0 – 0 sample cyclic shift~~<br>~~1 – floor($N_{FFT}$/14) sample cyclic shift~~<br>~~….~~<br>~~13 – floor($N_{FFT}$/14*13) sample cyclic shift~~<br>~~14-15 – Reserved~~<br><br>~~For AMC permutation,~~<br>~~0 – 0 sample cyclic shift~~<br>~~1 – floor($N_{FFT}$/9) sample cyclic shift~~<br>~~….~~<br>~~8 – floor($N_{FFT}$/9*8) sample cyclic shift~~<br>~~9-15 – Reserved~~ |
| ~~}~~ | | |
| } | | |
| **Pilot Pattern Modifier** | 1 bit | 0: Not applied, 1: Applied |
| **Pilot Pattern Index** | 2 bits | Pilot pattern used for this allocation [see 8.4.6.3.3 (AMC), 8.4.6.1.2.6 (TUSC)]:<br>0b00 – Pilot Pattern #A<br>0b01 – Pilot Pattern #B<br>0b10 – Pilot Pattern #C<br>0b11 – Pilot Pattern #D |
| *Reserved* | ~~2~~3 bits | Shall be set to zero |
| } | | |

***Insert new subclause 8.4.5.3.12:***

### 8.4.5.3.12 Multicast and Broadcast Service MAP IE (MBS_MAP_IE)

In the DL-MAP, a BS may transmit DIUC=14 with the MBS_MAP_IE() to indicate when the next data for a multicast and broadcast service flow will be transmitted. The offset value is associated with a CID value, and indicates the frame that the next data will be transmitted in by using the CID value. (See Table 286a.)

**Table 286a—Multicast and Broadcast Service MAP IE**

| Syntax | Size | Notes |
|---|---|---|
| MBS_MAP_IE() { | — | — |
| **Extended-2 DIUC** | 4 bits | MBS_MAP_IE() = 0x00 |
| **Length** | 8 bits | — |
| **MBS Zone identifier** | 7 bits | MBS Zone identifier corresponds to the identifier provided by the BS at connection initiation |

## Table 286a—Multicast and Broadcast Service MAP IE *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Macro diversity enhanced** | 1 bit | 0 = Non Macro-Diversity enhanced zone;<br>1 = Macro-Diversity enhanced zone |
| If(Macro diversity enhanced = 1){ | — | — |
| **Permutation** | 2 bits | 0b00 = PUSC permutation<br>0b01 = FUSC permutation<br>0b10 = Optional FUSC permutation<br>0b11 = Adjacent subcarrier permutation |
| **DL_PermBase** | 5 bits | — |
| **PRBS_ID** | 2 bits | — |
| **OFDMA Symbol Offset** | 7 bits | The offset of the OFDMA symbol measured in OFDMA symbols from beginning of the downlink frame in which the DL-MAP is transmitted. Counting from the frame preamble and starting from 0 |
| **DIUC change indication** | 1 bit | Used to indicate DIUC change is included |
| *Reserved* | 3 bits | Shall be set to zero |
| if (DIUC change indication = 1) { | — | — |
| **Reserved** | 3 bits | — |
| **Boosting** | 3 bits | Refer to Table 273 |
| **DIUC** | 4 bits | — |
| **No. Subchannels** | 6 bits | Indication of burst size of MBS MAP message with the number of subchannels |
| **NO. OFDMA symbols** | 6 bits | Indication of burst size of MBS MAP message with the number of OFDMA symbols |
| **Repetition Coding Indication** | 2 bits | 0b00—No repetition coding<br>0b01—Repetition coding of 2 used<br>0b10—Repetition coding of 4 used<br>0b11—Repetition coding of 6 used |
| } | — | — |
| } else { | — | — |
| **DIUC** | 4 bits | — |
| **CID** | 16 bits | CID for Single BS MBS service |
| **OFDMA Symbol Offset** | 8 bits | The offset of the OFDMA symbol in which the burst starts, measured in OFDMA symbols from beginning of the downlink frame in which the DL-MAP is transmitted. |
| **Subchannel offset** | 6 bits | The lowest index OFDMA subchannel used for carrying the burst, starting from subchannel 0. |
| **Boosting** | 3 bits | Refer to Table 273 |
| **SLC_3_indication** | 1 bit | Used to notify sleep mode class 3 is used for single BS MBS service |

### Table 286a—Multicast and Broadcast Service MAP IE *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **NO. OFDMA Symbols** | 6 bits | — |
| **NO. Subchannels** | 6 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00—No repetition coding<br>0b01—Repetition coding of 2 used<br>0b10—Repetition coding of 4 used<br>0b11—Repetition coding of 6 used |
| if (SLC 3_indication = 1) { | — | — |
| **Next MBS_MAP_IE frame offset** | 8 bits | The Next MBS_MAP_IE frame offset value is lower 8 bits of the frame number in which the BS shall transmit the next MBS_MAP_IE frame. |
| } | — | — |
| } | — | — |
| if !(byte boundary) { | — | — |
| **Padding Nibble** | *variable* | Padding to reach byte boundary |
| } | — | — |
| } | — | — |

**Next MBS_MAP_IE frame offset**

The Next MBS_MAP_IE frame offset value is lower 8 bits of the frame number in which the BS shall transmit the next MBS_MAP_IE frame.

At the MBS region, MBS MAP message are located from the first subchannel and first OFDMA symbol of MBS region.

***Insert new subclause 8.4.5.3.13:***

### 8.4.5.3.13 DL PUSC Burst Allocation in Other Segment IE

In the DL-MAP, a BS may transmit DIUC=15 with the DL PUSC Burst Allocation in Other Segment IE () to indicate that data is transmitted to the MS in other segment through other BS. (See Table 286b.)

### Table 286b—DL PUSC Burst Allocation in Other Segment IE

| Syntax | Size | Notes |
|---|---|---|
| DL PUSC Burst Allocation in Other Segment IE() { | — | — |
| **Extended DIUC** | 4 bits | DL PUSC Burst Allocation in Other Segment IE () = 0x0B |
| **Length** | 4 bits | Length = 0x09 |
| **CID** | 16 bits | — |
| **DIUC** | 4 bits | — |

### Table 286b—DL PUSC Burst Allocation in Other Segment IE *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Segment** | 2 bits | Segment number for other BS's sector |
| **Boosting** | 3 bits | Refer to Table 273. |
| **IDcell** | 5 bits | Cell ID for other BS's sector |
| **DL_PermBase** | 5 bits | — |
| **PRBS_ID** | 2 bits | — |
| **Repetition coding indication** | 2 bits | 0b00: No repetition coding<br>0b01: Repetition coding of 2 used<br>0b10: Repetition coding of 4 used<br>0b11: Repetition coding of 6 used |
| **Used Subchannels** | 6 bits | Used subchannels groups at other BS's sector:<br>Bit #0: Subchannel group 0<br>Bit #1: Subchannel group 1<br>Bit #2: Subchannel group 2<br>Bit #3: Subchannel group 3<br>Bit #4: Subchannel group 4<br>Bit #5: Subchannel group 5 |
| **OFDMA symbol offset** | 8 bits | — |
| *Reserved* | 1 bit | Shall be set to zero. |
| **# OFDMA symbols** | 7 bits | — |
| **Subchannel offset** | 6 bits | — |
| **# subchannels** | 6 bits | — |
| *Reserved* | 7 bits | Shall be set to zero |
| } | — | — |

***Insert new subclause 8.4.5.3.14:***

### 8.4.5.3.14 HO anchor active DL MAP IE

This MAP IE is in the DL-MAP of active non-anchor BS and indicates the burst from Anchor BS. When an MS receives a HO Anchor Active DL-MAP IE on DL-MAP message from an active non-anchor BS, it can decode a data burst transmitted from Anchor BS by using the 'Anchor Preamble' in HO Anchor Active DL-MAP IE. (See Table 286c.)

### Table 286c—HO anchor active DL MAP IE

| Syntax | Size | Notes |
|---|---|---|
| **HO Anchor_Active DL MAP IE () {** | — | — |
| **Extended-2 DIUC** | 4 bits | HO Anchor_Active MAP IE = 0x02 |
| **Length** | 8 bits | *variable* |
| for (each bursts) { | — | — |

**Table 286c—HO anchor active DL MAP IE** ***(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **Anchor Preamble** | 8 bits | Preamble of anchor BS |
| **Anchor CID** | 16 bits | Basic CID in anchor BS |
| **DIUC** | 4 bits | — |
| **OFDMA symbol offset** | 8 bits | — |
| **Subchannel offset** | 6 bits | — |
| **Repetition coding indication** | 2 bits | 0b00—No repetition coding<br>0b01—Repetition coding of 2 used<br>0b10—Repetition coding of 4 used<br>0b11—Repetition coding of 6 used |
| } | — | — |
| *padding nibble* | 0 or 4 bits | Shall be set to zero. |
| } | — | — |

***Insert new subclause 8.4.5.3.15:***

### 8.4.5.3.15 HO active anchor DL MAP IE

This MAP IE is in the DL-MAP of the anchor BS and indicates the burst from active non-anchor BS. When an MS receives a HO Active Anchor DL-MAP IE on DL-MAP message from an Anchor BS, it can decode a data burst transmitted from the active non-anchor BS by using the ‘Active Preamble’ in HO Active Anchor DL-MAP IE.(See Table 286d.)

**Table 286d—HO active anchor DL MAP IE**

| Syntax | Size | Notes |
|---|---|---|
| HOActive_Anchor DL MAP IE() { | — | — |
| **Extended-2 DIUC** | 4 bits | HO Active_Anchor MAP IE = 0x01 |
| **Length** | 8 bits | *variable* |
| for (each bursts) { | — | — |
| **Active Preamble** | 8 bits | Preamble of active BS |
| **Anchor CID** | 16 bits | Basic CID in anchor BS |
| **DIUC** | 4 bits | — |
| **OFDMA symbol offset** | 8 bits | — |
| **Repetition coding indication** | 2 bits | 0b00: No repetition coding<br>0b01: Repetition coding of 2 used<br>0b10: Repetition coding of 4 used<br>0b11: Repetition coding of 6 used |
| **Subchannel offset** | 6 bits | — |

**Table 286d—HO active anchor DL MAP IE *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **# OFDMA symbols** | 7 bits | — |
| **# subchannels** | 6 bits | — |
| **Boosting** | 3 bits | Refer to Table 273. |
| } | — | — |
| *padding nibble* | 0 or 4 bits | Shall be set to zero. |
| } | — | — |

***Insert new subclause 8.4.5.3.16:***

#### 8.4.5.3.16 HO CID Translation MAP IE

The HO burst from active non-anchor BS is indicated by the MAP IE in DL-MAP of that BS with an Active CID. The Active CID is the CID assigned by the active non-anchor BS to translate the CID given by the Anchor BS.

Because the CID is different from the anchor CID, the CID Translation MAP IE should provide translation of the Active CID into the Anchor CID. This translation IE is transmitted by Active non-anchor BS and applied on both DL and UL IEs. The translation is valid only in the current frame. (See Table 286e.)

**Table 286e—HO CID Translation MAP IE**

| Syntax | Size | Notes |
|---|---|---|
| HO CID Translation MAP IE() { | — | — |
| **Extended-2 DIUC** | 4 bits | CID Translation MAP IE = 0x03 |
| **Length** | 8 bits | *variable* |
| for (each bursts) { | — | — |
| **Anchor Preamble** | 8 bits | Preamble of anchor BS |
| **Anchor CID** | 16 bits | Basic CID in anchor BS |
| **Active CID** | 16 bits | — |
| } | — | — |
| } | — | — |

***Insert new subclause 8.4.5.3.17:***

### 8.4.5.3.17 MIMO in another BS IE

In the DL-MAP, a BS may transmit MIMO_in_another_BS_IE () to indicate that data is transmitted to the MS through other BS at the same frame. This IE shall be right after the IE defining the same data or data region received in the anchor BS. (See Table 286f.)

**Table 286f—MIMO in another BS IE**

| Syntax | Size | Notes |
|---|---|---|
| MIMO_in_another_BS_IE () { | — | — |
| **Extended-2 DIUC** | 4 bits | MIMO in another BS IE = 0x04 |
| **Length** | 8 bits | *variable* |
| **Segment** | 2 bits | Segment number |
| **Used subchannels** | 6 bits | Used subchannels at other BS<br>Bit #0: 0-11<br>Bit #1:12-19<br>Bit #2: 20-31<br>Bit #3: 32-39<br>Bit #4: 40-51<br>Bit #5:52-59 |
| **IDCell** | 5 bits | Cell ID of other BS |
| **Num_Region** | 4 bits | — |
| *Reserved* | 3 bits | Shall be set to zero. |
| for ( i = 0; i< Num_Region; i++) { | — | — |
| **Matrix_indicator** | 2 bits | See matrix indicator defined in STC_DL_Zone_IE |
| **OFDMA Symbol offset** | 8 bits | — |
| **Subchannel offset** | 6 bits | — |
| **Boosting** | 3 bits | Refer to Table 273. |
| **No. OFDMA Symbols** | 7 bits | — |
| **No. subchannels** | 6 bits | — |
| **Num_layer** | 2 bits | — |
| *Reserved* | 2 bits | Shall be set to zero. |
| for (j = 0; j< Num_layer; j++) { | — | — |
| if (INC_CID == 1) { | — | — |
| **CID** | 16 bits | — |
| } | — | — |
| **Layer_index** | 2 bits | — |
| **DIUC** | 4 bits | 0-11 burst profiles. |

**Table 286f—MIMO in another BS IE *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| *Reserved* | 2 bits | Shall be set to zero. |
| } | — | — |
| } | — | — |
| **Padding** | *variable* | Padding to byte; shall be set to 0. |
| } | — | — |

***Insert new subclause 8.4.5.3.18:***

### 8.4.5.3.18 Macro-MIMO DL Basic IE format

Table 286g specifies DL-MAP IE for Macro-MIMO in MDHO Mode, which benefits from a combination of RF, diversity combining, and soft data combining.

**Table 286g—Macro MIMO DL Basic IE()**

| Syntax | Size | Notes |
|---|---|---|
| Macro_MIMO_DL_Basic_IE() { | — | — |
| **Extended-2 DIUC** | 4 bits | Macro MIMO DL Basic IE = 0x05 |
| **Length** | 8 bits | *variable* |
| **Segment** | 2 bits | Segment number |
| **Used subchannels** | 6 bits | Used subchannels groups at other BS's sector:<br>Bit #0: Subchannel group 0<br>Bit #1: Subchannel group 1<br>Bit #2: Subchannel group 2<br>Bit #3: Subchannel group 3<br>Bit #4: Subchannel group 4<br>Bit #5: ~~9~~ Subchannel group 5 |
| **Num_Region** | 4 bits | — |
| For (i=0; i<Num_Region; i++) { | — | — |
| **OFDMA Symbol offset** | 8 bits | — |
| **Subchannel offset** | 6 bits | — |
| **Boosting** | 3 bits | Refer to Table 273 |
| **No. OFDMA symbols** | 7 bits | — |
| **No. Subchannels** | 6 bits | — |
| **Packet index** | 4 bits | Packet index for each region |
| **Matrix indicator** | 2 bits | See matrix indicator defined in STC_DL_Zone_IE |
| **Num_layer** | 2 bits | — |

Table 286g—Macro MIMO DL Basic IE() *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| *Reserved* | 2 bits | Shall be set to zero |
| for (j=0; j<Num_layer; j++) { | — | — |
| if (INC_CID == 1) { | — | — |
| **CID** | 16 bits | — |
| } | — | — |
| **Layer_index** | 2 bits | — |
| **DIUC** | 4 bits | 0-11 burst profiles |
| *Reserved* | 2 bits | Shall be set to zero |
| } | — | — |
| } | — | — |
| **Padding** | *variable* | Padding to byte; shall be set to zero |
| } | — | — |

**Packet Index**

Indicates the packet index for the particular region. The regions with the same packet index shall be diversity combined at MS.

***Insert new subclause 8.4.5.3.19:***

### 8.4.5.3.19 UL noise and interference level IE format

For the open loop power control, UL interference and noise level shall be broadcast to MSs in the given BS coverage by BS. UL interference and noise level IE broadcast the UL interference and noise level (dBm) estimated in BS. All the UL interference and noise level are quantized in 0.5 dBm steps from –150 dBm (encoded 0x00) to –22.5 dBm (encoded 0xFF). (See Table 286h.)

Table 286h—UL interference and noise level extended IE

| Syntax | Size | Notes |
|---|---|---|
| UL interference and noise level_IE{ | — | — |
| **Extended DIUC** | 4 bits | UL_NI = 0xF |
| **Length** | 4 bits | Length = variable |

### Table 286h—UL interference and noise level extended IE *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Bitmap** | 8 bits | LSB indicates the there exists a ‘CQI/ACK/Periodic Ranging region NI’ field (1). Otherwise, it is 0.<br>The 2nd LSB indicates the there exists a ‘PUSC region NI’ field (1). Otherwise, it is 0.<br>The 3rd LSB indicates the there exists a ‘Optional PUSC region NI’ field (1). Otherwise, it is 0.<br>The 4th LSB indicates the there exists an ‘AMC region NI’ field (1). Otherwise, it is 0.<br>The 5th LSB indicates the there exists ‘AAS region NI’ field (1). Otherwise, it is 0.<br>The 6th LSB indicates the there exists “Periodic ranging region NI” field (1). Otherwise, it is ‘0’<br>The 7th LSB indicates the there exists 'Sounding region NI' field (1). Otherwise, it is ‘0’<br>The 8th LSB indicates the there exists 'MIMO region NI' field (1). Otherwise, it is ‘0’ |
| if (LSB of Bitmap = 1) { | — | — |
| **CQI/ACK/Periodic Ranging region NI** | 8 bits | Estimated average power level (dBm) per a subcarrier in CQI/ACK/Periodic Ranging region. |
| } | — | — |
| if (The 2nd LSB of Bitmap = 1) { | — | — |
| **PUSC region NI** | 8 bits | Estimated average power level (dBm) per a subcarrier in PUSC region. |
| } | — | — |
| if (The 3rd LSB of Bitmap = 1) { | — | — |
| **Optional PUSC region NI** | 8 bits | Estimated average power level (dBm) per a subcarrier in optional PUSC region. |
| } | — | — |
| if (The 4th LSB of Bitmap = 1) { | — | — |
| **AMC region NI** | 8 bits | Estimated average power level (dBm) per a subcarrier in AMC region. |
| } | — | — |
| if (The 5th LSB of Bitmap = 1) { | — | — |
| **AAS region NI** | 8 bits | Estimated average power level (dBm) per a subcarrier in AAS region. The interference and noise level shall be estimated before the beam forming. |
| } | — | — |
| if (The 6th LSB of Bitmap = 1) { | — | — |

### Table 286h—UL interference and noise level extended IE *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Periodic ranging region NI** | 8 bits | Estimated average power level (dBm) per a subcarrier in Periodic ranging region. The interference and noise level shall be estimated before the beam forming. When this field is present, the value for the periodic ranging region indicated in CQI/ACK/Periodic Ranging region NI shall be ignored. Instead, the value of this field shall be used for NI level of the periodic ranging region. |
| } | — | — |
| if (The 7th LSB of Bitmap = 1) { | — | — |
| **Sounding region NI** | 8 bits | Estimated average power level (dBm) per a subcarrier in sounding region. |
| } | — | — |
| if (The 8th LSB of Bitmap = 1) { | — | — |
| **MIMO region NI** | 8 bits | Estimated average power level (dBm) per a subcarrier in MIMO region. |
| } | — | — |
| } | — | — |

The UL interference and noise level that is indicated in the latest IE shall be used if necessary. MS shall not transmit any UL burst in open loop power control mode until it receives any UL noise and interference level IE.

***Insert new subclause 8.4.5.3.20:***

### 8.4.5.3.20 Dedicated DL control IE

Dedicated DL Control IE contains additional control information for each sub-burst in the Table 286l. Because each sub-burst may have its own control information format dependent on the MS capability, the length of the Dedicated DL Control IE is variable.(See Table 286i.)

### Table 286i—Dedicated DL control IE format

| Syntax | Size | Notes |
|---|---|---|
| Dedicated DL control IE() { | — | — |
| **Length** | 4 bits | Length of following control information in Nibble. |
| **Control header** | 4 bits | Bit #0: SDMA Control InfoBit<br>Bits #1-3: Reserved |
| If ( SDMA Control Info Bit == 1){ | — | — |
| **Num SDMA layers** | 2 bits | This value plus one indicates the total number of SDMA layers associated with the HARQ DL MAP IE. |

**Table 286i—Dedicated DL control IE format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| } | — | — |
| **Padding bits** | *variable* | — |
| } | — | — |

**SDMA Control Info**

The Dedicated DL Control IE with SDMA Control Info =1 shall be present within the first sub-burst allocation of each layer of SDMA allocations (including the first layer). Each SDMA layer has is own pilot pattern (layer *n* uses the pilot pattern defined for antenna *n*, see 8.4.8). When the SDMA control info is present, the OFDMA Symbol offset and Subchannel offset shall be reset to the beginning of the two dimensional data region defined in the HARQ DL MAP IE.

For allocations specified in an AAS zone with PUSC permutation, the 'Num SDMA layers' value shall be identical in all Dedicated DL Control IEs that describe allocations in the same major group.

***Insert new subclause 8.4.5.3.20.1:***

### 8.4.5.3.20.1 Reduced CID IE

Table 286j presents the format of reduced CID. BS may use reduced CID instead of basic CID or multicast CID to reduce the size of HARQ MAP message. The type of reduced CID is determined by BS considering the range of basic CIDs of SS connected with the BS and specified by the RCID_Type field of the Format Configuration IE.

The reduced CID is composed of 1 bit of prefix and *n*-bits of LSB of CID of SS. The prefix is set to 1 for the broadcast CID or multicast CID and set to 0 for basic CID. The reduced CID cannot be used instead of transport CID, primary management CID or secondary management CID.

Figure 229 shows the decoding of reduced CID when the RCID_Type is set to 3.

### Table 286j—RCID_IE format

| Syntax | Size | Notes |
|---|---|---|
| RCID_IE ( ) { | — | — |
| if (RCID_Type == 0){ | — | — |
| **CID** | 16 bits | Normal CID |
| }else{ | — | — |
| **Prefix** | 1 bit | For multicast, AAS, Padding and broadcast burst temporary disable RCID |
| if ( Prefix == 1){ | — | — |
| **RCID 11** | 11 bits | 11 LSB of multicast, AAS or broadcast CID |
| }else{ | — | — |
| if (RCID_Type == 1){ | — | — |
| **RCID 11** | 11 bits | 11 LSB of basic CID |
| } else if (RCID_Type == 2){ | — | — |
| **RCID 7** | 7 bits | 7 LSB of basic CID |
| } else if (RCID_Type == 3){ | — | — |
| **RCID 3** | 3 bits | 3 LSB of basic CID |
| } | — | — |
| } | — | — |
| } | — | — |
| } | — | — |

**CID**

Normal 16 bits CID

**Prefix**

A value of one indicates that 11 bits RCID for broadcast and multicast follows the prefix. Otherwise, the *n*-bits RCID for basic CID follows the prefix. The value of *n* is determined by the RCID_Type field in Format_Configuration_IE.

**RCID n**

*n*-bits LSB of CID

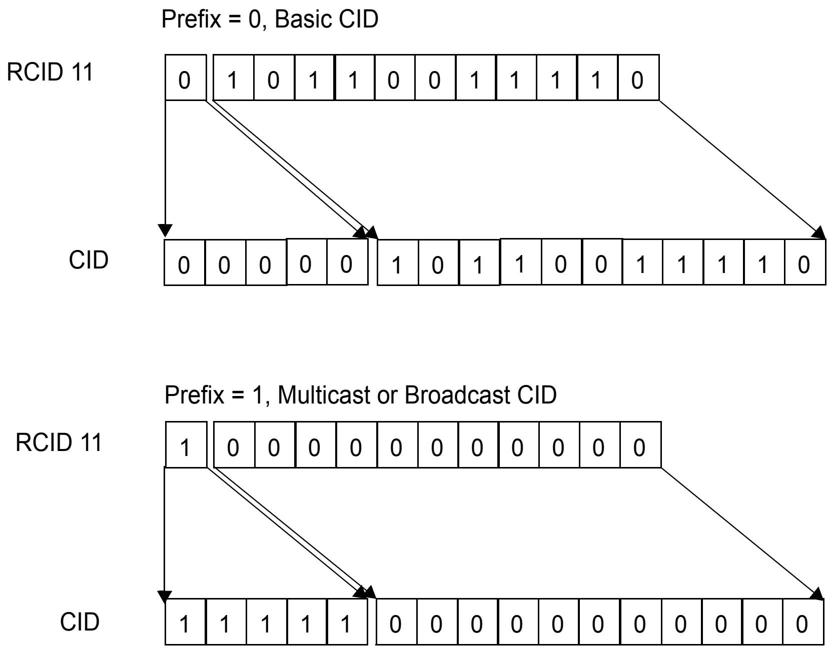

Prefix = 0, Basic CID
RCID 11
0 1 0 1 1 0 0 1 1 1 1 0
CID
0 0 0 0 0 1 0 1 1 0 0 1 1 1 1 0
Prefix = 1, Multicast or Broadcast CID
RCID 11
1 0 0 0 0 0 0 0 0 0 0 0
CID
1 1 1 1 1 0 0 0 0 0 0 0 0 0 0 0

**Figure 229b—Reduced CID decoding**

***Insert new subclause 8.4.5.3.20.2:***

#### 8.4.5.3.20.2 Skip IE

This IE may be sent by BS in the mandatory DL-MAP as a broadcast IE. This IE is used to indicate to mobility enabled MS (negotiated through capability exchange in REG-REQ and REG-RSP, defined in 11.7.13.1) whether to process subsequent IEs following the Skip_IE. There are two modes of operation. At the beginning of each DL-MAP, the processing of IEs is always enabled. When a Skip_IE is encountered, and if Mode is set to 1, the mobility enabled MS may skip the processing of all subsequent IEs in the DL-MAP. However, when a Skip_IE with Mode set to 0 is encountered, the mobility enabled MS may disable the processing of subsequent IEs until the next Skip_IE is encountered in the DL-MAP. When the next Skip_IE with Mode set to 0 is encountered, the MS shall enable the processing of subsequent IEs. This process continues until the end of the DL-MAP.

**Table 286k—Skip IE**

| Syntax | Size | Notes |
|---|---|---|
| Skip_IE() { | — | — |
| **Extended-2 DIUC** | 4 bits | SkipIE () = 0x06 |
| **Length** | 8 bits | Length in bytes |
| **Mode** | 1 bit | If set to 1, the MS can skip the processing of all subsequent IEs in the DL-MAP<br>If set to 0, the MS toggle the enabling and disabling of processing of IEs following the Skip_IE, until the next Skip_IE is encountered. |
| *Reserved* | 7 bits | — |
| } | — | — |

***Insert new subclause 8.4.5.3.21:***

### 8.4.5.3.21 HARQ DL MAP IE

The following modes of HARQ shall be supported by the HARQ DL MAP IE:

a) Chase combining HARQ for all FEC types (HARQ Chase). In this mode the burst profile is indicated by a DIUC.
b) Incremental redundancy HARQ with CTC (HARQ IR). In this mode the burst profile is indicated by the parameters $N_{EP}$, $N_{SCH}$.
c) Incremental redundancy HARQ for convolutional code (HARQ CC-IR).

The IE may also be used to indicate a non-HARQ transmission.

The HARQ DL MAP IE defines one or more two-dimensional data regions (a number of symbols by a number of subchannels). These allocations are further partitioned into bursts, termed sub-bursts, by allocating a specified number of slots to each burst. All sub-bursts of a data region shall only support one of the HARQ modes. The number of slots is indicated by duration or $N_{SCH}$ fields. The slots are allocated in a frequency-first order, starting from the slot with the smallest symbol number and smallest subchannel, and continuing to slots with increasing subchannel number. When the edge of the allocation is reached, the symbol number is increased by a slot duration, as depicted in Figure 229c. Each sub-burst is separately encoded.

The enhanced feedback 6-bit channel type or mandatory feedback channel type shall be used for CQI channels allocated through any of the DL HARQ sub-burst IEs.

Each HARQ Map IE and sub-burst IE shall be nibble-aligned. When there is an if-else clause, regardless of whether the ‘if’ clause or the ‘else’ clause is executed, the resulting Map IE shall be nibble-aligned. When there is a loop, nibble-alignment shall be required before the loop starts and inside the loop.

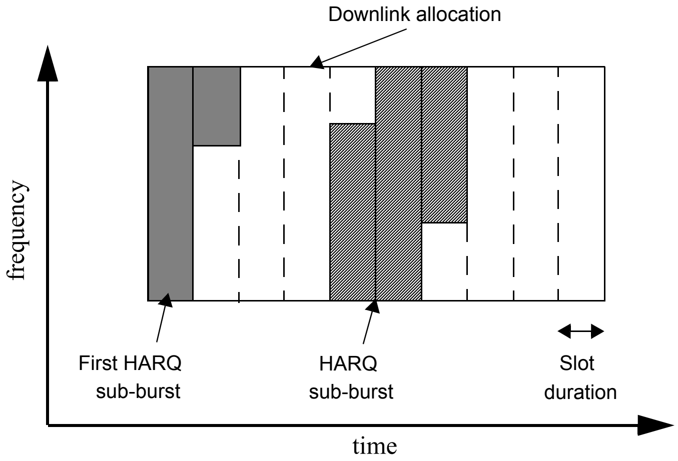

Downlink allocation
frequency
First HARQ sub-burst
HARQ sub-burst
Slot duration
time

Figure 229c—HARQ downlink allocation

Table 286l—HARQ DL MAP IE format

| Syntax | Size | Notes |
|---|---|---|
| HARQ DL MAP IE { | — | — |
| **Extended-2 DIUC** | 4 bits | HARQ_DL_MAP_IE() = 0x07 |
| **Length** | 8 bits | Length in bytes |
| **RCID_Type** | 2 bits | 0b00 = Normal CID<br>0b01 = RCID11<br>0b10 = RCID7<br>0b11 = RCID3 |
| *Reserved* | 2 bits | |
| While (data remains) { | — | — |
| **Boosting** | 3 bits | 0b000: normal (not boosted)<br>0b001: +6dB<br>0b010: –6dB<br>0b011: +9dB<br>0b100: +3dB<br>0b101: –3dB<br>0b110: –9dB<br>0b111: –12dB; |
| **Region_ID use indicator** | 1 bit | 0: not use Region_ID<br>1: use Region_ID |
| If (Region_ID use indicator == 0 ) { | | |
| **OFDMA symbol offset** | 8 bits | Offset from the start symbol of DL subframe |
| **Subchannel offset** | 7 bits | — |
| **Number of OFDMA symbols** | 7 bits | — |

### Table 286l—HARQ DL MAP IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Number of subchannels** | 7 bits | — |
| *Reserved* | 3 bits | — |
| } else { | — | — |
| **Region_ID** | 8 bits | Index to the DL region defined in DL region definition TLV in DCD |
| } | — | — |
| **Mode** | 4 bits | Indicates the mode of this HARQ region<br>0b0000 = Chase HARQ<br>0b0001 = Incremental redundancy HARQ for CTC<br>0b0010 = Incremental redundancy HARQ for Convolutional Code<br>0b0011 = MIMO Chase HARQ<br>0b0100 = MIMO IR HARQ<br>0b0101 = MIMO IR HARQ for Convolutional Code<br>0b0110 = MIMO STC HARQ<br>0b0111-0b1111 *Reserved* |
| **Sub-burst IE Length** | 8 bits | Length, in nibbles, to indicate the size of the sub-burst IE in this HARQ mode.<br>The MS may skip DL HARQ sub-burst IE if it does not support the HARQ Mode. However, the MS shall decode NACK Channel field from each DL HARQ sub-burst IE to determine the UL ACK channel it shall use for its DL HARQ burst. |
| If (Mode == 0b0000) { | — | — |
| **DL HARQ Chase sub-burst IE()** | *variable* | — |
| } else if (Mode == 0b0001) { | — | — |
| **DL HARQ IR CTC sub-burst IE()** | *variable* | — |
| } else if (Mode == 0b0010) { | — | — |
| **DL HARQ IR CC sub-burst IE() {** | *variable* | — |
| } else if (Mode==0b0011) { | — | — |
| **MIMO DL Chase HARQ Sub-Burst IE ()** | *variable* | — |
| } else if (Mode==0b0100) { | — | — |
| **MIMO DL IR HARQ Sub-Burst IE ()** | *variable* | — |
| } else if (Mode==0b0101) { | — | — |
| **MIMO DL IR HARQ for CC Sub-Burst IE ()** | *variable* | — |
| } else if (Mode == 0b0110) { | — | — |

### Table 286l—HARQ DL MAP IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **MIMO DL STC HARQ Sub-Burst IE ()** | *variable* | — |
| } | — | — |
| } | — | — |
| **Padding** | *variable* | Padding to byte; shall be set to 0 |
| } | — | — |

### Table 286m—DL HARQ Chase sub-burst IE format

| Syntax | Size | Notes |
|---|---|---|
| DL HARQ Chase sub-burst IE() { | — | — |
| **N sub burst[ISI]** | 4 bits | Number of sub-bursts in the 2D region |
| **N ACK channel** | 4 bits | Number of HARQ ACK enabled sub-bursts in the 2D region. |
| For (j=0; j< N sub burst; j++){ | — | — |
| **RCID_IE()** | *variable* | — |
| **Duration** | 10 bits | Duration in slots |
| **Sub-Burst DIUC Indicator** | 1 bit | If Sub-Burst DIUC Indicator is 1, it indicates that DIUC is explicitly assigned for this sub-burst. Otherwise, the this sub-burst will use the same DIUC as the previous sub-burst<br>If j is 0 then this indicator shall be 1. |
| *Reserved* | 1 bit | Shall be set to zero. |
| If( Sub-Burst DIUC Indicator == 1){ | — | — |
| **DIUC** | 4 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| *Reserved* | 2 bits | Shall be set to zero. |
| } | — | — |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |

### Table 286m—DL HARQ Chase sub-burst IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **ACK disable** | 1 bit | When ‘ACK Disable’ == 1, the allocated sub-burst does not require an ACK to be transmitted by the SS in the ACKCH Region (see 8.4.5.4.24). In this case, no ACK channel is allocated for the sub-burst in the ACKCH Region. For the burst, BS shall not perform HARQ retransmission and MS shall ignore ACID, AI_SN and SPID, which shall be set to ‘0’ by BS if they exist. |
| **Dedicated DL Control Indicator** | 2 bits | LSB #0 indicates inclusion of CQI control<br>LSB #1 indicates inclusion of Dedicated DL Control IE. |
| If( LSB #0 of Dedicated DL Control Indicator == 1){ | — | — |
| **Duration (d)** | 4 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS for 2^(d-1) frames. If d is 0b0000, deallocates all CQI feedback when the current ACID is completed successfully.<br>If d is 0b1111, the MS should report until the BS command for the MS to stop. |
| If (Duration != 0b0000){ | — | — |
| **Allocation Index** | 6 bits | Index to the channel in a frame the CQI report should be transmitted by the SS. |
| **Period (p)** | 3 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS in every 2^p frames. |
| **Frame offset** | 3 bits | The MS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the MS should start reporting in eight frames. |
| } | — | — |
| } | — | — |
| If (LSB #1 of Dedicated DL Control Indicator ==1) { | — | — |
| **Dedicated DL Control IE ()** | *variable* | — |
| } | — | — |
| } | — | — |
| } | — | — |

A non-HARQ MS is required to decode DL HARQ Chase sub-burst IEs with “ACK disabled” = 1 if the MS has the capability to decode the extended HARQ IEs. (See Table 286n.)

### Table 286n—DL HARQ IR CTC sub-burst IE format

| Syntax | Size | Notes |
|---|---|---|
| DL HARQ IR CTC sub-burst IE() { | — | — |
| **N sub burst** | 4 bits | — |
| **N ACK channel** | 4 bits | Number of HARQ ACK enabled sub-bursts in the 2D region |
| For (j=0; j< N sub burst; j++){ | — | — |
| **RCID_IE()** | *variable* | — |
| **$N_{EP}$** | 4 bits | — |
| **$N_{SCH}$** | 4 bits | — |
| **SPID** | 2 bits | — |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |
| **ACK disable** | 1 bit | When ‘ACK Disable’ == 1, the allocated sub-burst does not require an ACK to be transmitted by the SS in the ACKCH Region (see 8.4.5.4.24). In this case, no ACK channel is allocated for the sub-burst in the ACKCH Region. For the burst, BS shall not perform HARQ retransmission and MS shall ignore ACID, AI_SN and SPID, which shall be set to ‘0’ by BS if they exist. |
| *Reserved* | 2 bits | Shall be set to zero |
| **Dedicated DL Control Indicator** | 2 bits | LSB #0 indicates inclusion of CQI control<br>LSB #1 indicates inclusion of Dedicated DL Control IE |
| If( LSB #0 of Dedicated DL Control Indicator == 1){ | — | — |
| **Duration (*d*)** | 4 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS for 2^(*d*-1) frames. If d is 0b0000, deallocates all CQI feedback when the current ACID is completed successfully.<br>If d is 0b1111, the MS should report until the BS command for the MS to stop |
| If (Duration != 0b0000){ | — | — |
| **Allocation index** | 6 bits | Index to the channel in a frame the CQI report should be transmitted by the SS |
| **Period(p)** | 3 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS in every 2^p frames. |

### Table 286n—DL HARQ IR CTC sub-burst IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Frame offset** | 3 bits | The MS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the MS should start reporting in eight frames. |
| } | — | — |
| } | — | — |
| If (LSB #1 of Dedicated DL Control Indicator ==1) { | — | — |
| **Dedicated DL Control IE ()** | *variable* | — |
| } | — | — |
| } | — | — |
| } | — | — |

### Table 286o—DL HARQ IR CC sub-burst IE format

| Syntax | Size | Notes |
|---|---|---|
| DL HARQ IR CC sub-burst IE() { | — | — |
| **N sub burst** | 4 bits | — |
| **N ACK channel** | 4 bits | Number of HARQ ACK enabled sub-bursts in the 2D region |
| For (j=0; j< N sub burst; j++) { | — | — |
| **RCID_IE()** | *variable* | — |
| **Duration** | 10 bits | — |
| **Sub-Burst DIUC Indicator** | 1 bit | If Sub-Burst DIUC Indicator is 1, it indicates that DIUC is explicitly assigned for this sub-burst. Otherwise, the this sub-burst will use the same DIUC as the previous sub-burst<br>If *j* is 0 then this indicator shall be 1. |
| *Reserved* | 1 bit | — |
| If( Sub-Burst DIUC Indicator == 1){ | — | — |
| **DIUC** | 4 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| *Reserved* | 2 bits | — |
| } | — | — |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |

**Table 286o—DL HARQ IR CC sub-burst IE format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **SPID** | 2 bits | — |
| **ACK disable** | 1 bit | When 'ACK Disable' == 1, the allocated sub-burst does not require an ACK to be transmitted by the SS in the ACKCH Region (see 8.4.5.4.24). In this case, no ACK channel is allocated for the sub-burst in the ACKCH Region. For the burst, BS shall not perform HARQ retransmission and MS shall ignore ACID, AI_SN and SPID, which shall be set to '0' by BS if they exist. |
| **Dedicated DL Control Indicator** | 2 bits | LSB #0 indicates inclusion of CQI control<br>LSB #1 indicates inclusion of Dedicated DL Control IE |
| *Reserved* | 2 bits | Shall be set to zero. |
| If (LSB #0 of Dedicated DL Control Indicator == 1) { | — | — |
| **Duration (d)** | 4 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS for 2^(d-1) frames. If d is 0b0000, deallocates all CQI feedback when the current ACID is completed successfully.<br>If d is 0b1111, the MS should report until the BS command for the MS to stop |
| If (Duration != 0b0000){ | — | — |
| **Allocation index** | 6 bits | Index to the channel in a frame the CQI report should be transmitted by the SS |
| **Period(p)** | 3 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS in every $2^p$ frames. |
| **Frame offset** | 3 bits | The MS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the MS should start reporting in eight frames. |
| } | — | — |
| } | — | — |
| If ((LSB #1 of Dedicated DL Control Indicator ==1) { | — | — |
| **Dedicated DL Control IE ()** | *variable* | — |
| } | — | — |
| } | — | — |
| } | — | — |

### Table 286p—MIMO DL Chase HARQ sub-burst IE format

| Syntax | Size | Notes |
|---|---|---|
| MIMO_DL_Chase_HARQ_Sub-Burst_IE() { | — | — |
| **N sub burst** | 4 bits | Number of sub-bursts in the 2D region |
| **N ACK channel** | 6 bits | Number of HARQ ACK enabled sub-bursts in the 2D region |
| For (j=0; j< N sub burst; j++){ | — | — |
| **MU Indicator** | 1 bit | Indicates whether this DL burst is intended for multiple SS |
| **Dedicated MIMO DL Control Indicator** | 1 bit | — |
| **ACK Disable** | 1 bit | When 'ACK Disable' == 1, the allocated sub-burst does not require an ACK to be transmitted by the SS in the ACKCH Region (see 8.4.5.4.24). In this case, no ACK channel is allocated for the sub-burst in the ACKCH Region. For the burst, BS shall not perform HARQ retransmission and MS shall ignore ACID, AI_SN and SPID, which shall be set to '0' by BS if they exist. |
| If (MU indicator == 0) { | — | — |
| **RCID IE()** | *variable* | — |
| } | — | — |
| If (Dedicated MIMO DL Control Indicator ==1) { | — | — |
| **Dedicated MIMO DL Control IE ()** | *variable* | — |
| } | — | — |
| **Duration** | 10 bits | — |
| For (i=0;i<N_layer;i++) { | — | — |
| if (MU indicator == 1) { | — | — |
| **RCID IE()** | *variable* | — |
| } | — | — |
| **DIUC** | 4 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| If (ACK Disable ==0) { | — | — |
| **ACID** | 4 bits | — |

### Table 286p—MIMO DL Chase HARQ sub-burst IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **AI_SN** | 1 bit | — |
| } | — | — |
| } | — | — |
| } | — | — |
| } | — | — |

When an MS receives a MIMO HARQ burst allocation with Dedicated MIMO DL Control Indicator set to ‘1’, the MS shall store the information in Dedicated MIMO DL Control IE. When an MS receives a MIMO HARQ burst allocation with Dedicated MIMO DL Control Indicator is set to ‘0’, the MS shall use the stored Dedicated MIMO DL Control information from the last burst allocation where this information was included.

For MIMO HARQ allocation specified in the MIMO DL Chase HARQ Sub-Burst IE, MIMO DL IR HARQ Sub-Burst IE, or the MIMO DL IR HARQ for CC Sub-Burst IE, each layer shall be allocated its associated ACK channel. The number of ACK channels associated with the sub-burst IE may be greater than N_sub_burst.

For each multi SS sub-burst (MU Indicator = 1), if the dedicated pilot bit is set to 1 in the STC_ZONE IE (8.4.5.3.4) for the zone in which the sub-burst allocations are being made, N_layer for this sub-burst selects the pilot format for the sub-burst by interpreting N_layer as the number of transmit antennas (as defined in 8.4.8), and the SS with the first RCID shall be assigned the pilot pattern corresponding to antenna 1, of 8.4.8, the second to the pilot pattern corresponding to antenna 2, and so on.

### Table 286q—MIMO DL IR HARQ Sub-Burst IE format

| Syntax | Size | Notes |
|---|---|---|
| MIMO DL IR HARQ Sub-Burst IE { | — | — |
| **N sub burst** | 4 bits | Number of sub-bursts in the 2D region |
| **N ACK channel** | 6 bits | Number of HARQ ACK enabled sub-bursts in the 2D region |
| For (j=0; j< N sub burst; j++){ | — | — |
| **MU Indicator** | 1 bit | Indicates whether this DL burst is intended for multiple SS |
| **Dedicated MIMO DL Control Indicator** | 1 bit | — |

### Table 286q—MIMO DL IR HARQ Sub-Burst IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **ACK Disable** | 1 bit | When 'ACK Disable' == 1, the allocated sub-burst does not require an ACK to be transmitted by the SS in the ACKCH Region (see 8.4.5.4.24). In this case, no ACK channel is allocated for the sub-burst in the ACKCH Region. For the burst, BS shall not perform HARQ retransmission and MS shall ignore ACID, AI_SN and SPID, which shall be set to '0' by BS if they exist. |
| If (MU indicator == 0) { | — | — |
| **RCID IE()** | *variable* | — |
| } | — | — |
| If (Dedicated MIMO DL Control Indicator ==1) { | — | — |
| **Dedicated MIMO DL Control IE ()** | *variable* | — |
| } | — | — |
| $\mathbf{N_{SCH}}$ | 4 bits | — |
| For (i=0;i<N_layer;i++) { | — | — |
| if (MU indicator == 1) { | — | — |
| **RCID IE()** | *variable* | — |
| } | — | — |
| $\mathbf{N_{EP}}$ | 4 bits | — |
| If (ACK Disable ==0) { | — | — |
| **SPID** | 2 bits | — |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |
| } | — | — |
| } | — | — |
| } | — | — |
| } | — | — |

### Table 286r—MIMO DL IR HARQ for CC Sub-Burst IE format

| Syntax | Size | Notes |
|---|---|---|
| MIMO DL IR HARQ for CC Sub-Burst IE { | — | — |
| **N sub burst** | 4 bits | Number of sub-bursts in the 2D region |
| **N ACK channel** | 6 bits | Number of HARQ ACK enabled sub-bursts in the 2D region |
| For (j=0; j< N sub burst; j++){ | — | — |
| **MU Indicator** | 1 bit | Indicates whether this DL burst is intended for multiple SS |
| **Dedicated MIMO DL Control Indicator** | 1 bit | — |
| **ACK Disable** | 1 bit | When ‘ACK Disable’ == 1, the allocated sub-burst does not require an ACK to be transmitted by the SS in the ACKCH Region (see 8.4.5.4.24). In this case, no ACK channel is allocated for the sub-burst in the ACKCH Region. For the burst, BS shall not perform HARQ retransmission and MS shall ignore ACID, AI_SN and SPID, which shall be set to ‘0’ by BS if they exist. |
| If (MU indicator == 0) { | — | — |
| **RCID IE()** | *variable* | — |
| } | — | — |
| If (Dedicated MIMO DL Control Indicator ==1) { | — | — |
| **Dedicated MIMO DL Control IE ()** | *variable* | — |
| } | — | — |
| **Duration** | 10 bits | — |
| For (i=0;i<N_layer;i++) { | — | — |
| if (MU indicator == 1) { | — | — |
| **RCID IE()** | *variable* | — |
| } | — | — |
| **DIUC** | 4 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| If (ACK Disable ==0) { | — | — |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |
| **SPID** | 2 bits | — |

### Table 286r—MIMO DL IR HARQ for CC Sub-Burst IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| } | — | — |
| } | — | — |
| } | — | — |
| } | — | — |

### Table 286s—MIMO DL STC HARQ Sub-Burst IE format

| Syntax | Size | Notes |
|---|---|---|
| MIMO DL STC HARQ Sub-Burst IE { | — | — |
| **N sub burst** | 4 bits | Number of sub-bursts in the 2D region |
| **N ACK channel** | 6 bits | Number of HARQ ACK enabled sub-bursts in the 2D region |
| For (j=0; j< N sub burst; j++){ | — | — |
| **Tx count** | 2 bits | 0b00: initial transmission<br>0b01: odd retransmission<br>0b10: even retransmission<br>0b11: Reserved |
| **Duration** | 10 bits | — |
| **Sub-burst offset indication** | 1 bit | Indicates the inclusion of sub-burst offset |
| *Reserved* | 3 bits | — |
| If (Sub-burst offset indication == 1) { | — | — |
| **Sub-burst offset** | 8 bits | Offset in slots with respect to the previous sub-burst defined in this data region. If this is the first subburst within the data region, this offset is with respect to slot 0 of the data region. |
| } | — | — |
| **RCID IE()** | *variable* | — |
| **ACK Disable** | 1 bit | When ‘ACK Disable’ == 1, the allocated sub-burst does not require an ACK to be transmitted by the SS in the ACKCH Region (see 8.4.5.4.24). In this case, no ACK channel is allocated for the sub-burst in the ACKCH Region. For the burst, BS shall not perform HARQ retransmission and MS shall ignore ACID, AI_SN, and SPID, which shall be set to ‘0’ by BS if they exist. |
| if (Tx count ==00) { | — | — |
| **Dedicated MIMO DL Control Indicator** | 1 bit | |

### Table 286s—MIMO DL STC HARQ Sub-Burst IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| If (Dedicated MIMO DL Control Indicator ==1) { | — | — |
| **Dedicated MIMO DL Control IE ()** | *variable* | — |
| } | — | — |
| **DIUC** | 4 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| } | — | — |
| If (ACK Disable ==0) { | — | — |
| **ACID** | 4 bits | — |
| } | — | — |
| } | — | — |
| } | — | — |

This IE is used to support the STC subpacket retransmission.

***Insert new subclause 8.4.5.3.21.1:***

### 8.4.5.3.21.1 Dedicated MIMO DL Control IE format

Dedicated DL Control IE for MIMO contains additional control information for each sub-burst. Because each sub-burst may have its own control information format dependent on the MS capability, the length of the Dedicated DL Control IE for MIMO is variable.

### Table 286t—Dedicated MIMO DL Control IE format

| Syntax | Size | Notes |
|---|---|---|
| Dedicated MIMO DL Control IE() { | — | — |
| **Length** | 5 bits | Length of following control information in Nibble. |
| **Control header** | 3 bits | Bit #0: MIMO Control Info<br>Bit #1: CQI Control Info<br>Bit #2: Closed MIMO Control Info |
| **N_layer** | 2 bits | Number of coding/modulation layers<br>0b00 = 1 layer<br>0b01 = 2 layers<br>0b10 = 3 layers<br>0b11 = 4 layers |
| if( MIMO Control Info == 1){ | — | — |

### Table 286t—Dedicated MIMO DL Control IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Matrix** | 2 bits | Indicates transmission matrix (See 8.4.8)<br>0b00 = Matrix A<br>0b01 = Matrix B<br>0b10 = Matrix C<br>0b11 = Codebook |
| if (Dedicated Pilots == 1) { | — | Dedicated Pilots field in STC_Zone_IE() |
| **Num_Beamformed_Streams** | 2 bits | Indicates the number of beamformed streams which is equal to the number of pilot patterns<br>0b00 = 1 stream<br>0b01 = 2 streams<br>0b10 = 3 streams<br>0b11 = 4 streams |
| } | — | — |
| } | — | — |
| If( CQICH Control Info == 1){ | — | — |
| **Period** | 3 bits | Period (in frame) = 2^period |
| **Frame offset** | 3 bits | — |
| **Duration** | 4 bits | A CQI feedback is transmitted on the CQI channels indexed by the Allocation index for $10 \times 2^d$ frames. |
| For (j=0;N_layer+1;j++) { | — | — |
| **Allocation index**[1] | 6 bits | Index to CQICH assigned to this layer. |
| } | — | — |
| **CQICH_Num** | 2 bits | Number of additional CQICHs assigned to this SS (0–3) |
| for (i=0; i<CQICH_Num; i++) { | — | — |
| **Feedback type** | 3 bits | Type of feedback on this CQICH |
| **Allocation index** | 6 bits | — |
| } | — | — |
| } | — | — |
| if (Closed MIMO Control Info == 1){ | — | — |
| if (MIMO Control Info==1) { | — | — |
| **MIMO mode = Matrix** | — | |
| } Else { | — | — |
| **MIMO mode = Matrix in STC_Zone_IE()** | — | |
| } | — | — |
| If (MIMO mode == 00 or 01) { | — | — |

**Table 286t—Dedicated MIMO DL Control IE format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **Antenna Grouping Index** | 3 bits | Indicates the index of antenna grouping. See 8.4.8.3.4 and 8.4.8.3.5<br>If((Matrix_indicator == 00)<br>000~010 = 0b101110~0b110000 in Table 298d<br>else<br>000~101 = 0b110001~0b110110 in Table 298d |
| } elseif (MIMO mode == 10) { | | |
| **Num_stream** | 2 bits | Indicates the number of streams in Table 316f for 3 Tx and Table 316g for 4 Tx. |
| **Antenna Selection Index** | 3 bits | Indicates the index of antenna selection. See 8.4.8.3.4 and 8.4.8.3.5<br>000~110 = 0b110000~0b110101 in Table 298e |
| } elseif (MIMO mode == 11) { | | |
| **Num_stream** | 2 bits | Indicates number of streams |
| **Codebook Precoding Index** | 6 bits | Indicates the index of precoding matrix W in the codebook (see 8.4.8.3.6). |
| } | | |
| } | | |
| *Padding* | *variable* | Padding to Nibble; shall be set to 0 |
| } | — | — |

**Control header**

Four bits are used to indicate the following control information. If the first bit is set to 1, this means that MIMO Control information follows. If the second bit is set to 1, this IE shall contain CQI control information. Other bits are reserved for future extension.

**N_layer**

Specifies the number of layers contained in this burst. The layer is defined as a separate coding/modulation path.

**Matrix Indicator**

This field indicates MIMO matrix for the burst.

**Period**

Informs the SS of the period of CQI reports. A CQI feedback is transmitted on the CQICH every 2^p frames.

**Frame Offset**

Informs the SS when to start transmitting reports. The SS starts reporting at the frame number which has the same 3 LSBs as the specified Frame Offset. If the current frame is specified, the SS shall start reporting in eight frames.

**Duration**

Indicates when the SS should stop reporting unless the CQICH allocation is refreshed beforehand. If Duration is set to 0b0000, the BS shall de-allocate the CQICH. If Duration is set to 0b1111, the CQICH is allocated indefinitely and the SS should report until it receives another MAP_IE with Duration set to 0b0000.

**Allocation Index**[1]

Indicates position from the start of the CQICH region.

**Feedback Type**

Indicates the type of feedback content on the allocated CQICH from SS. Its mapping shall be

0b000 = Fast DL measurement/Default Feedback with antenna grouping
0b001 = Fast DL measurement/Default Feedback with antenna selection
0b010 = Fast DL measurement/Default Feedback with reduced codebook
0b011 = Quantized precoding weight feedback
0b100 = Index to precoding matrix in codebook
0b101 = Channel Matrix Information
0b110–0b111 = *Reserved*

***Insert new subclause 8.4.5.3.22:***

### 8.4.5.3.22 DL HARQ ACK IE

The DL HARQ ACK IE is used by BS to send HARQ acknowledgment to UL HARQ enabled traffic. The bit position in the bitmap is determined by the order of the HARQ enabled UL bursts in the UL-MAP. The frame offset *j* between the UL burst and the HARQ ACK-BITMAP is specified by "HARQ_ACK_Delay_for UL Burst" field in the DCD message. For example, when an MS transmits a HARQ enabled burst at frame i and the burst is the *n*-th HARQ enabled burst in the MAP, the MS should receive HARQ ACK at *n*-th bit of the BITMAP which is sent by the BS at frame (*i*+*j*).

The existence of this IE shall be optional.

If the HARQ ACK BITMAP is omitted, the HARQ MS should retain the transmitted HARQ burst and retransmit it when the BS request retransmission with AI_SN. This IE may only be exist in the DL-MAP message.

**Table 286u—HARQ _ACK IE**

| Syntax | Size | Notes |
|---|---|---|
| HARQ_ACK_IE() { | — | — |
| **Extended-2 DIUC** | 4 bits | HARQ_ACK_IE () = 0x08 |
| **Length** | 8 bits | Length in bytes |
| **Bitmap** | *variable* | Bitmap size is determined by Length field |
| } | — | — |

**Bitmap**

Includes HARQ ACK information for HARQ enabled UL bursts. The size of BITMAP should be equal or larger than the number of HARQ enabled UL-bursts. Each byte carriers 8 ACK indications ordered from LSB (smallest index ACK channel) to MSB. An acknowledgement bit shall be 0 (ACK) if the corresponding uplink packet has been successfully received; otherwise, it shall be 1 (NAK).

***Insert new subclause 8.4.5.3.23:***

### 8.4.5.3.23 Enhanced DL MAP IE

The Enhanced DL Map IE may be used for BS to indicate to the MS the DL resource allocation based on the channel definition specified in the DL channel definition TLV in the DCD. (See Table 286v.)

**Table 286v—Enhanced DL MAP IE**

| Syntax | Size | Notes |
|---|---|---|
| Enhanced_DL_MAP_IE() { | — | — |
| **Extended-2 DIUC** | 4 bits | Enhanced_DL_MAP_IE () = 0x09 |
| **Length** | 8 bits | Length in bytes |
| **Num_Assignment** | 4 bits | Number of assignments in this IE |
| For (i=0; i<Num_Assignment; i++) { | — | — |
| if (INC_CID == 1) { | — | The DL-MAP starts with INC_CID =0. INC_CID is toggled between 0 and 1 by the CID-SWITCH_IE() (8.4.5.3.7) |
| **N_CID** | 8 bits | Number of CIDs |
| For (n=0; n<N_CID; n++) { | — | — |
| **CID** | 16 bits | — |
| } | — | — |
| } | — | — |
| **DIUC** | 4 bits | — |
| **Boosting** | 3 bits | Refer to Table 273 |
| **Repetition Coding Indication** | 2 bits | — |
| **Region_ID** | 8 bits | Index to the DL region defined in DL channel definition TLV in DCD |
| *Reserved* | 3 bits | Shall be set to zero |
| } | — | — |
| } | — | — |

**Num_Assignment**
Number of assignments in this IE

**Region_ID**
Index to the DL region defined in DL channel definition TLV in DCD message

***Insert new subclause 8.4.5.3.24:***

### 8.4.5.3.24 Closed-loop MIMO DL enhanced IE format

The Closed-loop MIMO DL enhanced IE may be used by BS to assign resource to close loop MIMO enabled MSs. (See Table 286w.)

**Table 286w—Closed-loop MIMO DL enhanced IE**

| Syntax | Size | Notes |
|---|---|---|
| CL_MIMO_DL_Enhanced_IE () { | — | — |
| **Extended-2 DIUC** | 4 bits | CL_MIMO_DL_enhanced_IE () = 0x0A |
| **Length** | 8 bits | Length in bytes |
| **Num_Region** | 4 bits | — |
| for ( i = 0; i< Num_Region; i++) { | — | — |
| **OFDMA Symbol offset** | 8 bits | — |
| **Subchannel offset** | 6 bits | — |
| **Boosting** | 3 bits | Refer to Table 273. |
| **No. OFDMA Symbols** | 7 bits | — |
| **No. subchannels** | 6 bits | — |
| **Matrix_indicator** | 2 bits | Indicates transmission matrix (see 8.4.8)<br>0b00 = Matrix A (Transmission diversity)<br>0b01 = Matrix B (Hybrid Scheme)<br>0b10 = Matrix C (Spatial Multiplexing)<br>0b11 = Codebook |
| if ( Matrix_indicator != 0b10) { | — | — |
| **RCID_IE** | *variable* | — |
| **DIUC** | 4 bits | — |
| **Repetition_Coding_indication** | 2 bits | — |
| If (Matrix indicator == 0b00 or 0b01) | — | — |
| **Antenna Grouping Index** | 3 bits | Indicating the index of the antenna grouping index<br>If ((Matrix_indicator == 0b00)<br>0b000~0b010 = 0b101110~0b110000 in Table 298d<br>else<br>0b000~0b101 = 0b110001~0b110110 in Table 298d |
| *Reserved* | 3 bits | Shall be set to zero. |
| Elseif (Matrix_indicator == 0b11) { | — | — |
| **Num stream** | 2 bits | Indicates number of streams |
| **Codebook Precoding Index** | 6 bits | Indicate the index of the precoding matrix in the codebook |
| *Reserved* | 2 bits | Shall be set to zero. |

## Table 286w—Closed-loop MIMO DL enhanced IE *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| }Else { | — | — |
| **Num_MS** | 2 bits | Number of MSs who are assigned DL resource when antenna selection is used |
| *Reserved* | 2 bits | Shall be set to zero. |
| for (i = 0;i<Num_MS;i++) { | — | — |
| **RCID_IE** | *variable* | — |
| **DIUC** | 4 bits | — |
| **Repetition_Coding_indication** | 2 bits | — |
| **Num_stream** | 2 bits | Indicates the number of streams in<br>Table 316f for 3 Tx antenna and<br>Table 316g for 4 Tx antenna |
| **Antenna Selection index** | 3 bits | Indicates the index of antenna selection<br>See 8.4.8.3.4 and 8.4.8.3.5<br>0b000~0b010 = 0b110000~0b110010 in Table 316f<br>0b000~0b101 = 0b110000 ~ 0b 110101 in Table 316g |
| *Reserved* | 1 bit | Shall be set to zero. |
| } | — | — |
| } | — | — |
| } | — | — |
| **Padding** | *variable* | Padding to byte; shall be set to zero. |
| } | — | — |

**Num_Region:**

A field that indicates the number of the regions defined by OFDMA_Symbol_offset, Subchannel_offset, Boosting, No._OFDMA_Symbols and No._subchannels in this IE

**Matrix_indicator:**

The values of these two bits indicate the STC matrix (see 8.4.8)

**Antenna Grouping Index:**

A field that indicates the index of the antenna grouping index

**Antenna Selection Index:**

A field that indicates the index of the selected antenna

**Codebook Precoding Index:**

A field that indicates the index of the precoding matrix in the codebook

**Num_stream:**

The value of these 2 bits plus one indicate the number of MIMO transmission streams

**Stream_index:**

A field that specifies the stream index

***Insert new subclause 8.4.5.3.25:***

### 8.4.5.3.25 Broadcast Control Pointer IE

The structure of this IE is captured in Table 286x.

Table 286x—Broadcast Control Pointer IE format

| Syntax | Size | Notes |
|---|---|---|
| Broadcast Control Pointer IE() { | — | — |
| **Extended DIUC** | 4 bits | FDN = 0x0A |
| **Length** | 4 bits | Length in bytes |
| **DCD_UCD Configuration Change Counter** | 4 bits | A composite configuration change counter incremented for each change in either DCD or UCD |
| **DCD_UCD Transmission Frame** | 8 bits | The least significant eight bits of the frame number of the next DCD and/or UCD transmission. |
| **Skip Broadcast_System_Update** | 1 bit | — |
| If (Skip Broadcast_System_Update == 0) { | — | — |
| **Broadcast_System_Update_Type** | 3 bits | Shows the type of Broadcast_System_Update<br>0b000: For MOB_NBR-ADV Update<br>0b001: For Emergency Services Message<br>0b010 – 0b111: *Reserved* |
| **Broadcast_System_Update_Transmission_Frame** | 8 bits | The least significant eight bits of the frame number of the next Broadcast_System_Update transmission. |
| } else { | — | — |
| *Reserved* | 3 bits | Shall be set to zero. |
| } | — | — |
| } | — | — |

***Insert new subclause 8.4.5.3.26:***

### 8.4.5.3.26 AAS_SDMA_DL_IE format

Table 286y—AAS_SDMA_DL_IE

| Syntax | Size | Notes |
|---|---|---|
| AAS_SDMA_DL_IE(){ | — | — |
| **Extended-2 DIUC** | 4 bits | AAS_SDMA_DL_IE = 0x0E |
| **Length** | 8 bits | *variable* |
| **RCID_Type** | 2 bits | 0b00 = Normal CID<br>0b01 = RCID11<br>0b10 = RCID7<br>0b11 = RCID3 |
| **Num Burst Region** | 4 bits | — |
| *Reserved* | 2 bits | Shall be set to zero. |
| For (ii = 1: Num Region) { | — | — |
| **OFDMA symbol offset** | 8 bits | Starting symbol offset referenced to DL preamble of the downlink frame specified by the Frame Offset |
| If (Zone Permutation is AMC, TUSC1, or TUSC2) { | — | — |
| **Subchannel offset** | 8 bits | — |
| **No. OFDMA triple symbols** | 5 bits | Number of OFDMA symbols is given in multiples of 3 |
| **No. subchannels** | 6 bits | — |
| } Else { | — | — |
| **Subchannel offset** | 6 bits | — |
| **No. OFDMA symbols** | 7 bits | — |
| **No. subchannels** | 6 bits | — |
| } | — | — |
| **Number of Users** | 3 bits | SDMA users for the assigned region |
| *Reserved* | 2 bits | Shall be set to zero |
| For (jj = 1: Num_Users) { | — | — |
| **RCID_IE()** | *variable* | — |
| **Encoding Mode** | 2 bits | 0b00: No HARQ<br>0b01: HARQ Chase Combining<br>0b10: HARQ Incremental Redundancy<br>0b11: HARQ Conv. Code Incremental Redundancy |
| **CQICH Allocation** | 1 bit | 0: Not Included<br>1: Included |
| **ACKCH Allocation** | 1 bit | 0: Not Included<br>1: Optionally included for HARQ users |
| **Pilot Pattern Modifier** | 1 bit | 0: Not Applied<br>1: Applied<br>Shall be set to 0 if PUSC AAS zone |
| If (AAS DL Preamble Used) { | — | — |

### Table 286y—AAS_SDMA_DL_IE *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Preamble Modifier Index** | 4 bits | Preamble Modifier Index |
| } | — | — |
| If (Pilot Pattern Modifier) { | — | — |
| **Pilot Pattern** | 2 bits | See 8.4.6.3.3 3 (AMC), 8.4.6.1.2.6 (TUSC)<br>0b00: Pattern #A<br>0b01: Pattern #B<br>0b10: Pattern #C<br>0b11: Pattern #D |
| *Reserved* | 1 bit | Shall be set to zero |
| } Else { | — | — |
| *Reserved* | 3 bits | Shall be set to zero |
| } | — | — |
| If (Encoding Mode = = 00) { | — | No HARQ |
| **DIUC** | 4 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00: No repetition<br>0b01: Repetition of 2<br>0b10: Repetition of 4<br>0b11: Repetition of 6 |
| *Reserved* | 2 bits | Shall be set to zero. |
| } | — | — |
| If (Encoding Mode = = 01) { | — | HARQ Chase Combining |
| If (ACKCH Allocation) { | — | — |
| **ACK CH Index** | 5 bits | — |
| } Else { | — | — |
| *Reserved* | 1 bit | Shall be set to zero |
| } | — | — |
| **DIUC** | 4 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00: No repetition<br>0b01: Repetition of 2<br>0b10: Repetition of 4<br>0b11: Repetition of 6 |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |
| } | — | — |
| If (Encoding Mode = = 10) { | — | HARQ Incremental Redundancy |
| If (ACKCH Allocation) { | — | — |
| **ACK CH Index** | 5 bits | See DL Ack channel index in 8.4.5.4.24 |
| } Else { | — | — |
| *Reserved* | 1 bit | Shall be set to zero. |
| } | — | — |
| **$N_{EP}$** | 4 bits | — |

**Table 286y—AAS_SDMA_DL_IE *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **$N_{SCH}$** | 4 bits | Indicator for the number of first slots used for data encoding in this SDMA allocation region |
| **SPID** | 2 bits | — |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |
| } | — | — |
| If (Encoding Mode = = 11) { | — | HARQ Conv. Code Incremental Redundancy |
| If (ACKCH Allocation) { | — | — |
| **ACK CH Index** | 5 bits | See DL Ack channel index in 8.4.5.4.24 |
| *Reserved* | 2 bits | Shall be set to zero. |
| } Else { | — | — |
| *Reserved* | 3 bits | Shall be set to zero |
| } | — | — |
| **DIUC** | 4 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00: No repetition<br>0b01: Repetition of 2<br>0b10: Repetition of 4<br>0b11: Repetition of 6 |
| **SPID** | 2 bits | — |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |
| } | — | — |
| If (CQICH Allocation Included) { | — | — |
| **Allocation Index** | 6 bits | Index to the channel in a frame the CQI report should be transmitted by the SS |
| **Period (p)** | 3 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS in every $2^p$ frames |
| **Frame offset** | 3 bits | The MS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the MS should start reporting in eight frames |
| **Duration (d)** | 4 bits | A CQI feedback is transmitted on the CQI channels indexed by the (CQI Channel Index) by the SS for $2^{(d-1)}$ frames. If d is 0b0000, the CQICH is de-allocated. If d is 0b1111, the MS should report until the BS command for the MS to stop. |
| } | — | — |
| } | — | End of User loop |
| } | — | End of Burst Region Loop |
| **Padding** | *variable* | — |
| } | — | — |

In an AAS zone with PUSC permutation, all AAS_SDMA_DL_IEs that define allocations in a given major group shall contain the same value for the 'Number of users' field. In AAS zone with PUSC, user #*n* uses the pilot pattern as defined for antenna #*n* in 8.4.8.

***Insert a new subclause 8.4.5.3.27:***

### 8.4.5.3.27 PUSC ASCA Allocation

In the DL-MAP, a BS may transmit DIUC = 15 with the PUSC_ASCA_IE() to indicate that data is transmitted to a PUSC-ASCA supporting MS using the PUSC-ASCA permutation.(See Table 286z.)

Table 286z—PUSC ASCA Allocation

| Syntax | Size | Notes |
|---|---|---|
| PUSC_ASCA_Alloc_IE { | — | — |
| **Extended DIUC** | 4 bits | — |
| **Length** | 4 bits | Length = 0x06 |
| **DIUC** | 4 bits | — |
| **Short Basic CID** | 12 bits | 12 least significant bits of the Basic CID |
| **OFDMA Symbol offset** | 8 bits | — |
| **Subchannel offset** | 6 bits | — |
| **No. OFDMA Symbols** | 7 bits | — |
| **No. Subchannels** | 6 bits | — |
| **Repetition Coding Information** | 2 bits | 0b00 = No repetition coding<br>0b01 = Repetition coding of 2 used<br>0b10 = Repetition coding of 4 used<br>0b11 = Repetition coding of 6 used |
| **Permutation ID** | 4 bits | — |
| *Reserved* | 7 bits | Shall be set to zero. |
| } | — | — |

**DIUC**
DIUC used for the burst.

**Short Basic CID**
12 least significant bits of the Basic CID.

**OFDMA Symbol offset**
The offset of the OFDMA symbol in which the burst starts, measured in OFDMA symbols from beginning of the downlink frame in which the DL-MAP is transmitted.

**Subchannel offset**
The lowest index OFDMA subchannel used for carrying the burst, starting from subchannel 0.

**No. OFDMA Symbols**
The number of OFDMA symbols that are used (fully or partially) to carry the downlink PHY Burst.

**No. of subchannels**
The number of subchannels with subsequent indexes, used to carry the burst.

**Repetition coding Indication**
Indicates the repetition code used inside the allocated burst.

**Permutation ID**
Identifies the PUSC ASCA permutation used to carry the burst.

### 8.4.5.4 UL-MAP IE format

***Change 8.4.5.4 as indicated:***

The OFDMA UL-MAP IE defines uplink bandwidth allocations. Uplink bandwidth allocations are specified either as block allocations (subchannel by symbol) with an absolute offset, or as an allocation with duration in slots with either a relative or absolute slot offset. Block allocations are used for fast feedback (UIUC=0), CDMA ranging and BW request allocations (UIUC=12) as well as PAPR/Safety zone allocations (UIUC=13). Slot allocations are used for all other UL bandwidth allocations. For UL allocations in non-AAS zones, the starting position for the allocation is determined considering the prior allocations appearing in the UL-MAP. For UL allocations in an AAS UL Zone, the starting position is included in the UL IE indicating an absolute slot offset from the beginning of the AAS zone. If an OFDMA UL-MAP IE with UIUC = 0 or UIUC = 12 or UIUC = 13 exists, they ~~must be~~ shall always be allocated first.

For the ~~T~~the first OFDMA UL-MAP IE, with UIUC other than 0, 12 or 13, the allocation shall start at the lowest numbered non-allocated subchannel on the first non-allocated OFDMA symbol defined by the allocation start time field of the UL-MAP message that is not allocated with UIUC = 0 or UIUC = 12 or UIUC = 13 (See Figure 217 for an example). These IEs shall represent the number of slots provided for the allocation. For allocations not in an AAS zone, ~~E~~each allocation IE shall start immediately following the previous allocation and shall advance in the time ~~domain~~axis. If the end of the UL ~~frame~~ zone has been reached, the allocation shall continue at the next subchannel at first OFDMA symbol ~~(define by the allocation start time field)~~allocated to that zone that is not allocated with UIUC = 0 or UIUC = 12 or UIUC = 13. The CID represents the assignment of the IE to either a unicast, multicast, or broadcast address. A UIUC shall be used to define the type of uplink access and the burst type associated with that access. A Burst Descriptor shall be specified in the UCD for each UIUC to be used in the UL-MAP. For further details on allocations in an UL AAS zone, see 8.4.4.6.

The format of the UL-MAP IE is defined in Table 287.

***Change Table 287 and the text that follows as indicated:***

**Table 287—OFDMA UL-MAP IE format**

| Syntax | Size | Notes |
|---|---|---|
| UL-MAP_IE() { | — | — |
| **CID** | 16 bits | — |
| **UIUC** | 4 bits | — |
| if (UIUC == 11) { | | |
| **Extended UIUC 2 dependent IE** | *variable* | See 8.4.5.4.4.2 |
| } | | |
| elseif (UIUC == 12) { | — | — |
| **OFDMA symbol offset** | 8 bits | — |
| **Subchannel offset** | 7 bits | — |
| **No. OFDMA symbols** | 7 bits | — |
| **No. subchannels** | 7 bits | — |

### Table 287—OFDMA UL-MAP IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Ranging method** | 2 bits | 0b00 – Initial Ranging/Handover Ranging over two symbols<br>0b01 – Initial Ranging/Handover Ranging over four symbols<br>0b10 – BW Request/Periodic Ranging over one symbol<br>0b11– BW Request/Periodic Ranging over three symbols |
| ~~*Reserved*~~Dedicated ranging indicator | 1 bit | ~~shall be set to zero~~<br>0: the OFDMA region and Ranging Method defined are used for the purpose of normal ranging<br>1: the OFDMA region and Ranging Method defined are used for the purpose of ranging using dedicated CDMA code and transmission opportunities assigned in the MOB_PAG-ADV message or in the MOB_SCN-RSP message. |
| } else if (UIUC == 13) { | — | — |
| **PAPR_Reduction_and_Safety_Zone_Allocation_IE** | 32 bits | — |
| } else if (UIUC == 14) { | — | — |
| **CDMA_Allocation_IE()** | 32 bits | — |
| } else if (UIUC == 15) { | — | — |
| **Extended UIUC dependent IE** | *variable* | See subclauses following 8.4.5.4.3 |
| } else if (UIUC == 0) { | — | — |
| **FAST-FEEDBACK_Allocation_IE()** | 32 bits | — |
| } else { | — | — |
| **Duration** | 10 bits | In OFDMA slots (see 8.4.3.1) |
| **Repetition coding indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| if (AAS or AMC UL Zone) { | — | AAS/AMC Allocations include absolute slot offset. |
| **Slot offset** | 12 bits | Offset from start of the AAS or AMC zone for this allocation, specified in slots. |
| } | — | — |
| } | — | — |
| ~~Padding nibble, if needed~~ | ~~4 bits~~ | ~~Completing to nearest byte, shall be set to 0.~~ |
| } | — | — |

**CID**

Represents the ~~assignment of the IE~~SS to which the IE is assigned.

**UIUC**

UIUC used for the burst.

**OFDMA ~~S~~symbol offset**
The offset of the OFDMA symbol in which the burst starts, the offset value is defined in units of OFDMA symbols and is relevant to the Allocation Start Time field given in the UL-MAP message.

**Subchannel offset**
The lowest index subchannel used for carrying the burst, starting from subchannel 0. ~~When allocation of mini-subchannels is used, this offset will always be even numbered and will point to the first subchannel of the couple splitted into mini-subchannels and used in the allocation.~~

**No. OFDMA ~~S~~symbols**
The number of OFDMA symbols that are used to carry the uplink Burst.

**No. subchannels**
The number of subchannels with subsequent indices.

**Duration**
Indicates the duration, in units of OFDMA slots, of the allocation.

**Repetition coding indication**
Indicates the repetition code used inside the allocated burst. Repetition shall be used only for UIUC indicating QPSK modulation.

When a ranging allocation (UIUC = 12) is present in the UL-MAP, and the SS is in ranging backoff state, it shall count the ranging opportunities present in the ranging region. Only ranging allocations allocated in permutation zones supported by the SS, and matching the type of backoff the SS (ranging or BW request) shall be considered as containing relevant ranging opportunities.

The subchannel offsets in all formats of UL-MAP_IE are referred to logical subchannels before applying the mapping indicated by UL subchannels bitmap in UCD and rotation scheme (see 8.4.6.2.6) for the uplink.

For Sub-UL-DL-MAPs, the current UL zone is automatically reset to the first UL zone at the beginning of a new Sub-MAP. The current UL zone is thereafter updated whenever an UL-MAP IE contains an explicit OFDMA symbol offset.

***Change the title of 8.4.5.4.1 as indicated:***

#### 8.4.5.4.1 UIUC ~~A~~allocation

***Change the second sentence of the first paragraph as indicated:***

~~These tones~~ The data subcarriers within these subchannels may be used by all SSs to reduce PAPR of their transmissions.

***Change Table 288 as indicated:***

Table 288—OFDMA UIUC values

| UIUC | Usage |
|---|---|
| 0 | FAST-FEEDBACK Channel |
| 1–10 | Different burst profiles (Data Grant Burst Type) |
| 11 | ~~End of Map IE~~Extended UIUC 2 IE |
| 12 | CDMA Bandwidth Request, CDMA Ranging |
| 13 | PAPR reduction allocation, Safety zone |
| 14 | CDMA Allocation IE |
| 15 | Extended UIUC |

***Insert the following sentence at the beginning of the paragraph below Table 288:***

The UIUC=0 is used for allocation of FAST-FEEDBACK channel region. There shall not be more than one UL-MAP_IE with UIUC = 0 for a UL frame.

***Change the last paragraph from Note style to normative text style.***

***Change subclause 8.4.5.4.2 title as indicated:***

### 8.4.5.4.2 PAPR reduction/Safety zone/Sounding zone allocation IE

***Change Table 289 as indicated:***

**Table 289—PAPR reduction, ~~and~~ safety zone, and sounding zone allocation IE format**

| Syntax | Size | Notes |
|---|---|---|
| PAPR_Reduction_~~and_~~Safty_Sounding_Zone_Allocation_IE() { | — | — |
| **OFDMA symbol offset** | 8 bits | — |
| **Subchannel offset** | 7 bits | — |
| **No. OFDMA symbols** | 7 bits | — |
| **No. subchannels** | 7 bits | — |
| **PAPR Reduction/Safety Zone** | 1 bit | 0 = PAPR reduction allocation<br>1 = Safety zone allocation |
| **Sounding Zone** | 1 bit | 0 = PAPR/Safety Zone<br>1 = Sounding Zone Allocation |
| *Reserved* | ~~2~~1 bit | Shall be set to zero |
| } | — | — |

***Change the fields descriptions below Table 289:***

**OFDMA ~~S~~symbol offset**
The offset of the OFDMA symbol in which the ~~burst~~PAPR-reduction/safety-zone starts, the offset value is defined in units of OFDMA symbols and is relevant to the Allocation Start Time field given in the UL-MAP message.

**Subchannel offset**
The lowest index subchannel that are used for ~~carrying~~ the ~~burst~~PAPR-reduction/safety-zone, starting from subchannel 0.

**No. OFDMA ~~S~~symbols**
The number of OFDMA symbols that are used ~~to carry~~for the uplink ~~Burst~~PAPR-reduction/safety-zone.

**Number of subchannels**
The number of subchannels with subsequent indexes that are used ~~to carry~~for the ~~burst~~PAPR-reduction/safety-zone.

#### 8.4.5.4.3 CDMA allocation UL-MAP IE format

***Change Table 290 as indicated:***

**Table 290—CDMA Allocation IE format**

| Syntax | Size | Notes |
|---|---|---|
| CDMA_Allocation_IE() { | | |
| **Duration** | 6 bits | |
| **UIUC** | 4 bits | UIUC for transmission |
| **Repetition Coding Indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| **Frame Number Index** | 4 bits | LSBs of relevant frame number |
| **Ranging Code** | 8 bits | |
| **Ranging Symbol** | 8 bits | |
| **Ranging subchannel** | 7 bits | |
| **BW request mandatory** | 1 bit | 1= yes, 0= no |
| } | | |

***Insert the following text below Table 290:***

**Frame Number Index**
Identifies the frame in which the CDMA code, which this message responds to, was transmitted. The four least significant bits of the frame number are used as the frame number index.

#### 8.4.5.4.4 UL-MAP extended IE format

***Insert new subclause 8.4.5.4.4.1, containing the text currently in 8.4.5.4.4.***

#### 8.4.5.4.4.1 UL-MAP extended IE format

***Insert the following text and table at the end of the new 8.4.5.4.4.1:***

Table 290a defined the encoding for Extended UIUC that shall be used by UL-MAP extended IEs.

**Table 290a—Extended UIUC Code Assignment for UIUC=15**

| Extended UIUC (hexadecimal) | Usage |
|---|---|
| 00 | Power_control_IE |
| 01 | Mini-subchannel_allocation_IE |
| 02 | AAS_UL_IE |
| 03 | CQICH_Alloc_IE |
| 04 | UL Zone IE |
| 05 | PHYMOD_UL_IE |
| 06 | MIMO_UL_Basic_IE |
| 07 | UL-MAP_Fast_Tracking_IE |
| 08 | UL_PUSC_Burst_Allocation_in_Other_Segment_IE |
| 09 | Fast_Ranging_IE |
| 0A | UL Allocation Start IE |
| 0B … 0F | *Reserved* |

***Insert new subclause 8.4.5.4.4.2:***

### 8.4.5.4.4.2 UL-MAP extended-2 IE format

A UL-MAP IE entry with a UIUC value of 11, indicates that the IE carries special information and conforms to the structure shown in Table 290b. A station shall ignore an extended-2 IE entry with an extended-2 UIUC value for which the station has no knowledge. In the case of a known extended-2 UIUC value but with a length field longer than expected, the station shall process information up to the known length and ignore the remainder of the IE.

**Table 290b—UL-MAP extended-2 IE format**

| Syntax | Size | Note |
|---|---|---|
| UL_extended-2_IE() { | — | — |
| **Extended-2 UIUC** | 4 bits | 0x00 … 0x0F |
| **Length** | 8 bits | Length in bytes of Unspecified data field |
| **Unspecified Data** | *variable* | — |
| } | — | — |

Table 290c defines the encoding for Extended-2 UIUC that shall be used by UL-MAP extended-2 IEs.

**Table 290c—Extended-2 UIUC Code Assignment for UIUC=11**

| Extended-2 Type (hexadecimal) | Usage |
|---|---|
| 00 | CQICH_Enhanced Allocation_IE |
| 01 | HO_Anchor_Active_UL-MAP_IE |
| 02 | HO_Active Anchor UL MAP |
| 03 | Anchor_BS_switch_IE |
| 04 | UL_sounding_command_IE |
| 05 | *Reserved* |
| 06 | MIMO UL Enhanced IE |
| 07 | HARQ UL MAP IE |
| 08 | HARQ ACKCH Region Allocation IE |
| 09 …0D | *Reserved* |
| 0E | AAS_SDMA_UL_IE |
| 0F | Feedback_polling_IE |

### 8.4.5.4.5 Power Control IE format

***Change Table 292 as indicated:***

**Table 292—OFDMA Power Control IE**

| Syntax | Size | Notes |
|---|---|---|
| Power_Control_IE() { | | |
| **Extended UIUC** | 4 bits | Fast power control = 0x00 |
| **Length** | 4 bits | Length = 0x0~~1~~2 |
| **Power control** | 8 bits | Signed integer, which expresses the change in power level (in 0.25 dB units) that the SS should apply to correct its current transmission power. |
| **Power measurement frame** | 8 bits | |
| } | | |

***Insert the following text below Table 292:***

**Power measurement frame**
The 8 LSB of the frame number in which the BS measured the power corrections referred to in the message.

*Change the title of 8.4.5.4.6 as indicated:*

### 8.4.5.4.6 AAS uplink IE format

*Change the subclause as indicated:*

Within a frame, the switch from non-AAS to AAS-enabled traffic is marked by using the extended UIUC = 15 with the AAS_UL_IE() to indicate that the subsequent allocation ~~until the end of the frame~~ shall be for AAS traffic. The AAS_UL_IE defines a UL AAS Zone that spans continuous OFDMA symbols of length defined by the AAS zone length field. Multiple UL AAS Zones can exist within the same frame. When used, the CID in the UL-MAP_IE() shall be set to the broadcast CID. All UL bursts in the AAS portion of the frame may be preceded by an AAS preamble based on the indication in the AAS_UL_IE(). The preamble is defined in ~~8.4.9.4.3.1~~8.4.4.6.4.2.

**Table 293—OFDMA ~~uplink~~ AAS uplink IE**

| Syntax | Size | Notes |
|---|---|---|
| AAS_UL_IE() { | | |
| **Extended UIUC** | 4 bits | AAS = 0x02 |
| **Length** | 4 bits | Length = 0x0~~3~~4 |
| **Permutation** | 2 bits | 0b00 = PUSC permutation<br>0b01 = Optional PUSC permutation<br>0b10 = adjacent-subcarrier permutation<br>0b11 = *Reserved* |
| **UL_PermBase** | 7 bits | |
| **OFDMA symbol offset** | 8 bits | |
| **AAS zone length** | 8 bits | Number of OFDMA symbols in AAS zone |
| ~~**Preamble indication**~~<br>**Uplink_preamble_config** | 2 bits | ~~0b00 = No preamble~~<br>~~0b01 = Preamble used~~<br>~~0b10-0b11 = *Reserved*~~<br>0b00 - 0 symbols<br>0b01 - 1 symbols<br>0b10 - 2 symbols<br>0b11 - 3 symbols |
| **Preamble type** | 1 bit | 0 – Frequency shifted preamble is used in this UL AAS zone<br>1 – Time shifted preamble is used in this UL AAS zone |
| ~~**First bin index**~~ | ~~6 bits~~ | ~~When Permutation = 0b10, this indicates the index of the first band allocated to this AMC segment~~ |
| ~~**Last bin index**~~ | ~~6 bits~~ | ~~When Permutation = 0b10, this indicates the index of the last band allocated to this AMC segment~~ |
| *Reserved* | 4 bits | Shall be set to zero |
| } | | |

**Permutation**
Defines the permutation used within the UL AAS Zone
**UL_PermBase**
Permutation Base for specified UL AAS Zone

**OFDMA Symbol offset**
The symbol offset of the UL AAS Zone. This is referenced to the 'Allocation Start Time' field in the UL-MAP.
**Uplink_preamble_config**
Defines the number of UL AAS preambles to be used before each UL burst in the AAS Zone.

Following AAS_IE indicating AMC permutation, the AMC type shall be 2x3 (2 bins by 3 symbols).

### 8.4.5.4.7 UL Zone switch IE format

***Change the first paragraph as indicated:***

In the UL-MAP, a BS may transmit UIUC = 15 with the UL_ZONE_IE() to indicate that the subsequent allocations shall use a specific permutation. UL_Zone_IE() may appear ahead of all uplink allocation IE and indicate the permutation of the first and the following slots. If UL_Zone_IE() does not appear ahead of all uplink allocation IEs, t~~T~~he uplink frame shall start in PUSC mode with UL_~~IDcell~~PermBase as indicated in the UCD message. Allocations subsequent to this IE shall use the permutation it instructs. No burst allocation or ranging channel allocation shall span multiple zones.

***Change Table 294 as indicated:***

**Table 294—OFDMA uplink ZONE IE format**

| Syntax | Size | Notes |
|---|---|---|
| UL_ZONE_IE() { | | |
| **Extended ~~D~~UIUC** | 4 bits | UL_ZONE = 0x04 |
| **Length** | 4 bits | Length = 0x03 |
| **OFDMA symbol offset** | 7 bits | |
| **Permutation** | 2 bits | 0b00 = PUSC permutation<br>~~0b01 = PUSC permutation~~<br>~~0b10 = Optional PUSC permutation~~<br>0b01 = Optional PUSC permutation<br>0b~~11~~10 = Adjacent subcarrier permutation<br>0b11 = *Reserved* |
| **~~PUSC~~ UL_~~IDcell~~PermBase** | 7 bits | |
| **AMC type** | 2 bits | Indicates the AMC type in case permutation type = 0b10, otherwise shall be set to 0.<br>AMC type (NxM = N bins by M symbols):<br>0b00 - 1x6<br>0b01 - 2x3<br>0b10 - 3x2<br>0b11 - Reserved |
| **Use All SC indicator** | 1 bit | 0 = Do not use all subchannels<br>1 = Use all subchannels |
| *Reserved* | 5 bits | Shall be set to zero |
| } | | |

***Insert the following at the end of 8.4.5.4.7***

This IE should not be used within SUB-DL-UL-MAP.

***Change the definition of 'Permutation' field below Table 294 as indicated:***

**Permutation**

Indicates the permutation that shall be used by the transmitter for allocations following this IE. Permutation changes are only allowed on a zone boundary. The UL_~~IDcell~~PermBase indicated by the IE shall be used as the basis of the permutation (see 8.4.6.2.2, 8.4.6.2.3).

***Insert the following text after the end of Table 294:***

**Use all SC indicator**

When the 'Use All SC indicator' is set to 0, subchannels indicated by allocated subchannel bitmap in UCD shall be used. Otherwise, all subchannels shall be used.

### 8.4.5.4.8 Mini-subchannel allocation IE

***Change Table 295 as indicated:***

**Table 295—Mini-subchannel allocation IE format**

| Syntax | Size | Notes |
|---|---|---|
| Mini_subchannel_allocation_IE() { | | |
| **Extended ~~D~~UIUC** | 4 bits | Mini_subchannel_allocation = 0x01 |
| **Length** | 4 bits | Length(M) = 0x0~~3~~7 if *M*=2<br>0x0~~4~~9 if *M*=3<br>0x0~~6~~f if *M*=6 |
| **CType** | 2 bits | 0b00 – 2 mini-subchannels (defines *M*=2)<br>0b01 – 2 mini-subchannels (defines *M*=2)<br>0b10 – 3 mini-subchannels (defines *M*=3)<br>0b11 – 6 mini-subchannels (defines *M*=6) |
| **Duration** | ~~10~~6 bits | In OFDMA slots |
| For (*j*=0; *j*<*M*; *j*++) { | | |
| **CID(*j*)** | 16 bits | |
| **UIUC(*j*)** | 4 bits | Allowed values are 1–10 |
| **Repetition(*j*)** | 2 bits | Indicates the repetition code used inside the allocated burst for minisubchannel with index *j*<br>0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used<br><br>Repetition shall be used only for M=2 or M=3 |
| } | | |
| **Padding** | *n* bits | Padding bits shall be set to zero<br>*n* = 0 if *M*=2<br>~~2~~4 if *M*=3<br>0 if *M*=6 |
| } | | |

### 8.4.5.4.9 FAST-FEEDBACK message mapping

***Change the subclause as indicated:***

Each FAST-FEEDBACK message occupies one UL slot. FAST-FEEDBACK messages are mapped in to the region marked by UIUC=0 in the UL-MAP, in a ~~time~~frequency-first order, as shown in Figure 230.

***Replace Figure 230 with the following figure:***

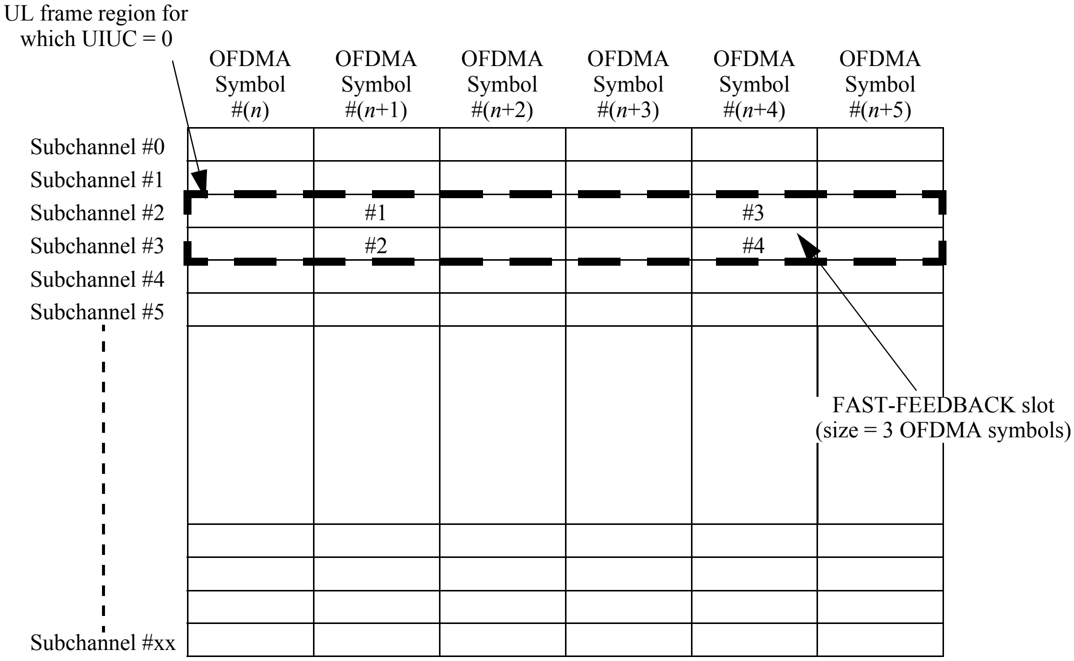

UL frame region for which UIUC = 0
OFDMA Symbol #(n)
OFDMA Symbol #(n+1)
OFDMA Symbol #(n+2)
OFDMA Symbol #(n+3)
OFDMA Symbol #(n+4)
OFDMA Symbol #(n+5)
Subchannel #0
Subchannel #1
Subchannel #2
Subchannel #3
Subchannel #4
Subchannel #5
Subchannel #xx
#1
#2
#3
#4
FAST-FEEDBACK slot (size = 3 OFDMA symbols)

**Figure 230—Mapping order of FAST-FEEDBACK messages to the FAST-FEEDBACK region**

***Insert the following text at the end of the subclause:***

The FAST-FEEDBACK region shall be allocated using the FAST-FEEDBACK allocation IE as defined in Table 295a.

**Table 295a—FAST-FEEDBACK allocation IE format**

| Syntax | Size | Notes |
|---|---|---|
| FASTFEEDBACK_allocation_IE() { | | |
| **OFDMA symbol offset** | 8 bits | |
| **Subchannel offset** | 7 bits | |
| **No. OFDMA symbols** | 7 bits | |
| **No subchannels** | 7 bits | |
| *Reserved* | 3 bits | |
| } | | |

***Change the title of 8.4.5.4.10 as indicated:***

### 8.4.5.4.10 ~~FAST_FEEDBACK~~ Fast-feedback channels

***Change the second sentence of the first paragraph as indicated:***

The allocations are done in unicast manner through the FAST_FEEDBACK MAC subheader (see 6.3.2.2.6), CQICH Control IE (see 6.3.2.3.43.5) or CQICH Allocation IE (see 8.4.5.4.12), and the transmission takes place in a specific UL region designated by UIUC = 0.

***Change the paragraph below Table 296 as indicated:***

The fast-feedback code words used in Table 296 belong to a set of orthogonal vectors and are mapped directly to the data subcarriers of a tile in frequency first order starting from the first OFDMA symbol ~~(see 8.4.9.4.2), where subcarriers(0) is the lowest numbered data subcarrier in the tile,~~ and the tile indices are defined in Equation (113) for PUSC and Equation (115) for optional PUSC ~~by the permutation (see 8.4.6.2)~~. The vectors are defined in Table 297.

***Replace Equation (106) with the following equation:***

$$\begin{aligned} P0 &= \exp\left(j \cdot \frac{\pi}{4}\right) \\ P1 &= \exp\left(j \cdot \frac{3\pi}{4}\right) \\ P2 &= \exp\left(-j \cdot \frac{3\pi}{4}\right) \\ P3 &= \exp\left(-j \cdot \frac{\pi}{4}\right) \end{aligned} \tag{106}$$

***Change the last paragraph as indicated:***

The fast feedback slot includes 4 bits of payload data, whose encoding depended on the instruction given in the FAST_FEEDBACK subheader, CQICH Control IE and CQICH Allocation IE. The following subclauses define these encodings.

### 8.4.5.4.10.1 Fast DL measurement feedback

***Insert the following text at the beginning of subclause 8.4.5.4.10.1:***

MIMO capable MS shall measure post processing CINR for each individual layers as shown in Figure 230a.When the FAST_FEEDBACK subheader Feedback Type field is “00”, the MS shall report the post processing average CINR (Avg_CINR) as defined in Equation (106a). When BS requests MS feedback through CQICH_Alloc_IE() or CQICH_Enhanced_Alloc_IE() with ‘00’ feedback_type field, MS shall report Avg_CINR or individual layer CINR as described in 8.4.5.4.12 and 8.4.5.4.16.

For vertically encoded MIMO system, defined the averaged CINR (Avg_CINR) as :

$$Avg\_CINR = e^{C(d,y|H)} - 1 \tag{106a}$$

where $C(d,y|H)$ is the receiver-constrained mutual information conditioned on knowing the channel knowledge. Note that $d$ is the transmitted signal, $y$ is the post-processing receive signal and $H$ is the channel matrix between transmit and receive antennas. For LMMSE receiver, the individual post-detector-processing signal to noise ratios are given as $\mathrm{CINR}_1, \ldots, \mathrm{CINR}_N$, as shown in Figure 230a and in Equation (106b).

$$C(d, y|H) = \frac{1}{N}\sum_{n=1}^{N}\log(1 + CINR_n) \tag{106b}$$

In this case,

$$Avg\_CINR = \left(\prod_{n=1}^{N}(1 + CINR_n)\right)^{1/N} - 1\,, \tag{106c}$$

when the individual post-detector processing CINR is high, the average CINR is

$$Avg\_CINR \approx \frac{1}{N}\sum_{n=1}^{N} CINR_n \text{ (in dB)} \tag{106d}$$

For ML MIMO detectors case,

$$C(d, y|H) = \frac{1}{N}\log det(I_N + H^H R^{-1} H) \tag{106e}$$

where

$I_N$ is an $N$ by $N$ identity matrix,
$R$ is the correlation matrix of interference plus noise measured at MS.

***Change 8.4.5.4.10.1 as indicated:***

~~When the FAST_FEEDBACK subheader Feedback Type field is “00” the SS shall report the S/N it measures on the DL. Equation (107) shall be used:~~

~~Payload bits nibble $= \begin{cases} 0, & S/N < -2dB \\ n, & 2 \cdot n - 4 < S/N < 2 \cdot n - 2, \quad 0 < n < 15 \\ 15, & S/N > 26dB \end{cases}$ (107)~~

When the Feedback_type field in CQICH_Enhanced_Alloc_IE() is 0b000 with CQICH type 0b101, Equation (107) shall be used:

$$\text{Payload bits nibble} = \begin{cases} 0, & S/N \le 1 - B \\ n, & (2n - 1 - B) < S/N \le (2n + 1 - B), \quad 0 < n < 15 \\ 15, & S/N > 29 - B \end{cases} \tag{107}$$

where B is the positive integer value indicated in the SN Reporting Base TLV (see 11.7.26). B shall default to “3” if the SN Reporting Base TLV was not included in the REG-RSP.

***Insert the following at the end of 8.4.5.4.10.1:***

For an MS that supports the feedback method by using Feedback header, if *M* is defined as the indication flag in UCD, the MS shall set the payload bits nibble as *M-1* instead of *M*, if the outcome of payload bits nibble calculation based on Equation (107) is *M.*

For band AMC operation, the SS shall report differential of CINR of four selected bands (increment: 1 and decrement: 0 with a step of 1 dB) on its fast-feedback channel.

MIMO capable SS shall measure post processing CINR for each individual layers as shown in Figure 230a. The SS shall report the post processing CINR averaged over layers. When the BS requests SS feedback through CQICH_Alloc_IE() SS shall report average CINR or individual layer CINR as described in 8.4.5.4.12. The layer is defined as a separate coding/modulation path.

***Insert new Figure 230a:***

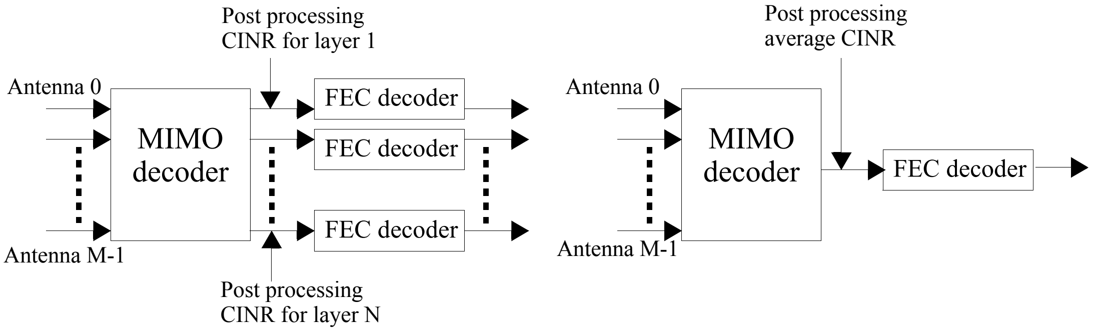


**Figure 230a—Post processed CINR for MIMO region**

For SS with more than one receive antennas, Equation (107a) shall be used:

$$\text{Payload bits Nibble} = \begin{cases} 0 & CINR < (-2 - \Delta dB) \\ n & 2n - 2 - \Delta dB < CINR < (2n - 2 - \Delta dB) \qquad 0 < n < 15 \\ 15 & CINR > 26 - \Delta dB \end{cases} \tag{107a}$$

where

$\Delta$ = 10 log (*Nr*) for the cases of single transmit antenna BS or 2 and 4 transmit antenna BS using matrix A transmission format,
$\Delta$ = 10 log (*Nr*/2) for the case of 2 and 4 transmit antennas BS using matrix B transmission format. *Nr* is the number of receive antennas.

### 8.4.5.4.10.2 Fast MIMO feedback

***Insert the following text at the end of 8.4.5.4.10.2:***

When CQI Feedback Type field in CQICH_Enhanced_Alloc_IE() (see 8.4.5.4.15) is 0b011 and CQICH type is 0b101, the MS shall report the MIMO coefficient the BS should use for best DL reception. The mapping for the complex weights is shown in Figure 231. For this type of feedback, if *N* is the number of BS transmit antennas, then (*N*–1) CQICH shall be allocated to the MS and MS shall report the desired antenna weights of antenna 1 through *N*–1 based on antenna 0.

### 8.4.5.4.10.3 Mode Selection Feedback

***Change the first sentence of the first paragraph as indicated:***

For an SS that supports the STC option (see 8.4.8), ~~W~~when the FAST-FEEDBACK subheader Feedback Type field is “11” or at a specific frame indicated in the CQICH_Alloc_IE(), the SS shall send its selection in terms of MIMO mode (STTD versus SM) or permutation mode on the assigned FAST-FEEDBACK channel.

***Change Table 298 as indicated:***

**Table 298—Encoding of payload bits for Fast-feedback slot**

| Value (binary) | Description |
|---|---|
| 0b0000 | STTD and PUSC/FUSC permutation |
| 0b0001 | STTD and adjacent-subcarrier permutation |
| 0b0010 | SM and PUSC/FUSC permutation |
| 0b0011 | SM and adjacent-subcarrier permutation |
| 0b0100 | Closed-loop SM and PUSC/FUSC permutation |
| 0b0101 | Closed-loop SM and adjacent-subcarrier permutation |
| 0b0110 | Closed-loop SM + Beamforming and adjacent-subcarrier permutation |
| 0b0111 | Antenna Group A1 for rate 1<br>For 3-antenna BS, See 8.4.8.3.4.1<br>For 4-antenna BS, See 8.4.8.3.5.1 |
| 0b1000 | Antenna Group A2 for rate 1 |
| 0b1001 | Antenna Group A3 for rate 1 |
| 0b1010 | Antenna Group B1 for rate 2<br>For 3-antenna BS, see 8.4.8.3.4.2<br>For 4-antenna BS, see 8.4.8.3.5.2 |
| 0b1011 | Antenna Group B2 for rate 2 |
| 0b1100 | Antenna Group B3 for rate 2 |
| 0b1101 | Antenna Group B4 for rate 2 (only for 4-antenna BS) |
| 0b1110 | Antenna Group B5 for rate 2 (only for 4-antenna BS) |
| 0b1111 | Antenna Group B6 for rate 2 (only for 4-antenna BS) |

***Insert new table at the end of 8.4.5.4.10.3:***

**Table 298a—Encoding of payload bits for secondary Fast-feedback slot**

| Value (binary) | Description |
|---|---|
| 0000 | Antenna selection option 0 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 0001 | Antenna selection option 1 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 0010 | Antenna selection option 2 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 0011 | Antenna selection option 3 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 0100 | Antenna selection option 4 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 0101 | Antenna selection option 5 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 0110 | Antenna selection option 6 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 0111 | Antenna selection option 7 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 1000 | Reduced Precoding matrix codebook entry 0 |
| 1001 | Reduced Precoding matrix codebook entry 1 |
| 1010 | Reduced Precoding matrix codebook entry 2 |
| 1011 | Reduced Precoding matrix codebook entry 3 |
| 1100 | Reduced Precoding matrix codebook entry 4 |
| 1101 | Reduced Precoding matrix codebook entry 5 |
| 1110 | Reduced Precoding matrix codebook entry 6 |
| 1111 | Reduced Precoding matrix codebook entry 7 |

***Insert new subclause 8.4.5.4.10.4:***

### 8.4.5.4.10.4 Effective CINR feedback for fast-feedback channel

When the feedback type field in the CQICH_IE() is 0b01 or the effective CINR report is request by REP-REQ, the SS shall report the effective CINR, as defined in 6.3.18, according to Table 298b. To avoid ambiguity, both the BS and the SS must know the FEC type assumed for this report. The FEC type assumed for the MCS column is the first FEC type in the table in 11.8.3.7.2 for which the SS and BS have successfully negotiated the capability exchange. If none of the FEC types in 11.8.3.7.2 have been successfully negotiated, then the mandatory FEC type shall be assumed.

**Table 298b—Effective CINR feedback encoding**

| Label | Encoding | MCS |
|---|---|---|
| 0 | 0b0000 | QPSK 1/2, repetition 6 |
| 1 | 0b0001 | QPSK 1/2, repetition 4 |
| 2 | 0b0010 | QPSK 1/2, repetition 2 |
| 3 | 0b0011 | QPSK 1/2 |

**Table 298b—Effective CINR feedback encoding *(continued)***

| Label | Encoding | MCS |
|---|---|---|
| 4 | 0b0100 | QPSK 3/4 |
| 5 | 0b0101 | 16-QAM 1/2 |
| 6 | 0b0110 | 16-QAM 3/4 |
| 7 | 0b0111 | 64-QAM 1/2 |
| 8 | 0b1000 | 64-QAM 2/3 |
| 9 | 0b1001 | 64-QAM 3/4 |
| 10 | 0b1010 | 64-QAM 5/6 |
| 11 | 0b1011 | A decrease in CQICH duration is recommended (effective CINR has not changed from previous CQICH slot). This encoding shall not be repeated over consecutive CQI slots. |
| 12-15 | 0b1100-0b1111 | *Reserved* |

***Insert new subclause 8.4.5.4.10.5***

### 8.4.5.4.10.5 Enhanced Fast-feedback channels

Enhanced Fast-feedback slots may be individually allocated to an MS for transmission of PHY related information that requires fast response from the MS. The allocations are done either in a unicast manner through the Fast-feedback allocation subheader (see 6.3.2.2.6), or through the CQICH_Control IE() (see 6.3.2.3.43.5), or through the CQICH_Alloc_IE() (see 8.4.5.4.12), or through the CQICH_Enhanced_Alloc_IE() (see 8.4.5.4.16), or through the MIMO Compact DL-MAP IE() (see 6.3.2.3.43.6.7), Dedicated MIMO DL Control IE (8.4.5.3.21.1), AAS_SDMA_DL_IE (8.4.5.4.26). The transmission takes place in a specific UL region designated by UIUC = 0.

Each 3-bit MIMO Fast-feedback slot consists of 1/2 OFDMA slots mapped in a manner similar to the mapping of ACK Channel. An Enhanced Fast-feedback slot uses QPSK modulation on the 24 data subcarriers it contains, and can carry a data payload of 3 bits. Table 298c defines the mapping between the payload bit sequences and the subcarriers modulation.

**Table 298c— 3-bit MIMO Fast-feedback channel subcarrier modulation**

| 3-bit payload (binary) | Fast Feedback vector indices per Tile Even = {Tile(0), Tile(2),Tile(4)} or Odd = {Tile(1), Tile(3),Tile(5)} |
|---|---|
| 000 | 0,0,0 |
| 001 | 1,1,1 |
| 010 | 2,2,2 |
| 011 | 3,3,3 |
| 100 | 4,4,4 |
| 101 | 5,5,5 |
| 110 | 6,6,6 |
| 111 | 7,7,7 |

Each Enhanced Fast-feedback slot consists of 1 OFDMA slots mapped in a manner similar to the mapping of normal uplink data. An Enhanced Fast-feedback slot uses QPSK modulation on the 48 data subcarriers it contains and can carry a data payload of 6 bits. Table 298d defines the mapping between the payload bit sequences and the subcarriers modulation.

### Table 298d—Enhanced Fast-feedback channel subcarrier modulation

| 6-bit Payload (binary) | Fast-feedback vector indices per Tile Tile(0), Tile(1), ... Tile(5) | 6-bit Payload (binary) | Fast-feedback vector indices per Tile Tile(0), Tile(1), ... Tile(5) |
|---|---|---|---|
| 000000 | 0,0,0,0,0,0 | 100000 | 6,7,5,1,2,4 |
| 000001 | 1,1,1,1,1,1 | 100001 | 7,6,4,0,3,5 |
| 000010 | 2,2,2,2,2,2 | 100010 | 4,5,7,3,0,6 |
| 000011 | 3,3,3,3,3,3 | 100011 | 5,4,6,2,1,7 |
| 000100 | 4,4,4,4,4,4 | 100100 | 2,3,1,5,6,0 |
| 000101 | 5,5,5,5,5,5 | 100101 | 3,2,0,4,7,1 |
| 000110 | 6,6,6,6,6,6 | 100110 | 0,1,3,7,4,2 |
| 000111 | 7,7,7,7,7,7 | 100111 | 1,0,2,6,5,3 |
| 001000 | 2,4,3,6,7,5 | 101000 | 7,5,1,2,4,3 |
| 001001 | 3,5,2,7,6,4 | 101001 | 6,4,0,3,5,2 |
| 001010 | 0,6,1,4,5,7 | 101010 | 5,7,3,0,6,1 |
| 001011 | 1,7,0,5,4,6 | 101011 | 4,6,2,1,7,0 |
| 001100 | 6,0,7,2,3,1 | 101100 | 3,1,5,6,0,7 |
| 001101 | 7,1,6,3,2,0 | 101101 | 2,0,4,7,1,6 |
| 001110 | 4,2,5,0,1,3 | 101110 | 1,3,7,4,2,5 |
| 001111 | 5,3,4,1,0,2 | 101111 | 0,2,6,5,3,4 |
| 010000 | 4,3,6,7,5,1 | 110000 | 5,1,2,4,3,6 |
| 010001 | 5,2,7,6,4,0 | 110001 | 4,0,3,5,2,7 |
| 010010 | 6,1,4,5,7,3 | 110010 | 7,3,0,6,1,4 |
| 010011 | 7,0,5,4,6,2 | 110011 | 6,2,1,7,0,5 |
| 010100 | 0,7,2,3,1,5 | 110100 | 1,5,6,0,7,2 |
| 010101 | 1,6,3,2,0,4 | 110101 | 0,4,7,1,6,3 |
| 010110 | 2,5,0,1,3,7 | 110110 | 3,7,4,2,5,0 |
| 010111 | 3,4,1,0,2,6 | 110111 | 2,6,5,3,4,1 |
| 011000 | 3,6,7,5,1,2 | 111000 | 1,2,4,3,6,7 |
| 011001 | 2,7,6,4,0,3 | 111001 | 0,3,5,2,7,6 |
| 011010 | 1,4,5,7,3,0 | 111010 | 3,0,6,1,4,5 |

### Table 298d—Enhanced Fast-feedback channel subcarrier modulation *(continued)*

| 6-bit Payload (binary) | Fast-feedback vector indices per Tile Tile(0), Tile(1), ... Tile(5) | 6-bit Payload (binary) | Fast-feedback vector indices per Tile Tile(0), Tile(1), ... Tile(5) |
|---|---|---|---|
| 011011 | 0,5,4,6,2,1 | 111011 | 2,1,7,0,5,4 |
| 011100 | 7,2,3,1,5,6 | 111100 | 5,6,0,7,2,3 |
| 011101 | 6,3,2,0,4,7 | 111101 | 4,7,1,6,3,2 |
| 011110 | 5,0,1,3,7,4 | 111110 | 7,4,2,5,0,1 |
| 011111 | 4,1,0,2,6,5 | 111111 | 6,5,3,4,1,0 |

The Fast-feedback channel is orthogonally modulated with QPSK symbols. Let $M_{n,8m+k}(0 \le k \le 7)$ be the modulation symbol index of the *k*-th modulation symbol in the *m*-th uplink tile of the *n*-th Fast-feedback channel. The possible modulation patterns composed of $M_{n,m8}$, $M_{n,\,8m+1}$, $\ldots$ $M_{n,8m+7}$ the *m*-th tile of the *n-th* Fast-feedback channel are defined in Table 298e.

### Table 298e—Orthogonal Modulation Index in ~~FAST_FEEDBACK~~ Fast-feedback ~~C~~channel

| Vector index | $M_{n,m8}$, $M_{n,\,8m+1}$, $\ldots$ $M_{n,8m+7}$ |
|---|---|
| 0 | P0, P1, P2, P3, P0, P1, P2, P3 |
| 1 | P0, P3, P2, P1, P0, P3, P2, P1 |
| 2 | P0, P0, P1, P1, P2, P2, P3, P3 |
| 3 | P0, P0, P3, P3, P2, P2, P1, P1 |
| 4 | P0, P0, P0, P0, P0, P0, P0, P0 |
| 5 | P0, P2, P0, P2, P0, P2, P0, P2 |
| 6 | P0, P2, P0, P2, P2, P0, P2, P0 |
| 7 | P0, P2, P2, P0, P2, P0, P0, P2 |

where

$$P0 = \exp\left(j \cdot \frac{\pi}{4}\right)$$

$$P1 = \exp\left(j \cdot \frac{3\pi}{4}\right)$$

$$P2 = \exp\left(-j \cdot \frac{3\pi}{4}\right)$$

$$P3 = \exp\left(-j \cdot \frac{\pi}{4}\right)$$

$M_{n,8m+k}$ is mapped to a Fast-feedback channel tile, as shown in Figure 231a, for PUSC uplink subchannel, and in Figure 231b, for optional PUSC uplink subchannel. A Fast-feedback channel is mapped to one subchannel composed of six tiles.

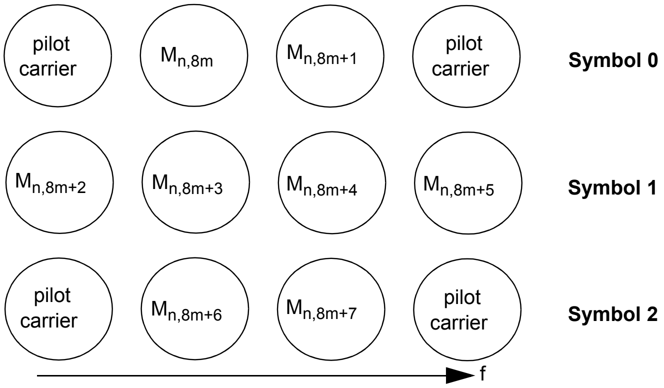

pilot carrier
$M_{n,8m}$
$M_{n,8m+1}$
pilot carrier
Symbol 0
$M_{n,8m+2}$
$M_{n,8m+3}$
$M_{n,8m+4}$
$M_{n,8m+5}$
Symbol 1
pilot carrier
$M_{n,8m+6}$
$M_{n,8m+7}$
pilot carrier
Symbol 2
f

**Figure 231a—Subcarrier mapping of Fast-feedback modulation symbols for PUSC**

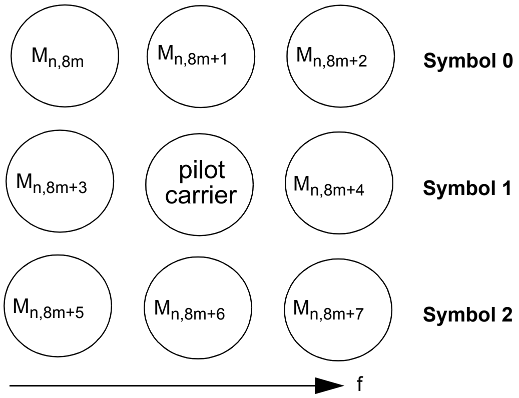

$M_{n,8m}$
$M_{n,8m+1}$
$M_{n,8m+2}$
Symbol 0
$M_{n,8m+3}$
pilot carrier
$M_{n,8m+4}$
Symbol 1
$M_{n,8m+5}$
$M_{n,8m+6}$
$M_{n,8m+7}$
Symbol 2
f

**Figure 231b—Subcarrier mapping of Fast-feedback modulation symbols for optional PUSC**

The Enhanced Fast-feedback slot includes 6 bits of payload data, whose encoding depends on the instruction given in the Fast-feedback subheader, the CQICH_Control IE(), the CQICH_Alloc_IE(), or through the CQICH_Enhanced_Alloc_IE(). The following subclauses define these encodings.

***Insert new subclause 8.4.5.4.10.6:***

### 8.4.5.4.10.6 Fast DL measurement feedback for Enhanced Fast-feedback channel

When the Fast-feedback allocation subheader Feedback Type field is 0b00 or the feedback is requested through CQICH_Alloc_IE (see 8.4.5.4.12), or the Feedback_type field in CQICH_Enhanced_Alloc_IE() is 0b000-0b010 with CQICH type 0b000 or 0b100 (see 8.4.5.4.15), the MS shall report the SNR it measures on the DL. Equation (107b) shall be used.

$$\text{Payload bits} = \begin{cases} 0, & S/N \le -\mathrm{B} \\ n, & (n-1-B) < (S/N) \le (n-B),\ 0 < n < 31 \\ 31, & S/N > 30 - \mathrm{B} \end{cases} \tag{107b}$$

where B is the positive integer value indicated in the SN Reporting Base TLV (see 11.7.26). B shall default to “3” if the SN Reporting Base TLV was not included in the REG-RSP.

For MIMO capable MSs, if the BS allocates a single CQICH to the MS in UL-MAP (CQICH_Num = 0) for the purposes of Fast DL Measurement, the MS shall report the effective post processing SNR Eff_SNR as defined in 8.4.5.4.10.1. Otherwise, if the BS allocate multiple CQICHs to the MS in UL-MAP (CQICH_Num > 0) for the purposes of Fast DL Measurement, the MS shall report post processing S/N of individual layers in order of layer indices.

***Insert new subclause 8.4.5.4.10.7***

#### 8.4.5.4.10.7 Fast MIMO feedback of Quantized Precoding Weight for Enhanced Fast-feedback channel

When the Fast-feedback allocation subheader Feedback Type field is 0b01 or 0b10, or the CQI Type field in the MIMO Compact DL-MAP IE() (see 6.3.2.3.43.6.7) is 0b01, or the Feedback Type field in CQICH_Enhanced_Alloc_IE() (see 8.4.5.4.15) is 0b011 with CQICH type 0b000 or 0b100, the MS shall report the MIMO coefficient the BS should use for best DL reception. The mapping for the complex weights is shown in Figure 231c. For this type of feedback, if *N* is the number of BS transmit antennas, then *(N-1)* CQICH shall be allocated to the SS and SS shall report the desired antenna weights of antenna 1 through *N-1* based on antenna 0.

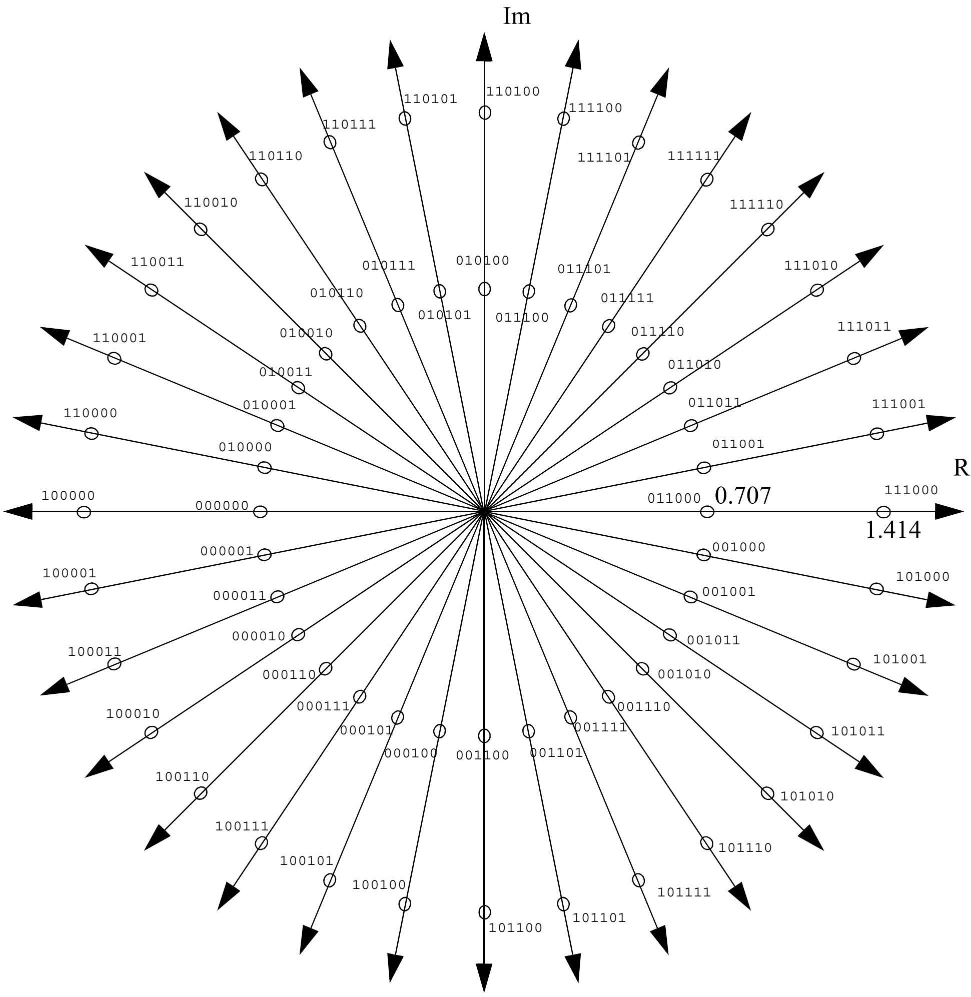

Im
110101
110100
110111
111100
110110
111101
111111
110010
111110
110011
010111
010100
011101
111010
010110
011111
010101
011100
110001
010010
011110
111011
010011
011010
110000
010001
011011
111001
010000
011001
Re
100000
000000
011000
0.707
111000
1.414
001000
000001
100001
101000
000011
001001
000010
001011
100011
101001
000110
001010
100010
000111
001110
000101
001111
101011
000100
001100
001101
100110
101010
100111
101110
100101
101111
100100
101101
101100

**Figure 231c—Mapping of MIMO coefficients for quantized precoding weights for enhanced fast MIMO feedback payload bits**

***Insert new subclause 8.4.5.4.10.8:***

### 8.4.5.4.10.8 MIMO Mode Feedback for Enhanced Fast-feedback channel

When the Enhanced Fast-feedback channel is employed, the SS may report the MIMO mode feedback on the assigned CQICH when the Fast-feedback allocation subheader Feedback Type field is 0b00; or the Feedback Type field in the MIMO Compact DL-MAP IE() (see 6.3.2.3.43.6.7) is 0b000, 0b001, or 0b010; or the Feedback Type field in CQICH_Enhanced_Alloc_IE() (see 8.4.5.4.15) is 0b000, 0b001, or 0b010 with CQICH type 0b000 or 0b100. The encoding of payload bits is shown in Table 298f.

.

### Table 298f—Encoding of payload bits for MIMO Mode Feedback with Enhanced Fast-feedback Channel

| Value (binary) | Description |
|---|---|
| 101000 | STTD and PUSC/FUSC permutation |
| 101001 | STTD and adjacent-subcarrier permutation |
| 101010 | SM and PUSC/FUSC permutation |
| 101011 | SM and adjacent-subcarrier permutation |
| 101100 | Hybrid and PUSC/FUSC permutation |
| 101101 | Hybrid and adjacent-subcarrier permutation |
| 101110–110110 | Interpretation according to Table 298g, Table 298h or Table 298i, depending on if antenna grouping, antenna selection or a reduced precoding matrix codebook is used. |
| 110111 | Closed loop precoding with 1 stream. |
| 111000 | Closed loop precoding with 2 streams. |
| 111001 | Closed loop precoding with 3 streams. |
| 111010 | Closed loop precoding with 4 streams. |
| 111011–111111 | *Reserved* |

**Clarification of streams concept:**

The number of streams is the number of outputs from the space-time code.

### Table 298g—Interpretation of code words 0b101110-0b110110 in Table 298f in the case of using antenna grouping

| Value (binary) 6-bit/3-bit | Description |
|---|---|
| 101110/000 | Antenna Group A1 for rate 1<br>For 3-antenna BS, See 8.4.8.3.4.1<br>For 4-antenna BS, See 8.4.8.3.5.1 |
| 101111/001 | Antenna Group A2 for rate 1 |
| 110000/010 | Antenna Group A3 for rate 1 |
| 110001/000 | Antenna Group B1 for rate 2<br>For 3-antenna BS, See 8.4.8.3.4.2<br>For 4-antenna BS, See 8.4.8.3.5.2 |
| 110010/001 | Antenna Group B2 for rate 2 |
| 110011/010 | Antenna Group B3 for rate 2 |
| 110100/011 | Antenna Group B4 for rate 2 (only for 4-antenna BS) |
| 110101/100 | Antenna Group B5 for rate 2 (only for 4-antenna BS) |
| 110110/101 | Antenna Group B6 for rate 2 (only for 4-antenna BS) |

### Table 298h—Interpretation of code words 0b101110-0b110110 in Table 298f in the case of using antenna selection

| Value (binary) 6-bit/3-bit | Description |
|---|---|
| 101110/000 | Antenna selection option 0 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 101111/001 | Antenna selection option 1 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 110000/010 | Antenna selection option 2 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 110001/011 | Antenna selection option 3 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 110010/100 | Antenna selection option 4 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 110011/101 | Antenna selection option 5 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 110100/110 | Antenna selection option 6 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 110101/111 | Antenna selection option 7 (see Table 316f for 3 Tx and Table 316g for 4Tx) |
| 110110 | *Reserved* |

**Table 298i—Interpretation of code words 0b101110-0b110110 in Table 298f in the case of using reduced precoding matrix codebook**

| Value (binary) 6-bit/3-bit | Description |
|---|---|
| 101110/000 | Reduced Precoding matrix codebook entry 0 |
| 101111/001 | Reduced Precoding matrix codebook entry 1 |
| 110000/010 | Reduced Precoding matrix codebook entry 2 |
| 110001/011 | Reduced Precoding matrix codebook entry 3 |
| 110010/100 | Reduced Precoding matrix codebook entry 4 |
| 110011/101 | Reduced Precoding matrix codebook entry 5 |
| 110100/110 | Reduced Precoding matrix codebook entry 6 |
| 110101/111 | Reduced Precoding matrix codebook entry 7 |
| 110110 | *Reserved* |

***Insert new subclause 8.4.5.4.10.9:***

### 8.4.5.4.10.9 Anchor BS report

The MS may send its Anchor BS selection using the 8 codewords numbered from 32 to 39. Table 298j shows the encoding of payload bits for the Fast-feedback slot (see 8.4.5.4.9).

**Table 298j—Encoding of payload bits for Fast-feedback slot**

| Value (binary) | Description |
|---|---|
| 100000 | Anchor BS for TEMP_BS_ID=0b000 |
| 100001 | Anchor BS for TEMP_BS_ID=0b001 |
| 100010 | Anchor BS for TEMP_BS_ID=0b010 |
| 100011 | Anchor BS for TEMP_BS_ID=0b011 |
| 100100 | Anchor BS for TEMP_BS_ID=0b100 |
| 100101 | Anchor BS for TEMP_BS_ID=0b101 |
| 100110 | Anchor BS for TEMP_BS_ID=0b110 |
| 100111 | Anchor BS for TEMP_BS_ID=0b111 |

Also, the 40th codeword (i.e., 0b101000) is used as an acknowledgement for the Anchor_BS_Switch_IE.

When the 4-by-3 uplink tile structure is used (see 8.4.6.2.1), the number of tiles in a channel, $N$, is 6 and the number of subcarriers in a tile, $L$, is 12. When the 3-by-3 uplink tile structure is used (see 8.4.6.5.1), $N = 6$ and $L = 9$.

When the MS reports the measured S/N, each payload bit is repeated according to the predefined UEP ratio $R_0{:}R_1{:}R_2{:}R_3$, where $R_0$, $R_1$, $R_2$, and $R_3$ represent the repetition number for the first payload bit $b_0$ (MSB), the second payload bit $b_1$, the third payload bit $b_2$, and the fourth payload bit $b_3$ (LSB), respectively. In case of the 4-bit CQI payload, a ratio of $R_0{:}R_1{:}R_2{:}R_3$ = 26:19:14:7 is used for the 4-by-3 uplink tile structure, and $R_0{:}R_1{:}R_2{:}R_3$ = 19:14:10:5 is used for the 3-by-3 uplink tile structure.

The repeated bit sequence is interleaved according to Equation (107c) before binary DPSK modulation.

$$y = ((xR)/N)mod(R) + \lfloor x/N \rfloor, \tag{107c}$$

where

$y$ denotes the bit index in the interleaved bit sequence ($y$ = 0, 1, 2, $c$, $R$-1),
$x$ denotes bit index in the repeated bit sequence ($x$ = 0, 1, 2, $c$, $R$-1).

The length of the repeated bit sequence is $R = R_0 + R_1 + R_2 + R_3 = N(L-1) = 66$ for the 4-bit CQI. The interleaved bit sequence is divided into $N$ groups and each group has $L$-1 bits. The $n$-th group ($n$=0, 1, $c_{N-1}$) is used for binary DPSK modulation on the subcarriers in the $n$-th uplink tile, as shown in the Figure 208b. The first subcarrier in each tile is used as a phase reference. The $L$-1 bits in the $n$-th$^h$ group are mapped to $L$ DPSK symbols for the $n$-th tile as follows:

$$C_{n,k}^{CQI} = \begin{cases} 1 & (k = 0) \\ C_{n,k-1}^{CQI} & k > 0 \quad and\ (B_{n,k-1}^{CQI} = 0) \\ -C_{n,k-1}^{CQI} & k > 0 \quad and\ (B_{n,k-1}^{CQI} = 1) \end{cases} \tag{107d}$$

where

$C_{n,k}^{CQI}$ mapping symbol of the $k$-th subcarrier of the $n$-th tile ($k$=0, 1, …, $L$-1),
$B_{n,k}^{CQI}$ $k$-th bit of $n$-th group in the interleaved bit sequence ($k$=0, 1, …, $L$-2).

***Insert new subclause 8.4.5.4.10.10:***

### 8.4.5.4.10.10 UEP fast-feedback

When the UEP fast-feedback is employed and the Fast-feedback allocation subheader Feedback type field is ‘00’ or the BS requests the feedback through CQICH_Alloc_IE() or CQICH_Control IE(), the MS may report the feedback payload on the assigned CQICH by using the following UEP fast-feedback method. The UEP fast-feedback provides the payload bits carried by the fast-feedback channel with the unequal error protection (UEP) capability. The UEP fast-feedback repeats each payload bit according to a predefined repetition ratio, as illustrated in Figure 231d. The repeated bit sequence is interleaved and used for binary DPSK modulation on the subcarriers for the fast-feedback channel.

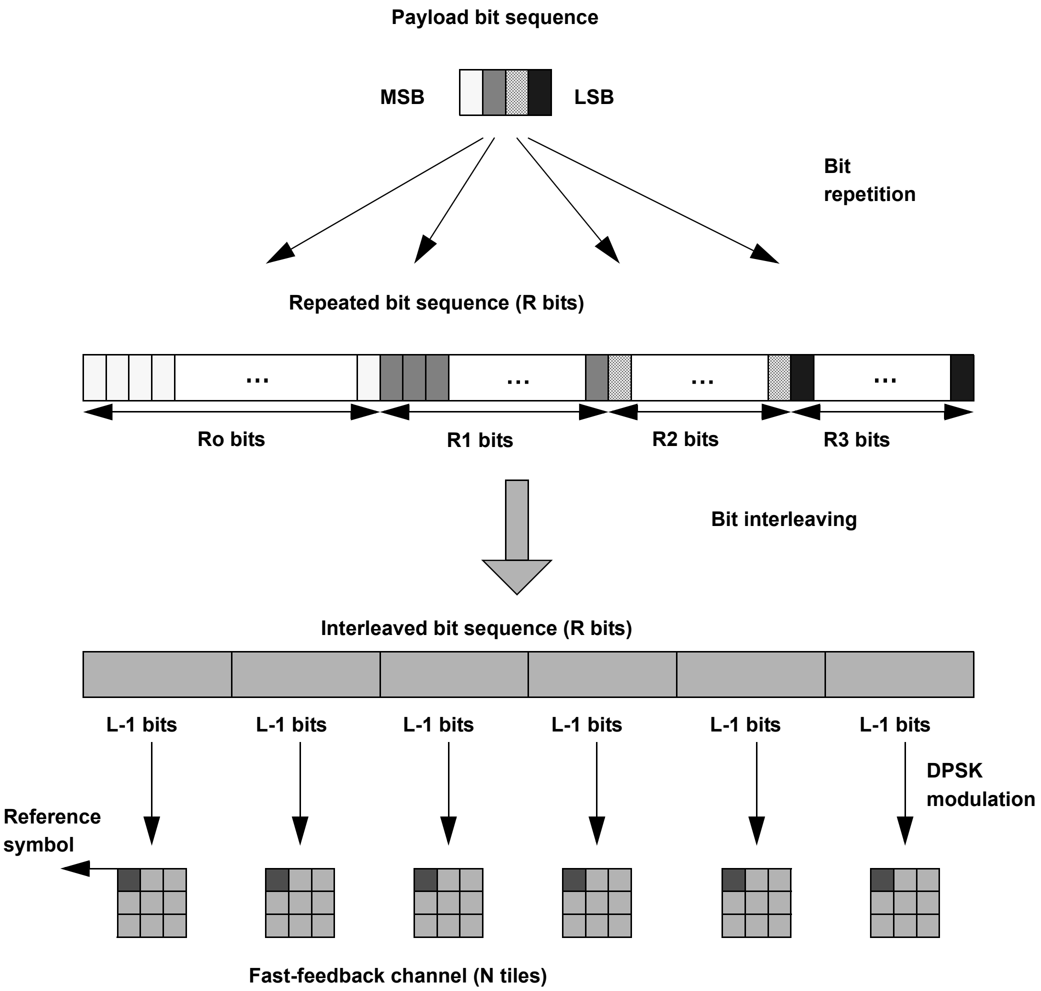

Payload bit sequence
MSB
LSB
Bit repetition
Repeated bit sequence (R bits)
...
Ro bits
R1 bits
R2 bits
R3 bits
Bit interleaving
Interleaved bit sequence (R bits)
L-1 bits
L-1 bits
L-1 bits
L-1 bits
L-1 bits
L-1 bits
DPSK modulation
Reference symbol
Fast-feedback channel (N tiles)

**Figure 231d—Mapping of the payload bit sequence to a Fast-feedback channel**

***Insert new subclause 8.4.5.4.10.11:***

### 8.4.5.4.10.11 Band AMC differential CINR feedback for Enhanced Fast-feedback channel

When the Band AMC operation is triggered, the SS shall report the differential of CINR for five selected bands (increment: 1 and decrement: 0 with a step of 1 dB) on its enhanced or primary fast-feedback channel. The first 32 codewords with MSB of 0 are used.

***Insert new subclause 8.4.5.4.10.12***

### 8.4.5.4.10.12 Indication Flag Feedback

For an MS that supports the feedback method using the Feedback header, the MS can send an indication flag on the Fast-feedback channel, the Enhanced Fast-feedback channel, or the primary/secondary Fast-feedback channel. The indication flag is a specific encoding of the payload bits on the Fast-feedback channel or the Enhanced Fast-feedback channel. The indication flag is used by the MS to indicate to the BS its intention to transmit a Feedback header or a Bandwidth Request header without the need to perform bandwidth request ranging. After receiving the indication flag from the MS, the BS may allocate the required UL resource to the MS.

For the case of Fast-feedback channel or secondary Fast-feedback changeful the Indication Flag feedback operation is enabled, the specific encoding of the payload bits is defined in the Use CQICH indication flag TLV. This specific encoding is reserved for the purpose of indication flag and shall not be used to send other feedback information (see 8.4.5.4.10.1).

For the case of Enhanced Fast-feedback channel or primary Fast-feedback channel, the encoding of 0b111100 shall be used as the indication flag.

***Insert new subclause 8.4.5.4.10.13***

### 8.4.5.4.10.13 Primary and secondary Fast-feedback channels

A primary Fast-feedback slot consists of 1 OFDMA slots mapped in a manner similar to the mapping of normal uplink data. A primary Fast-feedback slot uses QPSK modulation on the 48 data subcarriers of UL PUSC tiles it contains, and can carry a data payload of 6 bits. The primary Fast-feedback slot has identical mapping between the payload bit sequences and the subcarriers modulation as the Enhanced Fast-feedback 6-bit payload slot except null pilot subcarriers within the slot. (See Figure 231e.)

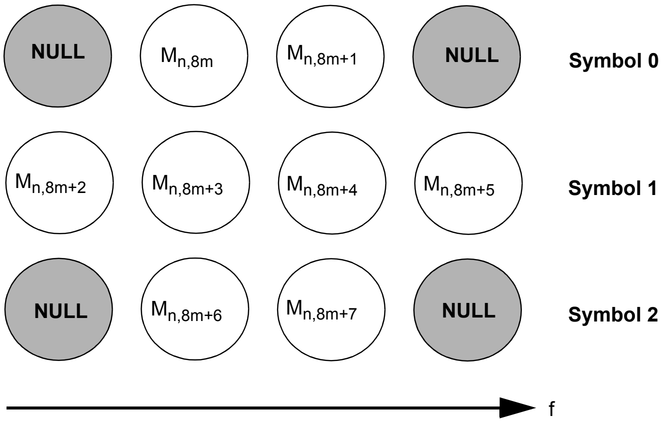


**Figure 231e—Subcarrier mapping of Primary Fast-feedback modulation symbol for PUSC**

A secondary Fast-feedback slot consists of 1 OFDMA slot mapped in a manner similar to the mapping of normal uplink data. A secondary Fast-feedback slot uses QPSK modulation on the 24 pilot subcarriers of UL PUSC tiles it contains, and can carry a data payload of 4 bits. Table 298k defines the mapping between the payload bit sequences and the subcarriers modulation.

### Table 298k—Secondary Fast-feedback channel subcarrier modulation with 4 bit

| Four-bit payload (binary) | Vector indices per tile Tile(0), Tile(1),Tile(2), Tile(3),Tile(4), Tile(5) | Four-bit payload (binary) | Vector indices per tile Tile(0), Tile(1),Tile(2), Tile(3),Tile(4), Tile(5) |
|---|---|---|---|
| 0000 | 0,0,0,1,1,1 | 1000 | 0,0,1,3,2,2 |
| 0001 | 1,1,1,0,0,0 | 1001 | 1,3,2,2,3,1 |
| 0010 | 2,2,2,3,3,3 | 1010 | 2,2,3,1,0,0 |
| 0011 | 3,3,3,2,2,2 | 1011 | 3,3,1,0,1,1 |
| 0100 | 0,1,2,3,0,1 | 1100 | 0,0,3,2,0,3 |
| 0101 | 1,2,3,0,1,3 | 1101 | 1,2,0,2,2,0 |
| 0110 | 2,3,0,1,2,3 | 1110 | 2,1,3,3,1,2 |
| 0111 | 3,0,1,2,3,0 | 1111 | 3,2,2,1,1,2 |

The secondary Fast-feedback channel is orthogonally modulated with QPSK symbols. Let $M_{n,4m+k}$ ($0 <= k <= 3$) be the modulation symbol index of the $k$-th modulation symbol in the $m$-th uplink PUSC tile of the $n$-th secondary Fast-feedback channel. The possible modulation patterns composed of $M_{n,4m+k}$ in the $m$-th tile of the $n$-th secondary Fast-feedback channel are defined in Table 298l.

### Table 298l—Orthogonal Modulation Index in Secondary Fast-feedback Channel

| Vector index | $M_{n,4m}$, $M_{n,4m+1}$, $M_{n,4m+2}$, $M_{n,4m+3}$ |
|---|---|
| 0 | P0, P0, P0, P0 |
| 1 | P0, P2, P0, P2 |
| 2 | P0, P1, P2, P3 |
| 3 | P1, P0, P3, P2 |

where

$$P_0 = \exp\left(j\frac{\pi}{4}\right),$$

$$P_1 = \exp\left(j\frac{3\pi}{4}\right),$$

$$P_2 = \exp\left(-j\frac{3\pi}{4}\right),$$

$$P_3 = \exp\left(-j\frac{\pi}{4}\right).$$

$M_{n,4m+k}$ are mapped to secondary Fast-feedback channel tile as shown in Figure 231f for PUSC uplink subchannel. A secondary Fast-feedback channel is mapped to one subchannel composed of six tiles.

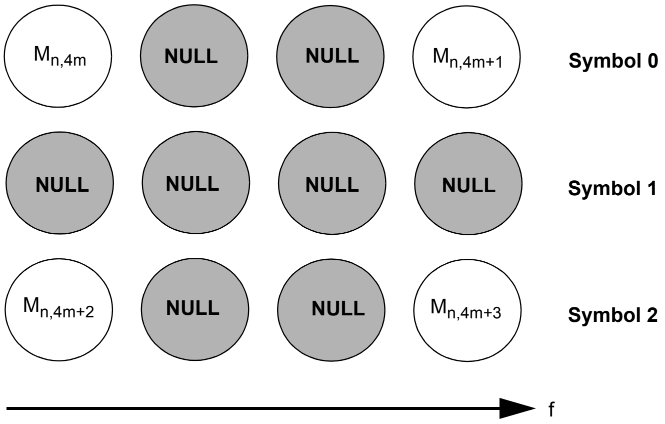


**Figure 231f—Subcarrier mapping of secondary Fast-feedback modulation symbols for PUSC**

*Insert new subclause 8.4.5.4.10.14:*

### 8.4.5.4.10.14 Extended rtPS bandwidth request

In the case of Extended rtPS service, the MS may request bandwidth allocation, which is defined as the Maximum Sustained Traffic Rate in service flow encodings. The codeword 0b111011 is used for that purpose.

*Insert new subclause 8.4.5.4.10.15*

### 8.4.5.4.10.15 MIMO feedback for transmit beamforming

Codebooks are defined for the feedback of MIMO transmit beamforming, whose codeword may be employed as the beamforming matrix in MIMO precoding in 8.4.8.3.6. The vector codebooks for 2x1, 3x1, and 4x1 with 3-bit feedback index are listed in Table 298m, Table 298n, and Table 298o. The notation $V(N_t, S, L)$ denotes the vector codebook, which consists of $2^L$ complex, unit vectors of a dimension $N_t$, and $S$ denotes the number of streams. The integer $L$ is the number of bits required for the index that can indicate any vector in the codebook.

**Table 298m—$V(2,1,3)$**

| Vector index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| v1 | 1 | 0.7940 | 0.7940 | 0.7941 | 0.7941 | 0.3289 | 0.5112 | 0.3289 |
| v2 | 0 | –0.5801 + *j*0.1818 | 0.0576 + *j*0.6051 | –0.2978 – *j*0.5298 | 0.6038 + *j*0.0689 | 0.6614 + *j*0.6740 | 0.4754 – *j*0.7160 | –0.8779 – *j*0.3481 |

**Table 298n—*V(3,1,3)***

| Vector index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| v1 | 1 | 0.500 | 0.500 | 0.500 | 0.500 | 0.4954 | 0.500 | 0.500 |
| v2 | 0 | –0.7201 – *j*0.3126 | –0.0659 + *j*0.1371 | –0.0063 + *j*0.6527 | 0.7171 + *j*0.3202 | 0.4819 – *j*0.4517 | 0.0686 – *j*0.1386 | –0.0054 – *j*0.6540 |
| v3 | 0 | 0.2483 – *j*0.2684 | –0.6283 – *j*0.5763 | 0.4621 – *j*0.3321 | –0.2533 + *j*0.2626 | 0.2963 – *j*0.4801 | 0.6200 + *j*0.5845 | –0.4566 + *j*0.3374 |

**Table 298o—*V(4,1,3)***

| Vector index | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| v1 | 1 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 | 0.3780 |
| v2 | 0 | –0.2698 – *j*0.5668 | –0.7103 + *j*0.1326 | 0.2830 – *j*0.0940 | –0.0841 + *j*0.6478 | 0.5247 + *j*0.3532 | 0.2058 – *j*0.1369 | 0.0618 – *j*0.3332 |
| v3 | 0 | 0.5957 + *j*0.1578 | –0.2350 – *j*0.1467 | 0.0702 – *j*0.8261 | 0.0184 + *j*0.0490 | 0.4115 + *j*0.1825 | –0.5211 + *j*0.0833 | –0.3456 + *j*0.5029 |
| v4 | 0 | 0.1587 – *j*0.2411 | 0.1371 + *j*0.4893 | –0.2801 + *j*0.0491 | –0.3272 – *j*0.5662 | 0.2639 + *j*0.4299 | 0.6136 – *j*0.3755 | –0.5704 + *j*0.2113 |

The codebooks in Table 298m, Table 298n, and Table 298o are produced by generating expressions one per table. These tables are optimized for generation efficiency and storage memory.

Three operations are employed and they employs floating point arithmetic in IEEE Std 754, whose final results are rounded to four decimal places. The first operation generates a unitary $N \times N$ matrix *H(v)* using an $N$ vector $v$ as:

$$H(\mathbf{v}) = \begin{cases} \boldsymbol{I}, & \mathbf{v} = \mathbf{e}_1 \\ \boldsymbol{I} - p\mathbf{w}\mathbf{w}^H, & otherwise \end{cases} , \tag{107e}$$

where

$\mathbf{w} = \mathbf{v}$ **-** $\mathbf{e}_1$ and $\mathbf{e}_1 = [1\ 0\ ...\ 0]$;

$p = \frac{2}{\|\mathbf{w}^H\mathbf{w}\|}$;

$\boldsymbol{I}$ is the *NxN* identity matrix;

$()^H$ denotes the conjugate transpose operation.

Two vector codebooks $V(3,1,6)$ and $V(4,1,6)$ are generated as follows. All the vector codewords $\mathbf{v}_i$, $i = 2, ...\ 2^L$ are derived from the first codeword $\mathbf{v}_1$ as:

$\tilde{\mathbf{v}}_i = H(s)Q^i(\mathbf{u})H^H(s)\mathbf{v}_i$, for $i = 2, ...\ 2^L$, $\mathbf{v}_i = \tilde{\mathbf{v}}_i e^{-j\phi_1}$, for $i = 2, ...\ 2^L$,

where

$$Q^i(\boldsymbol{u}) = diag\left(e^{j \cdot \frac{2\pi}{2^L} \cdot u_1 \cdot i}, \ldots, e^{j \cdot \frac{2\pi}{2^L} \cdot u_{N_t} \cdot i}\right) \text{ is a diagonal matrix;}$$

$$\mathbf{u} = \lfloor u_1 \ \ldots \ u_{N_t} \rfloor \text{ is an integer vector;}$$

$$\boldsymbol{v}_1 = \frac{1}{\sqrt{N_t}}\begin{bmatrix} 1 & e^{j \cdot \frac{2\pi}{N_t}} & \ldots & e^{j \cdot \frac{2\pi}{N_t} \cdot (N_t - 1)} \end{bmatrix}^T;$$

$\phi_i$ is the phase of the first entry of $\tilde{v}_i$.

The parameters for the generation of *V*(3,1,6) and *V*(4,1,6) are listed in Table 298p.

### Table 298p—Generating parameters for *V*(3,1,6) and *V*(4,1,6)

| $N_t$ | $L$ | **u** in $Q^i$(**u**) | ***s* in H(*s*)** |
|---|---|---|---|
| 3 | 6 | [1 26 57] | [1.2518–-j0.6409, –0.4570–*j*0.4974, 0.1177+*j*0.2360] |
| 4 | 6 | [1 45 22 49] | [1.3954–*j*0.0738, 0.0206+*j*0.4326, –0.1658–*j*0.5445, 0.5487–*j*0.1599]$^T$ |

The second operation generates an *N* by *M* + 1 unitary matrix from a unit *N* vector and a unitary *N* – 1 by *M* matrix as:

$$HC(\boldsymbol{v}_N, \boldsymbol{A}_{(N-1)M}) = H(\boldsymbol{v}_N)\begin{bmatrix} 1 & 0 \ldots & 0 \\ 0 & & \\ \ldots & & \\ 0 & & \boldsymbol{A}_{(N-1)M} \end{bmatrix} \tag{107f}$$

where

$N - 1 \geq M$; the $N - 1$ by $M$ unitary matrix has property $\mathbf{A}^H\mathbf{A} = \mathbf{I}$.

The third operation generates an *N* by *M* matrix from a unit *N* vector, $\mathbf{v}_N$, by taking the last *N* – 1 columns of H($\mathbf{v}_N$) as:

$$HE(\boldsymbol{v}_N) = H(\boldsymbol{v}_N)_{:,2:N}. \tag{107g}$$

The three operations jointly generate eleven matrix codebooks from vector codebooks as shown in Table 298q, where each entry is the generating operation of one codebook.

Table 298q contains operations to generate codebooks $V(N_t, S, L)$ for $N_t$ = 2, 3, 4, *S* = 2, 3, 4, and *L* = 3 and 6:

**Table 298q—Operations to generate codebooks**

| ***Nt, L \ S*** | **2** | **3** | **4** |
|---|---|---|---|
| 2, 3 | H(*V*(2,1,3)) | — | — |
| 3, 3 | HE(*V*(3,1,3)) | H(*V*(3,1,3)) | — |
| 4, 3 | — | HE(*V*(4,1,3)) | H(*V*(4,1,3)) |
| 2, 6 | H(*V*(2,1,6)) | — | — |
| 3, 6 | HC(*V*(3,1,3),*V*(2,1,3)) | HC(*V*(3,1,3),H(*V*(2,1,3))) | — |
| 4, 6 | HC(*V*(4,1,3),H(*V*(3,1,3))) | HE(*V*(4,1,6)) | H(*V*(4,1,6)) |

The set notation $V(N_t,1,L)$ in the input arguments of the operations denotes that each vector in the codebook $V(N_t,1,L)$ is sequentially taken as an input to the operations. The output of the operation with one or more codebooks as input arguments is also a codebook. For example, in HC(*V*(3,1,3),H(*V*(2,1,3))) has two codebooks as input. The first is *V*(3,1,3) with 8 vectors and the second is H(*V*(2,1,3)) with 8 2x2 matrices, which are computed from *V*(2,1,3). The feedback index is constructed by sequentially concatenating all the indexes of the input argument vector codebooks in binary format. For example, the feedback index of HC(*V*(3,1,3),H(*V*(2,1,3))) is constructed as $i_2 j_2$, where $i_2$ and $j_2$ are the indexes of the vectors in codebooks *V*(3,1,3) and *V*(2,1,3) in binary format respectively.

Table 298r, Table 298s, Table 298t are included to illustrate codebooks generated using the rules defined above.

**Table 298r—3-bit 2x2 codebook V(2,2,3)**

| **Matrix index (binary)** | **Column1** | **Column2** | **Matrix index (binary)** | **Column1** | **Column2** |
|---|---|---|---|---|---|
| 000 | 1 | 0 | 100 | 0.7941 | 0.6038 – j0.0689 |
| | 0 | 1 | | 0.6038 + j0.0689 | –0.7941 |
| 001 | 0.7940 | –0.5801 – j0.1818 | 101 | 0.3289 | 0.6614 – j0.6740 |
| | –0.5801 + j0.1818 | –0.7940 | | 0.6614 + j0.6740 | –0.3289 |
| 010 | 0.7940 | 0.0576 – j0.6051 | 110 | 0.5112 | 0.4754 + j0.7160 |
| | 0.0576 + j0.6051 | –0.7940 | | 0.4754 - j0.7160 | –0.5112 |
| 011 | 0.7941 | –0.2978 + j0.5298 | 111 | 0.3289 | –0.8779 + j0.3481 |
| | –0.2978 – j0.5298 | –0.7941 | | –0.8779 – j0.3481 | –0.3289 |

### Table 298s—3-bit 4x3 codebook V(4,3,3)

| Matrix index (binary) | Column1 | Column2 | Column3 |
|---|---|---|---|
| 000 | 0 | 0 | 0 |
| | 1 | 0 | 0 |
| | 0 | 1 | 0 |
| | 0 | 0 | 1 |
| 001 | –0.2698 + j0.5668 | 0.5957 – j0.1578 | 0.1587 + j0.2411 |
| | 0.3665 | 0.4022 + j0.4743 | –0.1509 + j0.2492 |
| | 0.4022 – j0.4743 | 0.3894 | –0.0908 – j0.2712 |
| | –0.1509 – j0.2492 | –0.0908 + j0.2712 | 0.8660 |
| 010 | –0.7103 – j0.1326 | –0.2350 + j0.1467 | 0.1371 – j0.4893 |
| | 0.1606 | –0.2371 + j0.2176 | 0.0522 – j0.5880 |
| | –0.2371 – j0.2176 | 0.8766 | 0.1672 – j0.1525 |
| | 0.0522 + j0.5880 | 0.1672 + j0.1525 | 0.5848 |
| 011 | 0.2830 + j0.0940 | 0.0702 + j0.8261 | –0.2801 – j0.0491 |
| | 0.8570 | –0.1568 – j0.3653 | 0.1349 – j0.0200 |
| | –0.1568 + j0.3653 | –0.1050 | 0.0968 – j0.3665 |
| | 0.1349 + j0.0200 | 0.0968 + j0.3665 | 0.8700 |
| 100 | –0.0841 – j0.6478 | 0.0184 – j0.0490 | –0.3272 + j0.5662 |
| | 0.3140 | –0.0485 – j0.0258 | 0.5454 + j0.4174 |
| | –0.0485 + j0.0258 | 0.9956 | 0.0543 + j0.0090 |
| | 0.5454 – j0.4174 | 0.0543 – j0.0090 | 0.3125 |
| 101 | 0.5247 – j0.3532 | 0.4115 – j0.1825 | 0.2639 – j0.4299 |
| | 0.3569 | –0.4508 – j0.0797 | –0.4667 + j0.2128 |
| | –0.4508 + j0.0797 | 0.6742 | –0.3007 + j0.2070 |
| | –0.4667 – j0.2128 | –0.3007 – j0.2070 | 0.5910 |
| 110 | 0.2058 + j0.1369 | –0.5211 – j0.0833 | 0.6136 + j0.3755 |
| | 0.9018 | 0.1908 – j0.0871 | –0.2857 + j0.0108 |
| | 0.1908 + j0.0871 | 0.5522 | 0.5644 + j0.2324 |
| | –0.2857 – j0.0108 | 0.5644 – j0.2324 | 0.1680 |
| 111 | 0.0618 + j0.3332 | –0.3456 – j0.5029 | –0.5704 – j0.2113 |
| | 0.8154 | 0.3037 – j0.1352 | 0.1698 – j0.2845 |
| | 0.3037 + j0.1352 | 0.4015 | –0.4877 + j0.3437 |
| | 0.1698 + j0.2845 | –0.4877 – j0.3437 | 0.4052 |

## Table 298t—3-bit 4x4 codebook V(4,4,3)

| Matrix index (binary) | Column1 | Column2 | Column3 | Column4 |
|---|---|---|---|---|
| 000 | 1 | 0 | 0 | 0 |
| | 0 | 1 | 0 | 0 |
| | 0 | 0 | 1 | 0 |
| | 0 | 0 | 0 | 1 |
| 001 | 0.3780 | –0.2698 + j0.5668 | 0.5957 – j0.1578 | 0.1587 + j0.2411 |
| | –0.2698 – j0.5668 | 0.3665 | 0.4022 + j0.4743 | –0.1509 + j0.2492 |
| | 0.5957 + j0.1578 | 0.4022 – j0.4743 | 0.3894 | –0.0908 – j0.2712 |
| | 0.1587 – j0.2411 | –0.1509 – j0.2492 | –0.0908 + j0.2712 | 0.8660 |
| 010 | 0.3780 | –0.7103 – j0.1326 | –0.2350 + j0.1467 | 0.1371 – j0.4893 |
| | –0.7103 + j0.1326 | 0.1606 | –0.2371 + j0.2176 | 0.0522 – j0.5880 |
| | –0.2350 – j0.1467 | –0.2371 – j0.2176 | 0.8766 | 0.1672 – j0.1525 |
| | 0.1371 + j0.4893 | 0.0522 + j0.5880 | 0.1672 + j0.1525 | 0.5848 |
| 011 | 0.3780 | 0.2830 + j0.0940 | 0.0702 + j0.8261 | –0.2801 – j0.0491 |
| | 0.2830 – j0.0940 | 0.8570 | –0.1568 – j0.3653 | 0.1349 – j0.0200 |
| | 0.0702 – j0.8261 | –0.1568 + j0.3653 | –0.1050 | 0.0968 – j0.3665 |
| | –0.2801 + j0.0491 | 0.1349 + j0.0200 | 0.0968 + j0.3665 | 0.8700 |
| 100 | 0.3780 | –0.0841 – j0.6478 | 0.0184 – j0.0490 | –0.3272 + j0.5662 |
| | –0.0841 + j0.6478 | 0.3140 | –0.0485 – j0.0258 | 0.5454 + j0.4174 |
| | 0.0184 + j0.0490 | –0.0485 + j0.0258 | 0.9956 | 0.0543 + j0.0090 |
| | –0.3272 – j0.5662 | 0.5454 – j0.4174 | 0.0543 – j0.0090 | 0.3125 |
| 101 | 0.3780 | 0.5247 – j0.3532 | 0.4115 – j0.1825 | 0.2639 – j0.4299 |
| | 0.5247 + j0.3532 | 0.3569 | –0.4508 – j0.0797 | –0.4667 + j0.2128 |
| | 0.4115 + j0.1825 | –0.4508 + j0.0797 | 0.6742 | –0.3007 + j0.2070 |
| | 0.2639 + j0.4299 | –0.4667 – j0.2128 | –0.3007 – j0.2070 | 0.5910 |

### Table 298t—3-bit 4x4 codebook V(4,4,3) *(continued)*

| | | | | |
|---|---|---|---|---|
| 110 | 0.3780 | 0.2058 + j0.1369 | –0.5211 – j0.0833 | 0.6136 + j0.3755 |
| | 0.2058 – j0.1369 | 0.9018 | 0.1908 – j0.0871 | –0.2857 + j0.0108 |
| | –0.5211 + j0.0833 | 0.1908 + j0.0871 | 0.5522 | 0.5644 + j0.2324 |
| | 0.6136 – j0.3755 | –0.2857 – j0.0108 | 0.5644 – j0.2324 | 0.1680 |
| 111 | 0.3780 | 0.0618 + j0.3332 | –0.3456 – j0.5029 | –0.5704 – j0.2113 |
| | 0.0618 – j0.3332 | 0.8154 | 0.3037 – j0.1352 | 0.1698 – j0.2845 |
| | –0.3456 + j0.5029 | 0.3037 + j0.1352 | 0.4015 | –0.4877 + j0.3437 |
| | –0.5704 + j0.2113 | 0.1698 + j0.2845 | –0.4877 – j0.3437 | 0.4052 |

### Table 298u—6 bit, 3x1 Codebook V(3,1,6)

| Matrix index (binary) | Column1 | Matrix index (binary) | Column1 |
|---|---|---|---|
| 000000 | 0.5774 | 100000 | 0.5437 |
| | –0.2887 + j0.5000 | | –0.1363 – j0.4648 |
| | –0.2887 – j0.5000 | | 0.4162 + j0.5446 |
| 000001 | 0.5466 | 100001 | 0.5579 |
| | 0.2895 – j0.5522 | | –0.6391 + j0.3224 |
| | 0.2440 + j0.5030 | | –0.2285 – j0.3523 |
| 000010 | 0.5246 | 100010 | 0.5649 |
| | –0.7973 – j0.0214 | | 0.6592 – j0.3268 |
| | –0.2517 – j0.1590 | | 0.1231 + j0.3526 |
| 000011 | 0.5973 | 100011 | 0.484 |
| | 0.7734 + j0.0785 | | –0.6914 – j0.3911 |
| | 0.1208 + j0.1559 | | –0.3669 + j0.0096 |
| 000100 | 0.4462 | 100100 | 0.6348 |
| | –0.3483 – j0.6123 | | 0.5910 + j0.4415 |
| | –0.5457 + j0.0829 | | 0.2296 – j0.0034 |
| 000101 | 0.6662 | 100101 | 0.4209 |
| | 0.2182 + j0.5942 | | 0.0760 – j0.5484 |
| | 0.3876 – j0.0721 | | –0.7180 + j0.0283 |
| 000110 | 0.412 | 100110 | 0.6833 |
| | 0.3538 – j0.2134 | | –0.1769 + j0.4784 |
| | –0.8046 – j0.1101 | | 0.5208 – j0.0412 |

### Table 298u—6 bit, 3x1 Codebook V(3,1,6) *(continued)*

| | | | |
|---|---|---|---|
| 000111 | 0.684 | 100111 | 0.4149 |
| | –0.4292 + j0.1401 | | 0.3501 + j0.2162 |
| | 0.5698 + j0.0605 | | –0.7772 – j0.2335 |
| 001000 | 0.4201 | 101000 | 0.6726 |
| | 0.1033 + j0.5446 | | –0.4225 – j0.2866 |
| | –0.6685 – j0.2632 | | 0.5061 + j0.1754 |
| 001001 | 0.6591 | 101001 | 0.419 |
| | –0.1405 – j0.6096 | | –0.2524 + j0.6679 |
| | 0.3470 + j0.2319 | | –0.5320 – j0.1779 |
| 001010 | 0.407 | 101010 | 0.6547 |
| | –0.5776 + j0.5744 | | 0.2890 – j0.6562 |
| | –0.4133 + j0.0006 | | 0.1615 + j0.1765 |
| 001011 | 0.6659 | 101011 | 0.3843 |
| | 0.6320 – j0.3939 | | –0.7637 + j0.3120 |
| | 0.0417 + j0.0157 | | –0.3465 + j0.2272 |
| 001100 | 0.355 | 101100 | 0.69 |
| | –0.7412 – j0.0290 | | 0.6998 + j0.0252 |
| | –0.3542 + j0.4454 | | 0.0406 – j0.1786 |
| 001101 | 0.7173 | 101101 | 0.3263 |
| | 0.4710 + j0.3756 | | –0.4920 – j0.3199 |
| | 0.1394 – j0.3211 | | –0.4413 + j0.5954 |
| 001110 | 0.307 | 101110 | 0.7365 |
| | –0.0852 – j0.4143 | | 0.0693 + j0.4971 |
| | –0.5749 + j0.6295 | | 0.2728 – j0.3623 |
| 001111 | 0.74 | 101111 | 0.3038 |
| | –0.3257 + j0.3461 | | 0.3052 – j0.2326 |
| | 0.3689 – j0.3007 | | –0.6770 + j0.5496 |
| 010000 | 0.3169 | 110000 | 0.727 |
| | 0.4970 + j0.1434 | | –0.5479 – j0.0130 |
| | –0.6723 + j0.4243 | | 0.3750 – j0.1748 |
| 010001 | 0.7031 | 110001 | 0.3401 |
| | –0.4939 – j0.4297 | | 0.4380 + j0.5298 |
| | 0.2729 – j0.0509 | | –0.5470 + j0.3356 |

### Table 298u—6 bit, 3x1 Codebook V(3,1,6) *(continued)*

| | | | |
|---|---|---|---|
| 010010 | 0.3649 | 110010 | 0.6791 |
| | 0.1983 + j0.7795 | | –0.1741 – j0.7073 |
| | –0.3404 + j0.3224 | | 0.0909 – j0.0028 |
| 010011 | 0.6658 | 110011 | 0.3844 |
| | 0.2561 – j0.6902 | | –0.1123 + j0.8251 |
| | –0.0958 – j0.0746 | | –0.1082 + j0.3836 |
| 010100 | 0.3942 | 110100 | 0.6683 |
| | –0.3862 + j0.6614 | | 0.5567 – j0.3796 |
| | 0.0940 + j0.4992 | | –0.2017 – j0.2423 |
| 010101 | 0.6825 | 110101 | 0.394 |
| | 0.5632 + j0.0490 | | –0.5255 + j0.3339 |
| | –0.1901 – j0.4225 | | 0.2176 + j0.6401 |
| 010110 | 0.3873 | 110110 | 0.6976 |
| | –0.4531 – j0.0567 | | 0.2872 + j0.3740 |
| | 0.2298 + j0.7672 | | –0.0927 – j0.5314 |
| 010111 | 0.7029 | 110111 | 0.3819 |
| | –0.1291 + j0.4563 | | –0.1507 – j0.3542 |
| | 0.0228 – j0.5296 | | 0.1342 + j0.8294 |
| 011000 | 0.387 | 111000 | 0.6922 |
| | 0.2812 – j0.3980 | | –0.5051 + j0.2745 |
| | –0.0077 + j0.7828 | | 0.0904 – j0.4269 |
| 011001 | 0.6658 | 111001 | 0.4083 |
| | –0.6858 – j0.0919 | | 0.6327 – j0.1488 |
| | 0.0666 – j0.2711 | | –0.0942 + j0.6341 |
| 011010 | 0.4436 | 111010 | 0.6306 |
| | 0.7305 + j0.2507 | | –0.5866 – j0.4869 |
| | –0.0580 + j0.4511 | | –0.0583 – j0.1337 |
| 011011 | 0.5972 | 111011 | 0.4841 |
| | –0.2385 – j0.7188 | | 0.5572 + j0.5926 |
| | –0.2493 – j0.0873 | | 0.0898 + j0.3096 |
| 011100 | 0.5198 | 111100 | 0.5761 |
| | 0.2157 + j0.7332 | | 0.1868 – j0.6492 |
| | 0.2877 + j0.2509 | | –0.4292 – j0.1659 |

Table 298u—6 bit, 3x1 Codebook V(3,1,6) *(continued)*

| | | | |
|---|---|---|---|
| 011101 | 0.571 | 111101 | 0.5431 |
| | 0.4513 – j0.3043 | | –0.1479 + j0.6238 |
| | –0.5190 – j0.3292 | | 0.4646 + j0.2796 |
| 011110 | 0.5517 | 111110 | 0.5764 |
| | –0.3892 + j0.3011 | | 0.4156 + j0.1263 |
| | 0.5611 + j0.3724 | | –0.4947 – j0.4840 |
| 011111 | 0.5818 | 111111 | 0.549 |
| | 0.1190 + j0.4328 | | –0.3963 – j0.1208 |
| | –0.3964 – j0.5504 | | 0.5426 + j0.4822 |

### 8.4.5.4.11 MIMO UL Basic IE format

***Change 8.4.5.4.11 as indicated:***

In the UL-MAP, a MIMO-enabled BS may transmit UIUC = 15 with the MIMO_UL_Basic_IE() to indicate the MIMO mode of the ~~subsequent~~ uplink allocations described in this IE ~~to a specific MIMO-enabled SS CID~~. The MIMO mode indicated in the MIMO_UL_Basic_IE() shall only apply to the ~~subsequent~~ uplink allocation within the IE ~~until the end of frame (see Table 299)~~. This IE may be used either for a MIMO enabled SS or for an SS that supports only collaborative SM. The IE may also be used to assign allocations in AAS zones to AAS enabled SSs that are capable of collaborative SM.

Table 299—MIMO UL basic IE format

| Syntax | Size | Notes |
|---|---|---|
| MIMO_UL_Basic_IE () { | | |
| **Extended ~~D~~UIUC** | 4 bits | MIMO = 0x0~~2~~6 |
| **Length** | 4 bits | ~~Length of the message in bytes (~~variable~~)~~ |
| **Num_Assign** | 4 bits | Number of burst assignment |
| For (*j*=0; *j*<Num_assign; *j*++) { | | |
| **Collaborative_SM _Indication** | 1 bit | 0: Non collaborative SM (Vertical coding assignment to a MIMO capable SS)<br>1: Collaborative SM (assignment to 2 collaborative SM capable SSs) |
| If ( Collaborative_SM _Indication == 0) { | | |
| **CID** | 16 bits | SS basic CID |
| **UIUC** | 4 bits | |

**Table 299—MIMO UL basic IE format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **MIMO_Control** | 1 bit | For dual transmission capable SS<br>0: STTD<br>1: SM<br>~~For Collaborative SM capable SS~~<br>~~0: pilot pattern A~~<br>~~1: pilot pattern B~~ |
| } Else { | | |
| **CID_A** | 16 bits | Basic CID of SS that shall use pilot pattern A |
| **UIUC_A** | 4 bits | UIUC used for the allocation that uses pilot pattern A |
| **CID_B** | 16 bits | Basic CID of SS that shall use pilot pattern B |
| **UIUC_B** | 4 bits | UIUC used for the allocation that uses pilot pattern B |
| } | | |
| **Duration** | 10 bits | In OFDMA slots (see 8.4.3.1) |
| } | | |
| *padding* | *variable* | Number of bits required to align to byte length, shall be set to zero. |
| } | | |

**Num_assign**

This field specifies the number of assignments in this IE.

**MIMO_Control**

MIMO_Control field specifies the MIMO mode of the corresponding UL burst. ~~For a dual transmission-capable SS, the value of 0 indicates STTD mode, the value of 1 indicates SM mode. For a collaborative SM- capable SS, the value of 0 indicates pilot pattern A, the value of 1 indicates pilot pattern B.~~

***Insert new text and Table 299a as shown:***

Table 299a summarizes the modes of operation specified by MIMO_UL_Basic_IE(). For each it details the following:

- Number of antennas;
- Values of Collaborative_SM_indication and MIMO_control;
- Number of different CID’s stated in the appropriate case of the “if” statement;
- Implicit type and rate of coding.

**Table 299a—MIMO_UL_Basic_IE operation modes**

| Mode | Number of Tx antennas per SS | Collaborative_ SM_ Indication | MIMO_ control | CIDs | Coding Type | Rate |
|---|---|---|---|---|---|---|
| Collaborative MIMO, 2 SSs | 1 | 1 | N/A | CID_A != CID_B | Two SS, each transmits from antenna #0 | 1 per SS |
| Spatial Multiplexing, Vertical coding | 2 | 0 | 1 | Single CID | SM with Vertical coding for Single user | 2 |
| STTD | 2 | 0 | 0 | Single CID | STTD | 1 |

**Vertical coding**
Indicates transmitting the same coded stream over multiple antennas.
**Rate**
The number of QAM symbols signaled per array channel use.

### 8.4.5.4.12 CQICH Allocation IE Format

*Change the first sentence as indicated:*

CQICH_Alloc_IE(), is introduced to dynamically allocate or de-allocate a CQICH to an SS. Once allocated, the SS transmit channel quality information on the assigned CQICH on ~~every~~ subsequent frames, until the SS receives a CQICH_Alloc_IE() to de-allocate the assigned CQICH.

*Change Table 300 as indicated:*

**Table 300—CQICH alloc IE format**

| Syntax | Size | Notes |
|---|---|---|
| CQICH_Alloc_IE() () { | | |
| **Extended ~~D~~UIUC** | 4 bits | CQICH = 0x03 |
| **Length** | 4 bits | Length of the message in bytes (variable). |
| **CQICH_ID** | variable | Index to uniquely identify the CQICH resource assigned to the SS.<br>The size of this field is dependent on system parameter defined in ~~D~~UCD. |
| **Allocation offset** | 6 bits | Index to the fast-feedback channel region marked by UIUC = 0. |
| **Period (p)** | 2 bits | A CQI feedback is transmitted on the CQICH every ~~2p~~$2^p$ frames. |
| **Frame offset** | 3 bits | The SS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the SS should start reporting in eight frames. |

### Table 300—CQICH alloc IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Duration (d)** | 3 bits | A CQI feedback is transmitted on the CQI channels indexed by the CQICH_ID for 10 x $2^d$ frames.<br>If d == 0, the CQI-CH is deallocated.<br>If d == 0b111, the SS should report until the BS command for the SS to stop. |
| **Report configuration included** | 1 bits | Update to CINR report configuration is included. |
| If (report configuration included == 1) { | | |
| **Feedback Type** | 2 bits | 0b00 = physical CINR feedback<br>0b01 = effective CINR feedback<br>0b10–0b11 = *Reserved* |
| **Report type** | 1 bit | 0: Report for preamble<br>1: Report for specific permutation zone |
| If (Report type == 0) { | | |
| **CINR preamble report type** | 1 bit | The type of preamble-based CINR report<br>0: Frequency reuse factor=1 configuration.<br>1: Frequency reuse factor=3 configuration. |
| } | | |
| Else { | | report for permutation zone. |
| **Zone permutation** | 3 bits | The type of zone for which to report<br>0b000 – PUSC with 'use all SC = 0'<br>0b001 – PUSC with 'use all SC = 1'<br>0b010 – FUSC<br>0b011 – Optional FUSC<br>0b100 – Safety Channel region<br>0b101 – AMC zone (only applicable to AAS mode)<br>0b110–111 – *Reserved* |
| **Zone type** | 2 bits | 0b00 – Non-STC zone<br>0b01 – STC zone<br>0b10 – AAS zone<br>0b11 – *Reserved* |
| **Zone PRBS_ID** | 2 bits | The PRBS_ID of the zone on which to report |
| If (Zone type == 0b000 or 0b001) { | | |
| **Major group indication** | 1 bit | If ‘0’ then the report may refer to any subchannel in the PUSC zone. |
| If (Major group indication == 1) { | | |
| **PUSC Major group bitmap** | 6 bits | Reported CINR shall only apply to the subchannels of PUSC major groups for which the corresponding bit is set.<br>Bit #*k* refers to major group *k*. |
| } | | |
| } | | |
| **CINR zone measurement type** | 1 bit | 0: measurement from pilot subcarriers and, if AAS zone, from AAS preamble.<br>1: measurement from data subcarriers |

### Table 300—CQICH alloc IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| } | | |
| If (feedback type == 0b00) { | | Physical CINR feedback |
| **Averaging parameter included** | 1 bit | |
| If (Averaging parameter included == 1) { | | |
| **Averaging parameter** | 4 bits | Averaging parameter $\alpha_{avg}$ used for deriving physical CINR estimates reported through CQICH. This value is given in multiples of 1/16 in the range of [1/16..16/16] in increasing order. |
| } | | |
| } | | |
| } | | |
| **MIMO_permutation_feedback_cycle** | 2 bits | 0b00 = No MIMO and permutation mode feedback<br>0b01 = The MIMO and permutation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every four ~~frames~~ allocated CQICH transmission opportunity. The first indication is sent on the ~~eighth~~fourth allocated CQICH ~~frame~~ transmission opportunity.<br>0b10 = The MIMO mode and permutation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every eight ~~frames~~ allocated CQICH transmission opportunity. The first indication is sent on the eighth allocated CQICH ~~frame~~ transmission opportunity.<br>0b11 = The MIMO mode and permutation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 16 ~~frames~~ allocated CQICH transmission opportunity. The first indication is sent on the 16th allocated CQICH ~~frame~~ transmission opportunity. |
| **Padding** | *variable* | ~~The padding bits is used to ensure the IE size is integer number of bytes.~~Number of bits required to align to byte length, shall be set to zero. |
| } | | |

***Change the description of 'MIMO_permutation_feedback_Cycle' field below Table 300 as indicated:***

**MIMO_permutation_feedback_Cycle**

This field specifies the MIMO and permutation mode fast feedback cycle. See ~~8.4.5.4.10.2~~8.4.5.4.10.3 for fast-feedback channel payload encoding for MIMO and permutation feedback. When MIMO_permutation_feedback_cycle is not equal to 0b00, the MIMO and permutation mode indication shall transmitted at certain CQICH frames instead of the normal CQI value.

***Insert the following fields description below Table 300:***

**Report configuration included**
Indicates whether an update to the report configuration exists in the IE. A value of ‘0’ indicates that the SS shall use the configuration defined in the last received CQI configuration.

**Report type**
Indicates whether the CINR metric shall be reported on the preamble (‘0’) or on a permutation zone (‘1’).

**Averaging parameter included**
Indicate whether a new averaging parameter $\alpha_{avg}$ for physical CINR reports exists in the IE. A value of ‘0’ indicates that the SS shall perform physical CINR measurements using the last known averaging parameter.

***Insert the following paragraph at the end of the subclause:***

For MIMO capable SSs, BS may allocate one or multiple CQICH channels to the SS in UL_MAP. If one CQICH channel is allocated, SS shall report the average post processing S/R. If multiple CQICH channels are allocated, SS shall report post processing SNR of individual layers, the order of CQICH channel allocation shall match the order of layer index.

### 8.4.5.4.13 UL ACK channel

***Replace the contents of the subclause with the following text:***

The uplink ACK (Acknowledgement) provides feedback for Downlink Hybrid ARQ. This channel shall only be supported by SS supporting HARQ. The SS transmits ACK or NAK feedback for Downlink packet data. One ACK channel occupies a half subchannel, which is three pieces of 3×3 uplink tile in the case of optional PUSC or three pieces of 4×3 uplink tile in the case of PUSC. The even half subchannel consists of Tile(0), Tile(2), and Tile(4). The odd half subchannel consists of Tile(1), Tile(3), and Tile(5).

The acknowledgement bit of the *n*-th ACK channel shall be ‘0’ (ACK) if the corresponding downlink packet has been successfully received; otherwise, it shall be ‘1’ (NAK). This 1 bit is encoded into a length 3 codeword over 8-ary alphabet for the error protection as shown in Table 301.

**Table 301—ACK channel subcarrier modulation**

| ACK 1-bit symbol | Vector Indices per Tile<br>Tile(0), Tile(1), Tile(2) |
|---|---|
| 0 | 0, 0, 0 |
| 1 | 4, 7, 2 |

The UL ACK channel is orthogonally modulated with QPSK symbols. Let $M_{n,8m+k}$ ( $0 \le k \le 7$ ) be the modulation symbol index of the *k*-th modulation symbol in the *m*-th uplink tile of the *n*-th UL ACK channel. The possible modulation patterns composed of $M_{n,8m}$, $M_{n,8m+1}$ , … ,$M_{n,8m+7}$ in the *m*-th tile of the *n*-th UL ACK channel are defined in Table 301a.

### Table 301a—Orthogonal Modulation Index in UL ACK Channel

| Vector index | $M_{n,8m}, M_{n,8m+1}, \ldots, M_{n,8m+7}$ |
|---|---|
| 0 | P0, P1, P2, P3, P0, P1, P2, P3 |
| 1 | P0, P3, P2, P1, P0, P3, P2, P1 |
| 2 | P0, P0, P1, P1, P2, P2, P3, P3 |
| 3 | P0, P0, P3, P3, P2, P2, P1, P1 |
| 4 | P0, P0, P0, P0, P0, P0, P0, P0 |
| 5 | P0, P2, P0, P2, P0, P2, P0, P2 |
| 6 | P0, P2, P0, P2, P2, P0, P2, P0 |
| 7 | P0, P2, P2, P0, P2, P0, P0, P2 |

where

$$P0 = \exp\left(j \cdot \frac{\pi}{4}\right)$$

$$P1 = \exp\left(j \cdot \frac{3\pi}{4}\right)$$

$$P2 = \exp\left(-j \cdot \frac{3\pi}{4}\right)$$

$$P3 = \exp\left(-j \cdot \frac{\pi}{4}\right)$$

$M_{n,8m+k}$ is mapped to UL ACK channel tile as shown in Figure 231a for PUSC uplink subchannel and in Figure 231b for optional PUSC uplink subchannel. An UL ACK channel is mapped to half subchannel composed of 3 tiles. In the figures, subcarrier index increases from left to right.

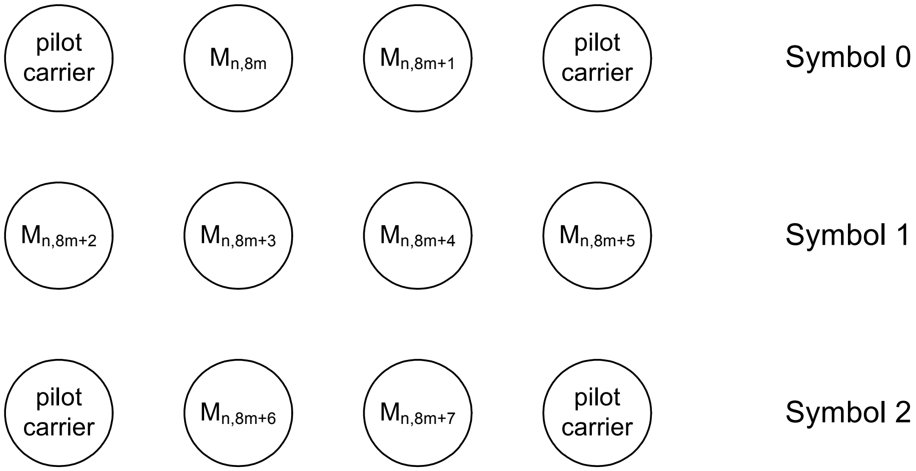

pilot carrier
$M_{n,8m}$
$M_{n,8m+1}$
pilot carrier
Symbol 0
$M_{n,8m+2}$
$M_{n,8m+3}$
$M_{n,8m+4}$
$M_{n,8m+5}$
Symbol 1
pilot carrier
$M_{n,8m+6}$
$M_{n,8m+7}$
pilot carrier
Symbol 2

**Figure 231g—Subcarrier mapping of UL ACK modulation symbols for PUSC**

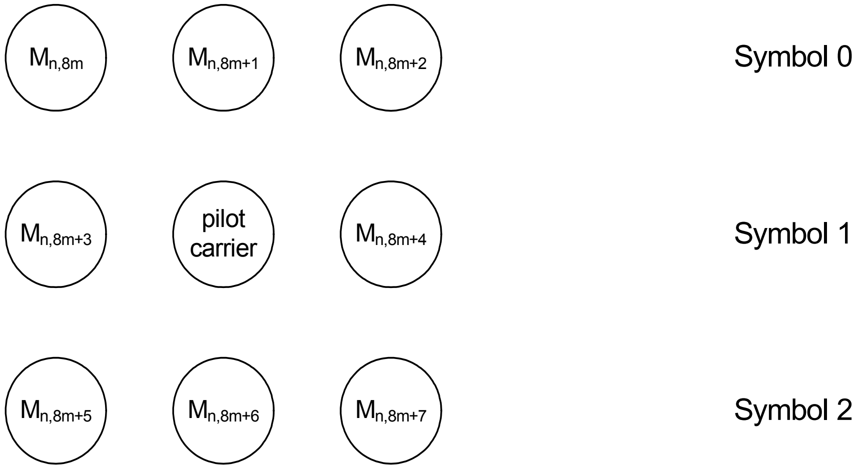

$M_{n,8m}$
$M_{n,8m+1}$
$M_{n,8m+2}$
Symbol 0
$M_{n,8m+3}$
pilot carrier
$M_{n,8m+4}$
Symbol 1
$M_{n,8m+5}$
$M_{n,8m+6}$
$M_{n,8m+7}$
Symbol 2

**Figure 231h—Subcarrier mapping of UL ACK modulation symbols for optional PUSC**

### 8.4.5.4.14 UL-MAP Physical Modifier IE

***Change the first paragraph as indicated:***

For an SS that supports the AAS option (see 8.4.4.6), ~~T~~the Physical Modifier Information Element indicates that the subsequent allocations shall utilize a preamble, which is either cyclically rotated in frequency or cyclically delayed [see Equation (104) and Equation (105)]. The PHYMOD_UL_IE can appear anywhere in the UL map, and it shall remain in effect until another PHYMOD_UL_IE is encountered, or until the end of the UL map. When BS schedules more than one UL transmission for an SS it shall guarantee that the preamble modifier is the same for all UL bursts of the SS.

***Change Table 302 as indicated:***

### Table 302—OFDMA UL-MAP Physical Modifier IE format

| Syntax | Size | Notes |
|---|---|---|
| PHYMOD_UL_IE() { | | |
| **Extended UIUC** | 4 bits | PHYMOD = 0x05 |
| **Length** | 4 bits | Length = 0x0~~3~~1 |
| **Preamble Modifier Type** | 1 bit | 0 – ~~Randomized preamble~~frequency shifted preamble<br>1 – ~~Cyclically shifted Preamble~~time shifted Preamble |
| if (Preamble Modifier Type == 0) { | | |
| **Preamble frequency shift index** | 4 bits | Indicates the value of *K* in Equation (105) |
| } else { | | |
| **Preamble Time Shift Index** | 4 bits | ~~Indicates the value of K in equation (1)~~<br>Specifies the cyclic time shift in equation (100):<br>For PUSC,<br>0 – 0 sample cyclic shift<br>1 – ~~floor(~~$N_{FFT}$/4~~)~~ sample cyclic shift<br>….<br>3 – ~~floor(~~$N_{FFT}$/4*3~~)~~ sample cyclic shift<br>4–15 – Reserved<br><br>For optional PUSC,<br>0 – 0 sample cyclic shift<br>1 – ~~floor(~~$N_{FFT}$/3~~)~~ sample cyclic shift<br>2 – ~~floor(~~$N_{FFT}$/3*2~~)~~ sample cyclic shift<br>3–15 – Reserved<br><br>For AMC permutation,<br>0 – 0 sample cyclic shift<br>1 – ~~floor(~~$N_{FFT}$/9~~)~~ sample cyclic shift<br>….<br>8 – ~~floor(~~$N_{FFT}$/9*8~~)~~ sample cyclic shift<br>9–15 – Reserved |
| } | | |
| **Pilot Pattern Modifier** | 1 bits | 0: Not applied, 1: Applied |
| **Pilot Pattern Index** | 2 bits | Pilot pattern used for this allocation (see 8.4.8.1.5 (Figure 249) and 8.4.6.3.3):<br>0b00 – Pilot Pattern #A<br>0b01 – Pilot Pattern #B<br>0b10 – Pilot Pattern #C<br>0b11 – Pilot Pattern #D |
| ~~*Reserved*~~ | ~~7 bits~~ | ~~Shall be set to zero~~ |
| } | | |

***Insert new subclause 8.4.5.4.15:***

### 8.4.5.4.15 UL allocation start IE

The UL Allocation start IE indicates the start offset of all subsequent UL allocation including allocation done by UL-MAP_IE and extended UL-MAP_IE. When this IE is included in UL-MAP or SUB-DL-UL-MAP, an SS shall determine all subsequent UL allocations based on the start offset defined in this IE except when the UL allocation already specified a start offset. This IE shall be supported by all SS.

**Table 302a—UL allocation start IE format test**

| Syntax | Size | Notes |
|---|---|---|
| UL Allocation start IE() { | — | — |
| **Extended UIUC** | 4 bits | UL_Allocation_start_IE() = 0x0A |
| **Length** | 4 bits | Length = 0x02 |
| **OFDMA symbol offset** | 8 bits | This value indicates start symbol offset of all subsequent UL allocations in this UL_MAP message (UL-MAP or SUB-UL-DL-MAP). |
| **Subchannel offset** | 7 bits | This value indicates start subchannel offset of all subsequent UL data burst allocations in this message (UL-MAP or SUB-UL-DL-MAP). |
| *Reserved* | 1 bit | Shall be set to zero. |
| } | — | — |

***Insert new subclause 8.4.5.4.16:***

### 8.4.5.4.16 CQICH Enhanced Allocation IE format

CQICH_Enhanced_Alloc_IE(), is introduced to dynamically allocate or de-allocate a CQICH to an SS. This IE shall only be used with Enhanced Fast-feedback channel in 8.4.5.4.10.4 and primary/secondary Fast-feedback channel in 8.4.5.4.10.12. Once allocated, the SS transmit feedback information of the specified type on the assigned CQICH with the determined period, until the SS receives a CQICH_Enhanced_Alloc_IE() to de-allocate the assigned CQICH.

**Table 302b—CQICH Enhanced allocation IE format**

| Syntax | Size | Notes |
|---|---|---|
| CQICH_Enhanced_Alloc_IE() { | — | — |
| **Extended-2 UIUC** | 4 bits | CQICH Enhance Alloc IE()=0x00 |
| **Length** | 8 bits | Length in bytes of following fields |
| **CQICH_ID** | *variable* | Index to uniquely identify the CQICH resource assigned to the MS |
| **Period (=p)** | 3 bits | A CQI feedback is transmitted on the CQICH every $2^p$ frames |

**Table 302b—CQICH Enhanced allocation IE format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **Frame offset** | 3 bits | The MS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the MS should start reporting in eight frames |
| **Duration (=d)** | 3 bits | A CQI feedback is transmitted on the CQI channels indexed by the CQICH_ID for $10\times2^d$ frames. If d==0b000, the CQICH is deallocated. If d == 0b111, the MS should report until the BS command for the MS to stop. |
| **CQICH_Num** | 4 bits | Number of CQICHs assigned to this CQICH_ID is (CQICH_Num +1) |
| for (i=0;i<CQICH_Num+1;i++) { | — | — |
| **Feedback Type** | 3 bits | 0b000 - 0b010 = Fast DL measurement/Default Feedback depending on CQICH types<br>0b011 = Quantized precoding weight feedback<br>0b100 = Index to precoding matrix in codebook<br>0b101 = Channel Matrix Information<br>0b110-0b111 = *Reserved* |
| **Allocation index** | 6 bits | Index to the Fast-feedback channel region marked by UIUC=0 |
| **CQICH Type** | 3 bits | 0b000 = 6-bit CQI,<br>0b001 = *Reserved*,<br>0b010 = 3-bit CQI (even)<br>0b011 = 3-bit CQI(odd)<br>0b100 = 6-bit CQI (primary)<br>0b101 = 4-bit CQI (secondary)<br>0b110-0b111 = *Reserved* |
| **STTD indication** | 1 bit | When CQICH type=000,<br>0 = Reserved<br>1 = use STTD in PUSC only (see Figure 249) |
| } | — | — |
| Band_AMC_Precoding_Mode | 1 bit | 0 = One common precoder for all bands.<br>1 = Distinct precoders for the bands with the highest S/N values, up to the number of short-term precoders fed back as specified by Nr_Precoders_feedback |
| If (Band_AMC_Precoding_Mode =1) {<br>Nr_Precoders_feedback (=N)<br>} | 3 bits | Nr of precoders feedback = N |
| Padding | *variable* | The padding bits are used to ensure the IE size is integer number of bytes. |
| } | — | — |

**Feedback Type**

For CQICH type=0b000, 0b001 or 0b100:

0b000 = Fast DL measurement/Default Feedback with antenna grouping

0b001 = Fast DL measurement/Default Feedback with antenna selection

0b010 = Fast DL measurement/Default Feedback with reduced codebook
When the MS transmits the feedback of S/N using 5 LSBs of 6 bits on it assigned CQICH, the MSB is set to 0 (see 8.4.5.4.10.5). MS may transmit, on its assigned CQICH, the feedback information specified in 8.4.5.4.10.7
For CQICH type= 0b010 or 0b011:
0b000 = Antenna grouping (see Table 298d of 8.4.5.4.10.7)
0b001 = Antenna selection (see Table 298e of 8.4.5.4.10.7)
0b010 = Reduced codebook (see Table 298f of 8.4.5.4.10.7)
For CQICH type= 0b101:
0b000 = Fast DL measurement (see 8.4.5.4.10.1 and 8.4.5.4.10.5)
0b001 = Default Feedback with antenna grouping (see Table 298 of 8.4.5.4.10.3)
0b010 = Antenna selection and reduced codebook (see Table 298a of 8.4.5.4.10.3)
0b011 = Quantized precoding weight feedback (see Figure 231 of 8.4.5.4.10.2)

***Insert new subclause 8.4.5.4.17:***

### 8.4.5.4.17 UL PUSC Burst Allocation in Other Segment IE

In the UL-MAP, a BS may transmit UIUC=15 with the UL PUSC Burst Allocation in Other Segment IE () to define uplink bandwidth allocation in other segment. (See Table 302c.)

Table 302c—UL PUSC Burst Allocation in Other Segment IE

| Syntax | Size | Notes |
|---|---|---|
| UL PUSC Burst Allocation in Other Segment IE () { | — | — |
| **Extended UIUC** | 4 bits | UL PUSC Burst Allocation in Other Segment IE () == 0x08 |
| **Length** | 4 bits | Length=0x08 |
| **UIUC** | 4 bits | — |
| **Segment** | 2 bits | Segment number for other BS' sector |
| **UL_Permbase** | 7 bits | UL Permbase for other BS' sector |
| **OFDMA symbol offset** | 8 bits | — |
| **Subchannel offset** | 6 bits | — |
| **Duration** | 10 bits | — |
| **Repetition coding indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| *Reserved* | 1 bit | Shall be set to zero |
| } | — | — |

***Insert new subclause 8.4.5.4.18:***

### 8.4.5.4.18 HO anchor active UL MAP IE

This MAP IE is in the UL-MAP of an active non-anchor BS and indicates the burst from the Anchor BS. When an MS receives a HO Anchor Active UL-MAP IE on UL-MAP message from an active non-anchor BS, it can send a data burst to the Anchor BS by using the 'Anchor Preamble' in HO Anchor Active UL-MAP IE. (See Table 302d.)

**Table 302d—HO anchor active UL MAP IE**

| Syntax | Size | Notes |
|---|---|---|
| HO Anchor Active UL MAP IE () { | — | — |
| **Extended-2 UIUC** | 4 bits | HO Anchor Active MAP IE() = 0x01 |
| **Length** | 8 bits | — |
| for (each bursts) { | — | — |
| **Anchor Preamble** | 16 bits | Preamble of anchor BS |
| **Anchor CID** | 16 bits | Basic CID in anchor BS |
| **Start subchannel offset** | 12 bits | — |
| **UIUC** | 4 bits | — |
| **Duration** | 10 bits | — |
| **Repetition coding indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| } | — | — |
| *padding nibble* | 0 or 4 bits | Shall be set to zero. |
| } | — | — |

***Insert new subclause 8.4.5.4.19:***

### 8.4.5.4.19 HO active anchor UL MAP IE

This MAP IE is in the UL-MAP of the anchor BS and indicates the burst from active non-anchor BS. When an MS receives a HO Active Anchor UL-MAP IE on UL-MAP message from an Anchor BS, it can send a data burst to the active non-anchor BS by using the 'Active Preamble' in HO Active Anchor UL-MAP IE. (See Table 302e.)

**Table 302e—HO active anchor UL MAP IE**

| Syntax | Size | Notes |
|---|---|---|
| **HO Active_Anchor UL MAP IE () {** | — | — |
| **Extended-2 UIUC** | 4 bits | HO Active_Anchor MAP IE() = 0x02 |
| **Length** | 8 bits | — |
| for (each bursts) { | — | — |
| **Active Preamble** | 16 bits | Preamble of active BS |
| **Anchor CID** | 16 bits | Basic CID in anchor BS |
| **Start subchannel offset** | 12 bits | — |
| **UIUC** | 4 bits | — |
| **Duration** | 10 bits | — |
| **Repetition coding indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| } | — | — |
| *padding nibble* | 0 or 4 bits | Shall be set to zero. |
| } | — | — |

***Insert new subclause 8.4.5.4.20:***

### 8.4.5.4.20 MIMO UL Enhanced IE format

In the UL-MAP, a MIMO-enabled BS may transmit MIMO_UL_Enhanced_IE() to indicate the MIMO configuration and pilot patterns of the subsequent uplink allocation to a specific MIMO-enabled MS CID. The MIMO mode indicated in the MIMO_UL_Basic_IE() shall only apply to the uplink allocation within the IE. (See Table 302f.)

**Table 302f—MIMO UL Enhanced IE**

| Syntax | Size | Notes |
|---|---|---|
| MIMO_UL_Enhanced_IE () { | — | — |
| **Extended-2 UIUC** | 4 bits | MIMO_UL_enhanced_IE=0x06 |
| **Length** | 8 bits | Length in bytes |
| **Num_Assign** | 4 bits | Number of burst assignment |
| For (j=0; j< Num_assign; j++){ | — | — |
| **Num_CID** | 2 bits | — |
| For ( i=0; i <Num_CID; i++){ | — | — |
| **CID** | 16 bits | MS basic CID |
| **UIUC** | 4 bits | — |
| **Matrix_Indicator** | 1 bit | For MS with dual antenna<br>0: Matrix A (STTD, see 8.4.8.4.3)<br>1: Matrix B (SM, see 8.4.8.4.3)<br>For MS with single antenna, skip this field. |
| **Pilot Pattern Indicator** | 1 bit | For MS with single antenna<br>0: pilot pattern A<br>1: pilot pattern B<br>For MS with dual antenna (for PUSC only)<br>0: pilot pattern A/B<br>1: pilot pattern C/D |
| *Reserved* | 2 bits | Shall be set to zero. |
| } | — | — |
| **Duration** | 10 bits | In OFDMA slots (see 8.4.3.1) |
| } | — | — |
| *Padding* | *variable* | Shall be set to zero. |
| } | — | — |

**Num_Assign**
A field that specifies the number of assignments in this IE.

**Matrix_Indicator**
A field that specifies the MIMO mode of UL burst. For MS with dual antenna it indicates STC Matrix and for MS with single antenna it is skipped.

**Pilot Pattern Indicator**
A field that indicates pilot patterns to MS with single antenna or to MS with dual antenna (see 8.4.8.1.5).

***Insert new subclause 8.4.5.4.21:***

### 8.4.5.4.21 OFDMA Fast_Ranging_IE format IE

A Fast_Ranging_IE may be placed in the UL-MAP message by a BS to provide a non-contention-based initial-ranging opportunity. The Fast_Ranging_IE shall be placed in the extended UIUC within a UL-MAP IE.

The format of the IE is PHY dependent as shown in Table 302g.

**Table 302g—OFDMA Fast_Ranging_IE format IE**

| Syntax | Size | Notes |
|---|---|---|
| Fast_Ranging_IE { | — | — |
| **Extended UIUC** | 4 bits | Fast_Ranging_IE() = 0x09 |
| **Length** | 4 bits | Length = 0x0B |
| **HO ID indicator** | 1 bit | 0: MAC Address is present<br>1: HO ID is present |
| *Reserved* | 3 bits | Shall be set to zero |
| if (HO ID indicator == 1) { | — | — |
| **HO ID** | 8 bits | — |
| *Reserved* | 40 bits | Shall be set to zero |
| } else { | — | — |
| **MAC address** | 48 bits | MS MAC address as provided on the RNG-REQ message on initial system entry |
| } | — | — |
| **UIUC** | 4 bits | UIUC ≠ 15. A four-bit code used to define the type of uplink access and the burst type associated with that access. |
| **Duration** | 10 bits | In OFDMA slots (see 8.4.3.1) |
| **Repetition coding indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| } | — | — |

**UIUC**
UIUC used for the burst.

**Duration**
Indicates the duration, in units of OFDMA slots, of the allocation.

**Repetition coding indication**
Indicates the repetition code used inside the allocated burst.

**HO ID indicator**
An indicator to indicate whether HO ID or MAC Address is being used to identify an MS during HO.

**HO ID**
An identifier assigned to an MS for use during initial ranging to the selected target BS.

***Insert new subclause 8.4.5.4.22:***

### 8.4.5.4.22 UL-MAP_Fast_Tracking_IE

In the UL-MAP, a BS may transmit UIUC = 15 with the UL-MAP_Fast_Tracking_IE() to provide fast power, time and frequency indications/corrections to MSs that have transmitted in the frame before the previous frame.

The CID used in the Information Element shall be a broadcast CID.

**Table 302h—UL-MAP_Fast_Tracking_IE**

| Syntax | Size | Notes |
|---|---|---|
| UL-MAP_Fast_Tracking_IE() { | — | — |
| **extended UIUC** | 4 bits | Fast Tracking_IE() = 0x07 |
| **Length** | 4 bits | *Variable* |
| **Map Index** | 2 bits | Index of SUB-DL-UL-MAP to which this IE refers, or zero if this IE refers to the mandatory UL-MAP.<br>Shall be set to zero. |
| *Reserved* | 6 bits | Shall be set to zero. |
| for (*i* = 1; *i* <= *n*; *i*++) { | — | For each Fast Indication bytes 1 to *n* (*n*=Length) |
| **Power correction** | 3 bits | Power correction indication:<br>0b000: no change;<br>0b001: +2 dB<br>0b010: –1 dB<br>0b011: –2 dB<br>0b100: –4 dB<br>0b101: -6 dB<br>0b110: +4 dB<br>0b111: +6 dB |
| **Frequency correction** | 3 bits | The correction is 0.1% of the carrier spacing multiplied by the 3-bit number interpreted as a signed integer (i.e., 0b100: –4; … 0b000: 0; … 0b011: 3) |
| **Time correction** | 2 bits | The correction is floor(2 / $F_s$) multiplied by:<br>0b00: 0;<br>0b01: 1;<br>0b10: –1;<br>0b11: *Reserved* |
| } | — | — |
| } | — | — |

The UL Fast tracking IE is an optional field in the UL-MAP. When this IE is sent it provides an indication about corrections that should be applied by MSs that have transmitted in the pervious UL frame. Each Indication byte shall correspond to one unicast allocation-IE that has indicated an allocation of an uplink transmission slot in the previous UL-MAP. The order of the indication bytes shall be the same as the order of the unicast allocation-IE in the UL-MAP.

The response time for corrections following receipt of this IE shall be equal to “Ranging Response Processing Time” as defined in 10.1.

***Insert new subclause 8.4.5.4.23:***

### 8.4.5.4.23 Anchor BS Switch IE

The Anchor_BS_switch_IE may be sent by a BS to indicate to one or more MS(s) to switch to a new specified Anchor BS at specific action time, or to cancel the switch. The Anchor_BS_switch_IE can also be used to allocate CQICH at the new Anchor BS.

**Table 302i—Anchor_BS_switch_IE format**

| Syntax | Size | Notes |
|---|---|---|
| Anchor_BS_switch_IE() { | — | — |
| **Extended UIUC2** | 4 bits | Anchor_BS_switch_IE() = 0x03 |
| **Length** | 8 bits | Length of the message in bytes |
| **N_Anchor_BS_switch** | 4 bits | Number of Anchor BS switching indicated in this IE |
| for (i = 0; i< N_Anchor_BS_switch; i++) { | — | — |
| **Reduced CID** | 12 bits | LSB 12 bits of basic CID of an MS whose anchor BS switching is indicated in this IE |
| **Action code** | 2 bits | 0b00 – The MS shall switch to the Anchor BS specified in the fast Anchor BS selection information in the Fast-feedback channel, at the default time specified by the switching period defined in the DCD.<br>0b01 – The MS shall switch to the Anchor BS specified in this IE and at the action time specified in this IE.<br>0b10 – The MS shall cancel all anchor switching procedure, stop switching timer and remain on the current anchor BS;<br>0b11 – *Reserved* |
| If (Action code == 01) { | — | — |
| **Action time (A)** | 3 bits | In units of frames. 0b000 means the MS shall switch at the default time specified by the switching period defined in the DCD |
| **TEMP_BS_ID** | 3 bits | TEMP_BS_ID of the anchor BS to switch to. (TEMP_BS_ID is the assigned ID to the BS when it was added to the diversity set of an MS) |
| **Reserved** | 2 bits | — |
| } | — | — |
| If ( Action code == 00 \|\| Action code == 01 ) { | — | — |
| **CQICH Allocation Indicator** | 2 bits | To indicate if CQICH allocation at the new Anchor BS is included in this IE. |
| If (CQICH_Allocation_Indicator == 1) { | — | — |
| **CQICH_ID** | *variable* | Index to uniquely identify he CQICH resource assigned to the MS after the MS switched to the new anchor BS |

**Table 302i—Anchor_BS_switch_IE format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **Feedback channel offset** | 6 bits | Index to the Fast-feedback channel region of the new Anchor BS marked by UIUC=0 |
| **Period (=p)** | 2 bits | A CQI feedback is transmitted on the CQICH every $2^p$ frames. |
| **Frame offset** | 3 bits | The MS starts reporting at the frame of which the number has the same 3 LSB as the specified frame offset. If the current frame is specified, the MS should start reporting in eight frames |
| **Duration (=d)** | 3 bits | A CQI feedback is transmitted on the CQI channels indexed by the CQICH_ID for $10 \times 2^d$ frames.<br>If d ==0b000, the CQI-CH is de-allocated.<br>If d ==0b111, the MS should report until the BS command for the MS to stop. |
| **MIMO_permutation_feedback_cycle** | 2 bits | 0b00 = No MIMO and permutation mode feedback<br>0b01 = the MIMO and permutation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 4 allocated CQICH transmission opportunity. The first indication is sent on the 4th allocated CQICH transmission opportunity.<br>0b10 = the MIMO mode and permultation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 8 allocated CQICH transmission opportunity. The first indication is sent on the 8th allocated CQICH transmission opportunity.<br>0b11 = the MIMO mode and permultation mode indication shall be transmitted on the CQICH indexed by the CQICH_ID every 16 allocated CQICH transmission opportunity. The first indication is sent on the 16th CQICH allocated CQICH transmission opportunity. |
| **Reserved** | *variable* | Number of bits required to align to byte length from CQICH Allocation Indicator bit field. Shall be set to zero. |
| } | — | — |
| }else{ | — | — |
| *Reserved* | 2 bits | — |
| } | — | — |
| } | — | — |
| *Reserved* | 4 bits | — |
| } | — | — |

***Insert new subclause 8.4.5.4.24:***

### 8.4.5.4.24 HARQ UL MAP IE

The following modes of HARQ shall be supported by the HARQ UL MAP IE:

1) Chase combining HARQ for all FEC types (HARQ Chase). In this mode, the burst profile is indicated by a DIUC.
2) Incremental redundancy HARQ for CTC (HARQ IR). In this mode, the burst profile is indicated by the parameters $N_{EP}$, $N_{SCH}$.
3) Incremental redundancy HARQ for convolutional code (HARQ CC-IR).

The IE may also be used to indicate also a non-HARQ transmission.

The HARQ UL MAP IE defines one or more bursts. Each burst is separately encoded.

When Allocation Start Indication is 1, the HARQ UL MAP IE indicates the starting symbol and subchannel of the allocation. The starting symbol and subchannel shall indicate a valid slot location in the uplink subframe. The slots are allocated in a time-first order (as specified in 8.4.5.4). The starting symbol and subchannel are relevant only in the context of the HARQ UL MAP IE in which they appear. Allocations made without an Allocation Start Indication (such as HARQ UL MAP IE with Allocation Start Indication 0, or regular UL-MAP_IE), shall be based on the global slot index, each of these allocations shall follow the last allocation which did not contain Allocation Start indication.

**Table 302j—HARQ UL MAP IE**

| Syntax | Size | Notes |
|---|---|---|
| HARQ UL MAP IE() { | — | — |
| **Extended-2 UIUC** | 4 bits | HARQ_UL-MAP_IE () = 0x07 |
| **Length** | 8 bits | Length in bytes |
| **RCID_Type** | 2 bits | 0b00 = Normal CID<br>0b01 = RCID11<br>0b10 = RCID7<br>0b11 = RCID3 |
| Reserved | 2 bits | |
| while (data remains) { | — | — |
| **Mode** | 3 bits | Indicates the mode of this IE<br>0b000 = Chase HARQ<br>0b001 = Incremental redundancy HARQ for CTC<br>0b010 = Incremental redundancy HARQ for convolutional code<br>0b011 = MIMO Chase HARQ<br>0b100 = MIMO IR HARQ<br>0b101 = MIMO IR HARQ for Convolutional Code<br>0b110 = MIMO STC HARQ<br>0b111 = *Reserved* |
| **Allocation Start Indication** | 1 bit | 0: No allocation start information<br>1: Allocation start information follows |

### Table 302j—HARQ UL MAP IE *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| If (Allocation Start Indication == 1) { | — | — |
| **OFDMA Symbol offset** | 8 bits | This value indicates start Symbol offset of subsequent sub-bursts in this HARQ ULMAP IE |
| **Subchannel offset** | 7 bits | This value indicates start Subchannel offset of subsequent sub-bursts in this HARQUL MAP IE |
| *Reserved* | 1 bit | Shall be set to zero. |
| } | — | — |
| **N sub Burst** | 4 bits | Indicates the number of bursts in this UL MAP IE |
| For (i =0 ;i < N Sub-burst; i++){ | | |
| If (Mode == 000) { | | |
| **UL HARQ Chase Sub-Burst IE ()** | | |
| } else if (Mode== 001) { | | |
| **UL HARQ IR CTC Sub-Burst IE ()** | | |
| } else if (Mode== 010) { | | |
| **UL HARQ IR CC Sub-Burst IE ()** | | |
| } else if (Mode== 011) { | | |
| **MIMO UL Chase HARQ Sub-Burst IE ()** | | |
| } else if (Mode== 100) { | | |
| **MIMO UL IR HARQ Sub-Burst IE ()** | | |
| } else if (Mode== 101) { | | |
| **MIMO UL IR HARQ for CC Sub-Burst IE ()** | | |
| } else if (Mode == 110) { | | |
| **MIMO UL STC HARQ Sub-Burst IE ()** | | |
| } | | |
| } | | |
| } | — | — |
| **Padding** | *variable* | Padding to byte; shall be set to 0 |
| } | — | — |

### Table 302k—UL HARQ Chase sub-burst IE format

| Syntax | Size | Notes |
|---|---|---|
| HARQ Chase UL Sub-Burst IE { | — | — |
| **RCID IE()** | *variable* | — |
| **Dedicated UL Control Indicator** | 1 bit | — |
| If (Dedicated UL Control Indicator ==1) { | — | — |
| **Dedicated UL Control IE ()** | *variable* | — |
| } | — | — |
| **UIUC** | 4 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| **Duration** | 10 bits | — |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |
| **ACK disable** | 1 bit | When 'ACK Disable' == 1, the allocated sub-burst does not require an ACK to be transmitted by the BS in the HARQ ACK BITMAP (see 8.4.5.3.22). In this case, no bit position is allocated for the sub-burst in the HARQ ACK BITMAP. For the burst, MS shall not perform HARQ retransmission and ignore ACID, AI_SN and SPID, which shall be set to '0' by BS if they exist. |
| *Reserved* | 1 bit | — |
| } | — | — |

### Table 302l—UL HARQ IR CTC sub-burst IE format

| Syntax | Size | Notes |
|---|---|---|
| HARQ IR CTC UL Sub-Burst IE { | — | — |
| **RCID IE()** | *variable* | — |
| **Dedicated UL Control Indicator** | 1 bit | — |
| If (Dedicated UL Control Indicator ==1) { | — | — |
| **Dedicated UL Control IE ()** | *variable* | — |
| } | — | — |
| **$N_{EP}$** | 4 bits | — |
| **$N_{SCH}$** | 4 bits | — |
| **SPID** | 2 bits | — |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |
| **ACK disable** | 1 bit | When 'ACK Disable' == 1, the allocated sub-burst does not require an ACK to be transmitted by the BS in the HARQ ACK BITMAP (see 8.4.5.3.22). In this case, no bit position is allocated for the sub-burst in the HARQ ACK BITMAP. For the burst, MS shall not perform HARQ retransmission and ignore ACID, AI_SN and SPID, which shall be set to '0' by BS if they exist. |
| *Reserved* | 3 bits | — |
| } | — | — |

### Table 302m—UL HARQ IR CC sub-burst IE format

| Syntax | Size | Notes |
|---|---|---|
| HARQ IR CC UL Sub-Burst IE { | — | — |
| **RCID IE()** | *variable* | — |
| **Dedicated UL Control Indicator** | 1 bit | — |
| If (Dedicated UL Control Indicator ==1) { | — | — |
| **Dedicated UL Control IE ()** | *variable* | — |
| } | — | — |
| **UIUC** | 4 bits | — |
| **Repetition Coding Information** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| **Duration** | 10 bits | — |
| **SPID** | 2 bits | — |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |
| **ACK disable** | 1 bit | When 'ACK Disable' == 1, the allocated sub-burst does not require an ACK to be transmitted by the BS in the HARQ ACK BITMAP (see 8.4.5.3.22). In this case, no bit position is allocated for the sub-burst in the HARQ ACK BITMAP. For the burst, MS shall not perform HARQ retransmission and ignore ACID, AI_SN and SPID, which shall be set to '0' by BS if they exist. |
| *Reserved* | 3 bits | — |
| } | — | — |

### Table 302n—MIMO UL Chase HARQ sub-burst IE format

| Syntax | Size | Notes |
|---|---|---|
| MIMO UL Chase HARQ Sub-Burst IE{ | — | — |
| **MU Indicator** | 1 bit | Indicates whether this UL burst is intended for multiple SS |
| **Dedicated MIMO UL Control Indicator** | 1 bit | — |
| **ACK Disable** | 1 bit | When ‘ACK Disable''== 1, the allocated sub-burst does not require an ACK to be transmitted by the BS in the HARQ ACK BITMAP (see 8.4.5.3.22). In this case, no bit position is allocated for the sub-burst in the HARQ ACK BITMAP. For the burst, MS shall not perform HARQ retransmission and ignore ACID, AI_SN and SPID, which shall be set to ‘0’ by BS if they exist. |
| if (MU indicator == 0) { | — | — |
| **RCID IE()** | *variable* | — |
| If (Dedicated MIMO UL Control Indicator ==1) { | — | — |
| **Dedicated MIMO UL Control IE ()** | *variable* | — |
| } | — | — |
| } else { | — | — |
| **Matrix** | 1 bit | Indicates transmission matrix (see 8.4.8) for MS with dual Tx antennas<br>0 = Matrix A<br>1 = Matrix B<br>Ignored by MS with single Tx antenna |
| } | — | — |
| **Duration** | 10 bits | — |
| For (i=0;i<N_layer;i++) { | — | — |
| if (MU indicator == 1) { | — | — |
| **RCID IE()** | *variable* | — |
| } | — | — |
| **UIUC** | 4 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| If (ACK Disable ==0) { | — | — |
| **ACID** | 4 bits | — |

### Table 302n—MIMO UL Chase HARQ sub-burst IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **AI_SN** | 1 bit | — |
| } | — | — |
| } | — | — |
| } | — | — |

When an MS receives a MIMO HARQ burst allocation with Dedicated MIMO UL Control Indicator set to ‘1’, the MS shall store the information in Dedicated MIMO UL Control IE. When an MS receives a MIMO HARQ burst allocation with Dedicated MIMO UL Control Indicator is set to ‘0’, the MS shall use the stored Dedicated MIMO UL Control information from the last burst allocation where this information was included.

For MIMO HARQ allocation specified in the MIMO UL Chase HARQ Sub-Burst IE, MIMO UL IR HARQ Sub-Burst IE, or the MIMO UL IR HARQ for CC Sub-Burst IE, each layer shall be allocated its associated bit position in the ACK channel bitmap. The number of bits in the ACK channel bitmap associated with the sub-burst IE may be greater than N_sub_burst.

For each single MS sub-burst (MU indicator = 0) matrix and layer information shall be read from Dedicated MIMO UL Control IE, if set by the indicator bit, and be applied to the burst accordingly. For each multiple-SS sub-burst (MU Indicator = 1), N_layer for this sub-burst shall be set to 2 and the first SS with the first RCID shall use the pilot pattern A for single antenna MS or the pilot pattern A/B for dual antenna MS in 8.4.8.1.5 and the first UIUC; whereas, the second MS with the second RCID shall use the pilot pattern B for single antenna MS or the pilot pattern C/D for dual antenna MS and the second UIUC.

### Table 302o—MIMO UL IR HARQ sub-burst IE format

| Syntax | Size | Notes |
|---|---|---|
| MIMO UL IR HARQ Sub-Burst IE{ | — | — |
| **MU Indicator** | 1 bit | Indicates whether this UL burst is intended for multiple SSs |
| **Dedicated MIMO UL Control Indicator** | 1 bit | — |
| **ACK Disable** | 1 bit | When ‘ACK Disable’ == 1, the allocated sub-burst does not require an ACK to be transmitted by the BS in the HARQ ACK BITMAP (see 8.4.5.3.22). In this case, no bit position is allocated for the sub-burst in the HARQ ACK BITMAP. For the burst, MS shall not perform HARQ retransmission and ignore ACID, AI_SN and SPID, which shall be set to ‘0’ by BS if they exist. |
| if (MU indicator == 0) { | — | — |
| **RCID IE()** | *variable* | — |
| If (Dedicated MIMO UL Control Indicator ==1) { | — | — |

### Table 302o—MIMO UL IR HARQ sub-burst IE format

| Syntax | Size | Notes |
|---|---|---|
| **Dedicated MIMO UL Control IE ()** | *variable* | — |
| } | — | — |
| } else { | — | — |
| **Matrix** | 1 bit | Indicates transmission matrix (see 8.4.8) for MS with dual Tx antennas<br>0 = Matrix A<br>1 = Matrix B<br>Ignored by MS with single Tx antenna |
| } | — | — |
| $\mathbf{N_{SCH}}$ | 4 bits | — |
| For (i=0;i<N_layer;i++) { | — | — |
| if (MU indicator == 1) { | — | — |
| **RCID IE()** | *variable* | — |
| } | — | — |
| $\mathbf{N_{EP}}$ | 4 bits | — |
| If (ACK Disable ==0) { | — | — |
| **SPID** | 2 bits | — |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |
| } | — | — |
| } | — | — |
| } | — | — |

### Table 302p—MIMO UL IR HARQ for CC sub-burst IE format

| Syntax | Size | Notes |
|---|---|---|
| MIMO UL IR HARQ for CC Sub-Burst IE{ | — | — |
| **MU Indicator** | 1 bit | Indicates whether this UL burst is intended for multiple SS |
| **Dedicated MIMO UL Control Indicator** | 1 bit | — |
| **ACK Disable** | 1 bit | When ‘ACK Disable’ == 1, the allocated sub-burst does not require an ACK to be transmitted by the BS in the HARQ ACK BITMAP (see 8.4.5.3.22). In this case, no bit position is allocated for the sub-burst in the HARQ ACK BITMAP. For the burst, MS shall not perform HARQ retransmission and ignore ACID, AI_SN and SPID, which shall be set to ‘0’ by BS if they exist. |
| if (MU indicator == 0) { | — | — |
| **RCID IE()** | *variable* | — |
| If (Dedicated MIMO UL Control Indicator ==1) { | — | — |
| **Dedicated MIMO UL Control IE ()** | *variable* | — |
| } | — | — |
| } else { | — | — |
| **Matrix** | 1 bit | Indicates transmission matrix (See 8.4.8) for MS with dual Tx antennas<br>0 = Matrix A<br>1 = Matrix B<br>Ignored by MS with single Tx antenna |
| } | — | — |
| **Duration** | 10 bits | — |
| For (i=0;i<N_layer;i++) { | — | — |
| if (MU indicator == 1) { | — | — |
| **RCID IE()** | *variable* | — |
| } | — | — |
| **UIUC** | 4 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| If (ACK Disable ==0) { | — | — |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |

### Table 302p—MIMO UL IR HARQ for CC sub-burst IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **SPID** | 2 bits | — |
| } | — | — |
| } | — | — |
| } | — | — |

### Table 302q—MIMO UL STC HARQ sub-burst IE format

| Syntax | Size | Notes |
|---|---|---|
| MIMO UL STC HARQ Sub-Burst IE{ | — | — |
| **Tx count** | 2 bits | 0b00: Initial transmission<br>0b01: Odd retransmission<br>0b10: Even retransmission<br>0b11: *Reserved* |
| **Duration** | 10 bits | — |
| **Sub-burst offset indication** | 1 bit | Indicates the inclusion of sub-burst offset. |
| *Reserved* | — | Shall be set to zero |
| **If (Sub-burst offset indication ==1) {** | — | — |
| **Sub-burst offset** | 8 bits | Offset in slots with respect to the previous sub-burst defined in this data region. If this is the first sub-burst within the data region, this off-set is with respect to slot 0 of the data region. |
| **}** | — | — |
| **RCI_D_IE()** | *Variable* | — |
| **ACK Disable** | 1 bit | When 'ACK Disable' == 1, the allocated sub-burst does not require an ACK to be transmitted by the BS in the HARQ ACK BITMAP (see 8.4.5.3.22). In this case, no bit position is allocated for the sub-burst in the HARQ ACK BITMAP. For the burst, MS shall not perform HARQ retransmission and ignore ACID, AI_SN and SPID, which shall be set to '0' by BS if they exist. |
| If (Tx count == 00) { | — | — |
| **UIUC** | 4 bits | — |

**Table 302q—MIMO UL STC HARQ sub-burst IE format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **Repetition Coding Information** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| } | — | — |
| If (ACK Disable == 0) { | — | — |
| **ACID** | 4 bits | — |
| } | — | — |
| } | — | — |

***Insert new subclause 8.4.5.4.24.1:***

### 8.4.5.4.24.1 Dedicated UL Control IE

**Table 302r—Dedicated UL control IE format**

| Syntax | Size | Notes |
|---|---|---|
| Dedicated UL control IE() { | — | — |
| **Length** | 4 bits | Length of following control information in Nibble. |
| **Control header** | 4 bits | Bit #0: SDMA Control Info<br>Bit #1–3: Reserved |
| If( SDMA Control Info Bit == 1){ | — | — |
| **Num SDMA layers** | 2 bits | This value plus one indicates the total number of SDMA layers associated with the HARQ UL MAP IE |
| **Pilot pattern** | 2 bits | 0b00 = pattern A<br>0b01 = pattern B<br>0b10 = pattern C<br>0b11 = pattern D |
| } | — | — |
| } | — | — |

**Length**

A field that indicates the following control information.

**Control Information**

Variable size control information.

**SDMA control information**

The Dedicated UL Control IE with SDMA Control Info = 1 shall be present within the first sub-burst allocation of each layer of SDMA allocations. When the SDMA control info is present, the OFDMA Symbol offset and Subchannel offset shall be reset to the Start OFDMA

Symbol offset and Start Subchannel offset of the HARQ UL MAP IE. The specified pilot pattern (see 8.4.8.1.5) is used for all sub-burst allocations until the next occurrence of SDMA Control Info or until the end of the current HARQ UL MAP IE. The information specified in this SDMA control info is first applied to the same sub-burst allocation that contains the Dedicated UL Control IE.

***Insert new subclause 8.4.5.4.24.2:***

### 8.4.5.4.24.2 Dedicated MIMO UL control IE format

Dedicated UL Control IE for MIMO contains additional control information for each sub-burst. (See Table 302s.)

**Table 302s—Dedicated MIMO UL control IE format**

| Syntax | Size | Notes |
|---|---|---|
| Dedicated MIMO UL Control IE() { | — | — |
| **Matrix** | 2 bits | Indicates transmission matrix (see 8.4.8)<br>0b00 = Matrix A (Transmit Diversity)<br>0b01 = Matrix B (Spatial Multiplexing)<br>0b10–0b11 = Reserved |
| **N_layer** | 2 bits | Number of coding/modulation layers<br>0b00 = 1 layer<br>0b01 = 2 layers<br>0b10-0b11 = Reserved |
| } | — | — |

***Insert new subclause 8.4.5.4.25:***

### 8.4.5.4.25 HARQ ACK Region Allocation IE

This IE may be used by the BS to define a UL region to include one or more ACK channel(s) for HARQ supporting MS. The IE format is shown in Table 302t. The slots in the ACKCH region are divided into two half-slots. The first half-slot is composed of tiles 0,2,4; the second half-slot is composed of tiles 1,3,5. In the ACKCH Region, ACK channel 2n is the first half of slot n; ACK channel ($2n+1$) is the second half of slot n. The slot number n is increased first along the subchannel axis until the end of the ACKCH region, and then along the time axis.

The HARQ enabled MS that receives HARQ DL burst at frame $i$ should transmit the ACK signal through the ACK channel in the ACKCH region at frame ($i+j$). The frame offset $j$ is defined by the “HARQ ACK Delay for DL Burst” field in the UCD message.

The half-subchannel offset in the ACKCH Region is determined by the order of HARQ enabled DL burst in the DL MAP. For example, when an MS receives a HARQ enabled burst at frame i, and the burst is the $n$-th HARQ enabled burst among the HARQ related IEs, the MS should transmit HARQ ACK at $n$-th half-subchannel in ACKCH Region that is allocated by the BS at frame ($i+j$).

Each SS should specify support of “UL ACK” channel (see 11.8.3.7.13).

When the "ACK disable" bit is set (in DL HARQ IR CTC Sub-Burst IE format), no ACK channel is allocated for the sub-burst.

**Table 302t—HARQ ACKCH region allocation IE**

| Syntax | Size | Notes |
|---|---|---|
| HARQ ACKCH_Region_IE() { | — | — |
| **Extended-2 UIUC** | 4 bits | HARQ_ACKCH_region_IE () = 0x08 |
| **Length** | 8 bits | Length in bytes |
| **OFDMA Symbol offset** | 8 bits | — |
| **Subchannel offset** | 7 bits | — |
| **No. OFDMA symbols** | 5 bits | — |
| **No. subchannels** | 4 bits | — |
| } | — | — |

**OFDMA Symbol offset**

**Subchannel offset**

**No. OFDMA Symbols**

**No. Subchannels**
Specify the start symbol offset, the start subchannel offset, the number of allocated symbols, and the number of subchannels for the HARQ acknowledgement region respectively.

HARQ ACK Region Allocation IE may override Fast-feedback Region. This means that when the HARQ ACK Region Allocation IE indicates the same region that is allocated for CQICH, then the region shall be used for HARQ ACK region.

***Insert new subclause 8.4.5.4.26:***

### 8.4.5.4.26 UL_Sounding_Command_IE

UL_Sounding_Command_IE is defined in 8.4.6.2.7.1, Table 316a.

***Insert new subclause 8.4.5.4.27:***

### 8.4.5.4.27 AAS_SDMA_UL_IE format

**Table 302u—AAS_SDMA_UL_IE**

| Syntax | Size | Notes |
|---|---|---|
| AAS_SDMA_UL_IE() { | — | — |
| **Extended-2 UIUC** | 4 bits | AAS_SDMA_UL_IE = 0x0E |
| **Length** | 8 bits | *variable* |
| **RCID_Type** | 2 bits | 0b00 = Normal CID<br>0b01 = RCID11<br>0b10 = RCID7<br>0b11 = RCID3 |
| **Num Burst Region** | 4 bits | — |
| *Reserved* | 2 bits | Shall be set to zero. |
| For (ii = 1: Num Region) { | — | — |
| **Slot offset** | 12 bits | Starting slot offset in AAS zone referenced to right after UL AAS preamble |
| **Slot duration** | 10 bits | — |
| **Number of Users** | 3 bits | SDMA users for the assigned region |
| *Reserved* | 3 bits | Shall be set to zero. |
| For (jj = 1: Num_Users) { | — | — |
| **RCID_IE()** | *variable* | — |
| **Encoding Mode** | 2 bits | 0b00: No HARQ<br>0b01: HARQ Chase Combining<br>0b10: HARQ Incremental Redundancy<br>0b11: HARQ Conv. Code Incremental Redundancy |
| **Power Adjust** | 1 bit | 0: Not Included<br>1: Included; Signed integer in 0.25 dB Unit |
| **Pilot Pattern Modifier** | 1 bit | 0: Not Applied<br>1: Applied |
| If (AAS UL Preamble Used) { | — | — |
| **Preamble Modifier Index** | 4 bits | Preamble Modifier Index |
| } | — | — |
| If (Pilot Pattern Modifier) { | — | Pilots per beam |
| **Pilot Pattern** | 2 bits | See 8.4.8.1.5 (Figure 249) and 8.4.6.3.3<br>0b00: Pattern #A<br>0b01: Pattern #B<br>0b10: Pattern #C<br>0b11: Pattern #D |
| *Reserved* | 2 bits | Shall be set to zero. |
| } | — | — |

### Table 302u—AAS_SDMA_UL_IE *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| If (Encoding Mode = = 0b00) { | — | — |
| **DIUC** | 4 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00: No repetition<br>0b01: Repetition of 2<br>0b10: Repetition of 4<br>0b11: Repetition of 6 |
| *Reserved* | 2 bits | Shall be set to zero. |
| } | — | — |
| If (Encoding Mode = = 0b01) { | — | HARQ Chase Combining |
| **DIUC** | 4 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00: No repetition<br>0b01: Repetition of 2<br>0b10: Repetition of 4<br>0b11: Repetition of 6 |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |
| *Reserved* | 1 bit | Shall be set to zero. |
| } | — | — |
| If (Encoding Mode = = 0b10) { | — | — |
| $\mathbf{N_{EP}}$ | 4 bits | — |
| $\mathbf{N_{SCH}}$ | 4 bits | Indicator for the number of first slots used for data encoding in this SDMA allocation region |
| **SPID** | 2 bits | — |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |
| *Reserved* | 1 bit | Shall be set to zero. |
| } | — | — |
| If (Encoding Mode = = 0b11) { | — | HARQ Conv. Code Incremental Redundancy |
| **DIUC** | 4 bits | — |
| **Repetition Coding Indication** | 2 bits | 0b00: No repetition<br>0b01: Repetition of 2<br>0b10: Repetition of 4<br>0b11: Repetition of 6 |
| **SPID** | 2 bits | — |
| **ACID** | 4 bits | — |
| **AI_SN** | 1 bit | — |
| *Reserved* | 3 bits | Shall be set to zero. |
| } | — | — |

**Table 302u—AAS_SDMA_UL_IE *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| If (Power Adjust Included) { | — | — |
| **Power adjustment** | 8 bits | Signed integer in 0.25 dB Unit |
| } | — | — |
| } | — | End of User loop |
| } | — | End of Burst Region Loop |
| **Padding** | *variable* | Shall be set to zero. |
| } | — | — |

***Insert new subclause 8.4.5.4.28:***

### 8.4.5.4.28 Feedback polling IE

This IE may be used by BS to schedule Feedback header transmission by the MS. When the Dedicated UL Allocation bit is set to 1, a dedicated UL allocation shall be included in this IE. The dedicated UL allocation shall be used by the MS to transmit Feedback header at the designated Feedback header transmission frame defined by this IE. When the Dedicated UL Allocation bit is set to 0, no dedicated UL allocation shall be included. Instead, at the designated transmission frame defined by this IE, the MS shall compose the Feedback header and the BS shall include a dedicated UL allocation for the transmission using normal UL MAP IE. (See Table 302v.)

**Table 302v—Feedback polling IE format**

| Syntax | Size | Notes |
|---|---|---|
| Feedback polling IE () { | — | — |
| **Extended-2 UIUC** | 4 bits | 0x0F |
| **Length** | 8 bits | Length in bytes of following fields |
| **Num_Allocations** | 4 bits | |
| **Dedicated UL Allocation Included** | 1 bit | 0: No dedicated UL resource is allocated in this feedback polling IE. BS shall provide UL allocation for the Feedback header transmission through UL-MAP at each designated transmitting frame defined by this IE<br>1: Dedicated UL resource is included |
| ***Reserved*** | 3 bits | Shall be set to zero. |
| For (i=0; i < Num Allocations; i++) { | — | — |
| **Basic CID** | 16 bits | — |
| **Allocation Duration (d)** | 3 bits | The allocation is valid for $4^{(d-1)}$ frame starting from the frame defined by Frame_offset<br>If d == 0b000, the pre-scheduled Feedback header transmission is released<br>If d == 0b111, the pre-scheduled Feedback header transmission shall be valid until the BS commands to release it. |

### Table 302v—Feedback polling IE format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| If (d != 0b000) { | — | — |
| **Feedback type** | 4 bits | See Table 7i |
| **Frame Offset** | 3 bits | The offset (in units of frames) from the current frame in which the first UL feedback header shall be transmitted on the allocated UL resource. The start value of frame offset shall be 1. |
| **Period (p)** | 2 bits | The UL resource region is dedicated to the MS in every $2^p$ frame. |
| If (Dedicated UL Allocation Included == 1) { | — | — |
| **UIUC** | 4 bits | — |
| **OFDMA symbol offset** | 8 bits | — |
| **Subchannel offset** | 7 bits | — |
| **Duration** | 3 bits | In OFDMA Slots |
| **Repetition coding indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| } | — | — |
| } | — | — |
| } | — | — |
| *Padding bits* | *variable* | To align octet boundary |
| } | — | — |

**Feedback type**
See Table 7i.

**Duration**
In OFDMA slots (see 8.4.3.1).

**Period (p)**
The UL resource region is dedicated to an MS in every $2^p$ frame.

**Dedicated UL Allocation**
0: No dedicated UL resource is allocated in feedback polling IE. BS shall provide UL allocation for the Feedback header transmission at each designated transmitting frame defined by this IE.
1: Dedicated UL resource is included.

**OFDMA symbol offset**
The offset of OFDMA symbol in which the burst starts, measured in OFDMA symbols from beginning of the designated transmission uplink frame for feedback header.

**Subchannel offset**
The lowest index OFDMA subchannel used for carrying the burst, starting from subchannel 0.

**Allocation Duration (d)**
The allocation is valid for $4^{(d-1)}$ frame starting from the frame defined by Frame offset
If d == 0b000, the dedicated allocation is de-allocated.

If d == 0b111, the dedicated resource shall be valid until the BS commands to de-allocate the dedicated allocation.

***Insert the following text and tables at the end of 8.4.5.5:***

### 8.4.5.5 Burst profile format

Table 304a defines the format of the Downlink_Burst_Profile with type=153, which is used in the DCD message (6.3.2.3.1) for MS only. The DIUC field is associated with the Downlink Burst Profile and Thresholds. The DIUC value is used in the DL-MAP message to specify the Burst Profile to be used for a specific downlink burst.

**Table 304a—OFDMA Downlink_Burst_Profile TLV format for multiple FEC types**

| Syntax | Size | Notes |
|---|---|---|
| Downlink burst profile{ | — | — |
| **Type = 153** | 8 bits | — |
| **Length** | 8 bits | — |
| *Reserved* | 2 bits | Shall be set to zero |
| **Coding Type** | 2 bits | 0b00: BTC<br>0b01: CTC<br>0b10: ZT CC<br>0b11: LDPC |
| **DIUC** | 4 bits | — |
| **TLV encoded information** | *variable* | — |
| } | — | — |

Table 304b defines the format of the Uplink_Burst_Profile with type=13, which is used in the UCD message (6.3.2.3.3) for MS only. The UIUC field is associated with the Uplink Burst Profile and Thresholds. The UIUC value is used in the UL-MAP message to specify the Burst Profile to be used for a specific uplink burst.

### Table 304b—OFDMA Uplink_Burst_Profile TLV format for multiple FEC types

| Syntax | Size | Notes |
|---|---|---|
| Uplink burst profile{ | — | — |
| **Type = 13** | 8 bits | — |
| **Length** | 8 bits | — |
| *Reserved* | 2 bits | Shall be set to zero |
| **Coding Type** | 2 bits | 0b00: BTC<br>0b01: CTC<br>0b10: ZT CC<br>0b11: LDPC |
| **UIUC** | 4 bits | — |
| **TLV encoded information** | *variable* | — |
| } | — | — |

DIUC/UIUC for mandatory CC shall be referred to Downlink/Uplink_burst_profile with type=1. If there is no Downlink(Uplink)_burst_profile with type of 153(13), MSs shall refer to Downlink(Uplink)_burst_profile with type of 1. The burst transmitted without CID in the DL-MAP IE shall be encoded using DIUC specified in the downlink burst profile with type of 1. This capability is determined by SBC-REQ/RSP (see 11.8.3.7.16).

MAP IEs that do not contain a CID or that contain broadcast/multicast CIDs shall always use type 1 DIUC (see Table 303).

### 8.4.5.6 Compressed maps

***Change the subclause as indicated:***

In addition to the standard DL-MAP and UL-MAP formats described in 6.3.2.3.2 and 6.3.2.3.4, the DL-MAP and UL-MAP may conform to the format presented in the following subclauses. The presence of the compressed DL-MAP format is indicated by the contents of the most significant two bits of the first data byte ~~following the DL Frame Prefix~~. These bytes overlay the HT and EC bits of a generic MAC header. When these bits are both set to 1 (an invalid combination for a standard header), the compressed DL-MAP format is present. A compressed UL-MAP shall only appear after a compressed DL-MAP. The presence of a compressed UL-MAP is indicated by a bit in the compressed DL-MAP data structure.

The compressed map must occur directly after the DL Frame Prefix, or can be used as a private map in an AAS zone. When located in an AAS zone, the private map can be pointed to by a broadcast map, the AAS DLFP message, or another private map in a previous frame. Other restrictions of private maps include:

- The private map must be the first message in a PHY burst.
- Private maps are only allowed to use unicast CID values.
- Allocations pointed to by a private map must occur within the same AAS zone as the private map.
- Both UL and DL allocations included in the private map are relative to the next frame + frame offset value negotiated with the SS (see 11.8.3.7.6).

When a private map chain is started that has UL IE, an AAS_UL_IE must be included in the first UL map so the AAS zone information is known by the SS. This information only needs to be included in the first private map of a private map chain, or after any parameters in the AAS zone is changed. The DL zone information is expected to be static for the duration of the private map chain; however, a AAS_DL_IE can be included to change the DL AAS zone parameters. The private map is an optional feature that can be negotiated between the SS and BS. In addition, there is a capability bit to indicate if an SS can support private map chains. This is to support applications that utilize private maps but do not require chains.

### 8.4.5.6.1 Compressed DL-MAP

***Change Table 305 as indicated:***

**Table 305—Compressed DL-MAP message format**

| Syntax | Size | Notes |
|---|---|---|
| Compressed_DL-MAP() { | | |
| **Compressed map indicator** | ~~2~~3 bits | Set to binary 110 ~~for~~to indicate a compressed map format |
| ~~*Reserved*~~ | ~~1 bit~~ | ~~Shall be set to zero~~ |
| **UL-MAP appended** | 1 bit | |
| ~~**CRC appended**~~*Reserved* | 1 bit | Shall be set to zero |
| **Map message length** | 11 bits | |
| **PHY Synchronization Field** | 32 bits | |
| **DCD Count** | 8 bits | |
| **Operator ID** | 8 bits | |
| **Sector ID** | 8 bits | |
| **No. OFDMA symbols** | 8 bits | Number of OFDMA symbols in the DL subframe including all AAS/permutation zone. |
| **DL IE count** | 8 bits | |
| for (*i* = 1; *i* <= DL IE count; *i*++) { | | |
| **DL-MAP_IE()** | *variable* | |
| } | | |
| if !(byte boundary) { | | |
| **Padding Nibble** | 4 bits | Padding to reach byte boundary |
| } | | |
| } | | |

***Change the description of 'UL-MAP appended' and 'CRC appended' field below Table 305 as indicated:***

**UL-MAP appended**

A value of 1 indicates a compressed UL-MAP (see ~~8.5.5.2.4.2~~8.4.5.6.2) is appended to the current compressed DL-MAP data structure.

**~~CRC appended~~**

~~A value of one indicates a~~ A CRC-32 value ~~is~~shall be appended to the end of the compressed map(s) data. The CRC is computed across all bytes of the compressed map(s) starting with the byte containing the Compressed map indicator through the last byte of the map(s) as specified by the Map message length field. The CRC calculation is the same as that used for standard MAC messages. ~~A value of zero indicates that no CRC is appended.~~

***Insert the following text at the end of the subclause:***

In case the UL-MAP is not appended to the DL-MAP, the UL-MAP (if such exists) message shall be always transmitted on the burst described by the first DL-MAP_IE of the DL-MAP.

### 8.4.5.6.2 Compressed UL-MAP

***Change the second sentence of the first paragraph as indicated:***

The message presents the same information as the standard format with the exception that the Generic MAC header ~~and the Uplink Channel ID are~~is omitted.

***Insert the following field after the 'Allocation Start Time' field in Table 306:***

| | | |
|---|---|---|
| **No. OFDMA symbols** | 8 bits | Number of OFDMA symbols in the UL subframe. |

### 8.4.5.7 AAS-FBCK-REQ/RSP message bodies

***Change field 'Frequency measurement resolution' in Table 307 as indicated:***

| | | |
|---|---|---|
| **Frequency measurement resolution** | 2 bits | if Measurement Data Type = 0 {<br>0b00 = 32 subcarriers<br>0b01 = 64 subcarriers<br>0b10 = 128 subcarriers<br>0b11 = 256 subcarriers<br>}<br>if Measurement Data Type = 1 {<br>0b00 = 1 subcarrier<br>0b01 = 4 subcarriers<br>0b10 = 8 subcarriers<br>0b11 = 16 subcarriers<br>} |

***Insert the following description after the description of 'Number of Frames' field below Table 307 as indicated:***

**Measurement Data Type**

Indicates the type of data on which the measurement is carried out. If the 'Measurement Data Type' field entry is set to '1' the measurement is carried out over all DL bursts for this SS during the period, that is indicated by Frame Number and Number of Frames. The measurement, thereby, extends over the DL bursts as a whole, including AAS DL preambles.

***Change the description of 'Frequency measurement resolution' below Table 307 as indicated:***

**Frequency measurement resolution**

Indicates the frequency measurement points to report on. Measurement points shall be on the frequencies corresponding to the negative subcarrier offset indices $-N_{used}/2 + n$ times the indicated subcarrier resolution and corresponding to the positive subcarrier offset indices $N_{used}/2 - n$ ~~×~~ times the indicated subcarrier resolution where $n$ is a positive integer. In case of measurement on the downlink data (value '1' of the 'Measurement Data Type' field) only the frequencies occurring in the allocations of the addressed SS shall be reported.

***Change the description of 'CINR mean value' field below Table 308 as indicated:***

**CINR mean value**

The mean CINR as measured on the element pointed to by data measurement type, frame number, and number of frames in the corresponding request. The ~~RSSI~~CINR is quantized as described in 8.3.9.2. When the AAS feedback response is unsolicited, this value corresponds to preceding frame.

***Change the description of the 'Re(Frequency_value[i] and Im(Frequency_value[i])' field below Table 308 as indicated:***

**Re( Frequency_value[i] ) and Im( Frequency_value[i] )**

The real (Re) and imaginary (Im) part of the mean measured complex amplitude on the frequency measurement point (low to high frequency) in signed integer fixed point format ([±][2 bits].[5 bits]).

### 8.4.5.8 Reduced AAS private maps

***Insert new subclause 8.4.5.8.1:***

#### 8.4.5.8.1 Reduced AAS private DL-MAP

The reduced AAS private DL-MAP format is presented in Table 308a. The reduced AAS private DL-MAP message eliminates the fields that are not relevant since the message is targeted to a single CID. The DL_PermBase of the zone containing the assigned DL allocation is assumed to have the same value as the zone in which the compressed private DL-MAP message is located.

### Table 308a—Reduced AAS-private DL-MAP message format

| Syntax | Size | Notes |
|---|---|---|
| Reduced_ AAS_Private_DL-MAP() { | — | — |
| **Compressed map indicator** | 3 bits | Set to 0b110 for compressed format |
| **UL-MAP appended** | 1 bit | 1 = reduced UL Private map is appended |
| **Compressed Map Type** | 2 bits | Shall be set to 0b11 for reduced private map |
| **Multiple IE** | 1 bit | 1 = Multiple IE Mode |
| *Reserved* | 1 bit | Shall be set to zero |
| if (Multiple IE) { | — | — |
| **NUM IE** | 8 bits | — |
| } | — | — |
| for (ii=1:NUM IE) { | — | — |
| **Periodicity** | 2 bits | 00 = single command, not periodic, or terminate periodicity. Otherwise, repeat DL and UL allocations once per $r$ frames, where $r = 2^{(n-1)}$, where n is the decimal equivalent of the periodicity field. |
| **CID Included** | 1 bit | 1 = CID included.<br>The CID shall be included in the first compressed private MAP if it was pointed to by a DL-MAP IE with INC_CID==0 or by a DL-MAP IE with a multicast CID. |
| **DCD Count Included** | 1 bit | 1 = DCD Count included.<br>The DCD count is expected to be the same as in the broadcast map that initiated the private map chain. The DCD count can be included in the private map it if changes. |
| **PHY modification Included** | 1 bit | 1 = included. |
| **CQICH Control Indicator** | 1 bit | 1 = CQICH control information included. |
| **Encoding Mode** | 2 bits | Encoding for DL traffic burst<br>0b00: No HARQ<br>0b01: Chase Combing HARQ<br>0b10: Incremental Redundancy HARQ<br>0b11: Conv. Code Incremental Redundancy |
| **Separate MCS Enabled** | 1 bit | Separate coding applied for reduced AAS_Private_MAP and DL data burst |
| If (Separate MCS Enabled) { | — | Specifies coding for the next private map in the allocation specified by this private map |
| **Duration** | 10 bits | Slot duration for reduced AAS Private Map |
| **DIUC** | 4 bits | Modulation and Coding Level |

### Table 308a—Reduced AAS-private DL-MAP message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Repetition Coding Indication** | 2 bits | 0b00: No repetition<br>0b01: Repetition of 2<br>0b10: Repetition of 4<br>0b11: Repetition of 6 |
| } | — | — |
| if (CID Included) { | — | — |
| **CID** | 16 bits | Must be a unicast CID |
| } | — | — |
| If (CQICH Control Indicator == 1) { | — | — |
| **Allocation Index** | 6 bits | CQICH subchannel index within Fast-feedback region marked with UIUC = 0 |
| **Report Period** | 3 bits | Reporting period indicator (in frames) |
| **Frame offset** | 3 bits | Start frame offset for initial reporting |
| **Report Duration** | 4 bits | Reporting duration indicator |
| **CQI Measurement Type** | 2 bits | 0b00 – CINR measurement based upon DL allocation<br>0b01 – CINR measurement based upon DL frame preamble<br>0b10, 0b11 – *Reserved* |
| *Reserved* | 2 bits | Shall be set to zero |
| } | — | — |
| if (DCD Count Included) { | — | — |
| **DCD Count** | 8 bits | Matches the value of the configuration change count of the DCD, which describes the downlink burst profiles that apply to this map |
| } | — | — |
| if (PHY modification Included) { | — | — |
| **Preamble Select** | 1 bit | 0 = Frequency shifted preamble<br>1 = Time shifted preamble |
| **Preamble Shift Index** | 4 bits | Updated preamble shift index to be used starting with the frame specified by the Frame Offset |
| **Pilot Pattern Modifier** | 1 bit | 0: Not Applied,<br>1: Applied<br>Shall be set to 0 if PUSC AAS zone |
| **Pilot Pattern Index** | 2 bits | pilot pattern used for this allocation [see 8.4.6.3.3 (AMC), 8.4.6.1.2.6 (TUSC)]:<br>0b00 – Pilot pattern #A<br>0b01 – Pilot pattern #B<br>0b10 – Pilot pattern #C<br>0b11 – Pilot pattern #D |
| } | — | — |

**Table 308a—Reduced AAS-private DL-MAP message format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **DL Frame Offset** | 3 bits | Defines the frame in which the burst is located. A value of zero indicates an allocation in the subsequent frame |
| if (current zone permutation is FUSC or optional FUSC) { | — | — |
| **Zone symbol offset** | 8 bits | The offset of the OFDMA symbol in which the zone containing the burst starts, measured in OFDMA symbols from beginning of the downlink frame referred to by the Frame Offset |
| } | — | — |
| **OFDMA Symbol Offset** | 8 bits | Starting symbol offset referenced to DL preamble of the downlink frame specified by the Frame Offset |
| If (current zone permutation is AMC, TUSC1 or TUSC2) { | | AMC (2 x 3 type), TUSC1 and TUSC2 all have triple symbol slot lengths |
| **Subchannel offset** | 8 bits | — |
| **No. OFDMA triple symbol** | 5 bits | Number of OFDMA symbols is given in multiples of three symbols |
| **No. subchannels** | 6 bits | — |
| } Else { | | — |
| **Subchannel offset** | 6 bits | — |
| **No. OFDMA Symbols** | 7 bits | — |
| **No. subchannels** | 6 bits | — |
| } | | — |
| **DIUC/$N_{EP}$** | 4 bits | DIUC for Encoding Mode 0b00, 0b01, 0b11<br>$N_{EP}$ for Encoding Mode 0b10 |
| If (HARQ Enabled) { | — | Encoding Mode 0b01, 0b10, 0b11 |
| **DL HARQ ACK bitmap** | 1 bit | HARQ ACK for previous UL burst |
| **ACK Allocation Index** | 6 bits | ACK channel index within HARQ ACK region |
| **ACID** | 4 bits | HARQ channel ID |
| **AI_SN** | 1 bit | HARQ Sequence Number Indicator |
| If (IR Type) { | | Incremental Redundancy |
| **$N_{SCH}$** | 4 bits | Applied for Encoding Mode 0b10 |
| **SPID** | 2 bits | Applied for Encoding Mode 0b10 and 0b11 |
| *Reserved* | 2 bits | — |
| } | — | — |

**Table 308a—Reduced AAS-private DL-MAP message format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| } | — | — |
| **Repetition Coding Indication** | 2 bits | 0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| If (UL-MAP appended) { | — | — |
| **Reduced_AAS_Private_UL-MAP()** | *variable* | — |
| } | — | — |
| *Reserved* | 3 bits | — |
| } | — | — |
| **Nibble Padding** | *variable* | Padding depends upon HARQ options |
| **CRC-16** | 16 bits | — |
| } | — | — |

A CRC 16-CCITT, as defined in ITU-T Recommendation X.25, shall be included at the end of each reduced private map. The CRC is computed across all bytes of the reduced map, including the appended UL map if included, starting with the byte containing the ‘compressed map indicator’ through the last byte of the map including padding.

The “DL Frame Offset” and “UL Frame Offset” fields define the latency between the Reduced Private Map and the DL or UL allocation made by the Reduced Private Map. This is valid for all values of the “Periodicity” field. A Reduced Private Map with “Periodicity = 00” indicates single allocation or termination of a periodic chain of private map allocations if such chain is established.

***Insert new subclause 8.4.5.8.2:***

### 8.4.5.8.2 Reduced AAS private UL-MAP

The reduced AAS private UL-MAP format is presented in Table 308b. The message may only appear after a reduced AAS private DL-MAP message to which it shall be appended.

### Table 308b—Reduced AAS private UL-MAP message format

| Syntax | Size | Notes |
|---|---|---|
| Reduced_ AAS_Private_UL-MAP() { | — | — |
| **AAS zone configuration Included** | 1 bit | 1 = AAS zone configuration included.<br>AAS configuration should be included in the first UL map of a private map chain to define the UL AAS Zone. |
| **AAS zone position Included** | 1 bit | 1 = AAS zone position included.<br>AAS zone position should be included in the first UL map of a private map chain to define the UL AAS Zone and any time the UL AAS zone is changed. |
| **UL MAP Information Included** | 1 bit | 1 = UL Map Information is included (UCD Count and Private Map Allocation Start Time). These fields should be included in the first allocation of a private map chain. |
| **PHY modification Included** | 1 bit | 1 = Preamble shift index included. |
| **Power Control Included** | 1 bit | 1 = Power control value included. |
| **Include Feedback header** | 2 bits | 0b00 = No feedback<br>0b01 = MS shall transmit a CINR feedback header (type 0b1011) based upon the DL allocation<br>0b10 = MS shall transmit a CINR feedback header (type 0b1011) based upon the DL frame preamble<br>0b11 = *Reserved* |
| **Encoding Mode** | 2 bits | Encoding for UL traffic burst<br>0b00: No HARQ<br>0b01: Chase Combing HARQ<br>0b10: Incremental Redundancy HARQ<br>0b11: Conv. Code Incremental Redundancy |
| if (AAS Zone Config Included) { | — | — |
| **Permutation** | 2 bits | 0b00 = PUSC permutation<br>0b01 = Optional PUSC permutation<br>0b10 = AMC permutation<br>0b11 = *Reserved* |
| **UL_PermBase** | 7 bits | — |
| **Preamble Indication** | 2 bits | 0b00 = 0 symbols<br>0b01 = 1 symbol<br>0b10 = 2 symbols<br>0b11 = 3 symbols |
| *Padding* | 5 bits | — |
| } | — | — |
| if (AAS Zone Position Included) { | — | — |
| **Zone Symbol Offset** | 8 bits | The symbol offset of the UL AAS Zone referenced to the start of the UL subframe in the frame specified by the UL frame offset. |

**Table 308b—Reduced AAS private UL-MAP message format *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **Zone Length** | 8 bits | The duration of the UL AAS Zone, specified in number of OFDMA symbols. |
| } | — | — |
| if (UL MAP Information Included) { | — | — |
| **UCD Count** | 8 bits | Matches the value of the configuration change count of the UCD, which describes the uplink burst profiles that apply to this map. |
| **Private Map Allocation Start Time** | 32 bits | Defines the start of the UL subframe relative to the start of the frame pointed to by the UL frame offset. This is defined in units of PS, and restricted to be less than $T_f$ |
| } | — | — |
| if (PHY modification included) { | — | — |
| **Preamble Select** | 1 bit | 0 = Frequency shifted preamble<br>1 = Time shifted preamble |
| **Preamble Shift Index** | 4 bits | — |
| **Pilot Pattern Modifier** | 1 bit | 0: Not Applied<br>1: Applied |
| **Pilot Pattern Index** | 2 bits | See 8.4.8.1.5 (Figure 249) and 8.4.6.3.3:<br>0b00 – Pilot pattern #A<br>0b01 – Pilot pattern #B<br>0b10 – Pilot pattern #C<br>0b11 – Pilot pattern #D |
| } | — | — |
| if (Power Control Included) { | — | — |
| **Power control** | 8 bits | Signed integer in 0.25 dB units |
| } | — | — |
| **UL Frame Offset** | 3 bits | Defines the frame in which the burst is located. A value of zero indicates an allocation in the subsequent frame |
| **Slot Offset** | 12 bits | The offset to the starting location of the uplink burst from the beginning of the UL AAS zone in slots |
| **Slot Duration** | 10 bits | The duration of the UL burst, specified in slots |
| **UIUC / $N_{EP}$** | 4 bits | UIUC for Encoding Mode 0b00, 0b01, 0b11<br>$N_{EP}$ for Encoding Mode 0b10 |
| if (HARQ Enabled) { | — | Encoding Mode 0b01, 0b10, 0b11 |
| **ACID** | 4 bits | HARQ channel ID |

Table 308b—Reduced AAS private UL-MAP message format *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **AI_SN** | 1 bit | HARQ Seq. Number Indicator |
| *Reserved* | 3 bits | Shall be set to zero |
| If (IR Type) { | — | Incremental Redundancy |
| $\mathbf{N_{SCH}}$ | 4 bits | Applied for Encoding Mode 0b10 |
| **SPID** | 2 bits | Applied for Encoding Mode 0b10 and 0b11 |
| *Reserved* | 2 bits | Shall be set to zero |
| } | — | — |
| } | — | — |
| **Repetition coding Indication** | 2 bits | Applied for Encoding Mode 0b00 and 0b01<br>0b00 – No repetition coding<br>0b01 – Repetition coding of 2 used<br>0b10 – Repetition coding of 4 used<br>0b11 – Repetition coding of 6 used |
| } | — | — |

### 8.4.6 OFDMA subcarrier allocations

***Change the subclause as indicated:***

For OFDMA, $F_s = floor(8/7 \cdot BW/8000) \cdot 8000$ . Subtracting the guard tones from $N_{FFT}$, one obtains the set of "used" subcarriers $N_{\text{used}}$. For both uplink and downlink, these used subcarriers are allocated to pilot subcarriers and data subcarriers. However, there is a difference between the different possible zones. For FUSC and PUSC, in the downlink, the pilot tones are allocated first; what remains are data subcarriers, which are divided into subchannels that are used exclusively for data. For PUSC ~~in the downlink or~~ in the uplink, the set of used subcarriers is first partitioned into subchannels, and then the pilot subcarriers are allocated from within each subchannel. Thus, in FUSC, there is one set of common pilot subcarriers, and in PUSC of the downlink, there is one set of common pilot subcarriers in each major group, but in PUSC of the uplink, each subchannel contains its own set of pilot subcarriers.

#### 8.4.6.1 Downlink

##### 8.4.6.1.1 Preamble

***Change the first paragraph as indicated:***

The first symbol of the downlink transmission is the preamble; there are ~~six~~three types of preamble carrier-sets, those are defined by allocation of different subcarriers for each one of them; those subcarriers are modulated using a boosted BPSK modulation with a specific Pseudo-Noise (PN) code.

***Change the third and forth paragraphs as indicated:***

Each segment uses ~~two~~one type~~s~~ of preamble out of the ~~six~~three sets in the following manner:

Each segment uses a preamble composed of a carrier-set out of the three available carrier-sets in the following manner: (In the case of segment ~~1~~0, the DC carrier will not be modulated at all and the appropriate PN will be discarded; therefore, DC carrier shall always be zeroed~~. For segment 2, the last carrier shall not be modulated~~, for the preamble symbol there will be 172 guard band subcarriers on the left side and the right side of the spectrum).

***Change the description of the 'k' variable below Equation (109) as indicated:***

*k* is a running index 0...~~576~~567.

***Change the paragraph above Figure 233 as indicated:***

Therefore, each segment eventually modulates each third subcarrier. As an example, Figure 233 depicts the preamble of segment 1 (in this figure subcarrier 0 corresponds to the first subcarrier used on the preamble symbol).

***Change the first sentence of the paragraph below Figure 233 as indicated:***

The PN series modulating the ~~pilots~~ preamble carrier-set are defined in Table 309.

***Insert the following text immediately before Table 309:***

For 1024 FFT size the PN series modulating the preamble carrier-set are defined in Table 309a (in case of segment 0, the DC carrier will not be modulated at all and the appropriate PN will be discarded; therefore, DC carrier shall always be zeroed, for the preamble symbol there will be 86 guard band subcarriers on the Left side and the right side of the spectrum).

For 512 FFT size the PN series modulating the preamble carrier-set are defined in Table 309b (in case of segment 1, the DC carrier will not be modulated at all and the appropriate PN will be discarded; therefore, DC carrier shall always be zeroed, for the preamble symbol there will be 42 guard band subcarriers on the Left side and 41 guard band subcarriers on the right side of the spectrum).

For 128 FFT size the PN series modulating the preamble carrier-set are defined in Table 309c (in case of segment 0, the DC carrier will not be modulated at all and the appropriate PN will be discarded; therefore, DC carrier shall always be zeroed, for the preamble symbol there will be 10 guard band subcarriers on the Left side and the right side of the spectrum).

***Change the title of Table 309 as indicated:***

**Table 309—Preamble modulation series per segment and IDcell for the 2k FFT mode**

***In Table 309, add '0x' before the text under the column 'Series to modulate ($W_k$)' at the 11th row.***

***Insert Table 309a through Table 309c:***

### Table 309a—Preamble modulation series per segment and IDcell for the 1K FFT mode

| Index | IDcell | Segment | Series to modulate (in hexadecimal format) |
|---|---|---|---|
| 0 | 0 | 0 | 0xA6F294537B285E1844677D133E4D53CCB1F182DE00489E53E6B6E77065C7EE7D0ADBEAF |
| 1 | 1 | 0 | 0x668321CBBE7F462E6C2A07E8BBDA2C7F7946D5F69E35AC8ACF7D64AB4A33C467001F3B2 |
| 2 | 2 | 0 | 0x1C75D30B2DF72CEC9117A0BD8EAF8E0502461FC07456AC906ADE03E9B5AB5E1D3F98C6E |
| 3 | 3 | 0 | 0x5F9A2E5CA7CC69A5227104FB1CC2262809F3B10D0542B9BDFDA4A73A7046096DF0E8D3D |
| 4 | 4 | 0 | 0x82F8A0AB918138D84BB86224F6C342D81BC8BFE791CA9EB54096159D672E91C6E13032F |
| 5 | 5 | 0 | 0xEE27E59B84CCF15BB1565EF90D478CD2C49EE8A70DE368EED7C9420B0C6FFAF9AF035FC |
| 6 | 6 | 0 | 0xC1DF5AE28D1CA6A8917BCDAF4E73BD93F931C44F93C3F12F0132FB643EFD5885C8B2BCB |
| 7 | 7 | 0 | 0xFCA36CCCF7F3E0602696DF745A68DB948C57DFA9575BEA1F05725C42155898F0A63A248 |
| 8 | 8 | 0 | 0x024B0718DE6474473A08C8B151AED124798F15D1FFCCD0DE574C5D2C52A42EEF858DBA5 |
| 9 | 9 | 0 | 0xD4EBFCC3F5A0332BEA5B309ACB04685B8D1BB4CB49F9251461B4ABA255897148F0FF238 |
| 10 | 10 | 0 | 0xEEA213F429EB926D1BDEC03ABB67D1DE47B4738F3E929854F83D18B216095E6F546DADE |
| 11 | 11 | 0 | 0xC03036FA9F253045DF6C0889A8B83BAEFCF90EB993C2D79BD911CA84075061AA43DA471 |
| 12 | 12 | 0 | 0x1E68EC22E5E2947FB0A29E4CC70597254B36C60331EACF779FE752D3F55DC41ABFC7DC9 |
| 13 | 13 | 0 | 0x63A57E75A0434F035AAC4504B265081D497F10C77928B71797C5D6C6824DC0F23BE34EE |
| 14 | 14 | 0 | 0xC57C4612816DE981C58FD6F8DE9DD41F2422ADBC522B0CE31F9A6D5F2A126DC08F69FB1 |
| 15 | 15 | 0 | 0x978256AF184E7ED17789B33D324C711B36BFBCCE5446EB03687E9A0A839C7CE156104D2 |
| 16 | 16 | 0 | 0x011EC823157DD73150640CEB7DDB0A1F8F91E09599A851D5C7CAF687CFB752D297D82FC |
| 17 | 17 | 0 | 0xC6DE82BEB7F57B9120E8A376D85C8F70FDC65BC660402DAC4AE6002EA2740C4F9E5973C |
| 18 | 18 | 0 | 0x4C74929D6F9FAB9E5BB761026038E076F6824295E0AF397806ECEBC6DC713F03ACDC27C |

## Table 309a—Preamble modulation series per segment and IDcell for the 1K FFT mode *(continued)*

| Index | IDcell | Segment | Series to modulate (in hexadecimal format) |
|---|---|---|---|
| 19 | 19 | 0 | 0x13E1E85C2234D0F3418001A35F135E10C6C918C36BC659FDA9D655D288A0BDAA8BF489D |
| 20 | 20 | 0 | 0xFD4AF2D8F4F08F1A7DF59291C9AEE788F641B8231CFB813376E0BEB68DFCFCBBE552445 |
| 21 | 21 | 0 | 0xEBBC77A493AA0C62C62F25EE5E8D0701F50386F49026FA31487C9FD5C5206CE4EB00576 |
| 22 | 22 | 0 | 0x134F936F9E875842587ADCA92187F2FC6D62FFC3A833D8CDE465F9972ABAA83763AAEB7 |
| 23 | 23 | 0 | 0x3CD1DA70670BC73363D1B4A66D280FF6AA7636D07ECF32BA26101E5EBA1594FB8A0420A |
| 24 | 24 | 0 | 0x918296B2937C2B6F73CF98F85A81B723D1C69DBDF3E019749C582DA22E789562729D475 |
| 25 | 25 | 0 | 0xC323981B8B2240865F48D61AE1B3B61D88522B7358952F949D4308CA15D1EE8FDFA683F |
| 26 | 26 | 0 | 0x7514A6FA5FBB250C5C8CE96F791D676036C344A44B24284477B44CB3E758F8BCD58F05B |
| 27 | 27 | 0 | 0x84C7FEC6E977FA1EC0C7CC9E0D067C73D8F846F82ABB3456D2104E1448D5A58D5975152 |
| 28 | 28 | 0 | 0x4841AFC277B86A0E067AF319422F501C87ACBFBDD66BFEA3644F879AE98BA8C5D605123 |
| 29 | 29 | 0 | 0xF35EA87318E459138A2CE69169AD5FD9F30B62DA04ED21320A9F59893F0D176752152FD |
| 30 | 30 | 0 | 0xA0C5F35C5971CD3DC55D7D2B9FD27AA17A198583F580EB0800744EE5B6B3648DEA95840 |
| 31 | 31 | 0 | 0xA6D3D33AD9B56862DBF076E3ACE6A3150510CCC8BE77DE4E6E10EB5FE163765647D07DF |
| 32 | 0 | 1 | 0x52849D8F020EA6583032917F36E8B62DFD18AD4D77A7D2D8EC2D4F20CC0C75B7D4DF708 |
| 33 | 1 | 1 | 0xCC53A152209DEC7E61A06195E3FA633076F7AE1BAFFE83CE565087C0507BA596E0BD990 |
| 34 | 2 | 1 | 0x17D98A7E32CCA9B142FE32DB37B2BF726E25AA7A557FFB5C400B47A38B16CF18E1EDE63 |
| 35 | 3 | 1 | 0xA5BA8C7E2C795C9F84EBBD425992766BDE5549A7A9F7EF7E44AFD941C6084568638FE84 |
| 36 | 4 | 1 | 0x33E57E78A5696255CA61AE36027036DA619E493A0A8F95D9915C6E61F3006CB9706BEBA |
| 37 | 5 | 1 | 0x09961E7309A9B7F3929C370C51910EBAB1B4F409FA976AE8679F354C84C4051F371F902 |
| 38 | 6 | 1 | 0x508A9EBAEF3C7E09CFCFC0B6F444A09B45A130EFC8C5B22BCE87213854E7C9D329C9ADC |
| 39 | 7 | 1 | 0xAACEEF9BCDC82E4AD525185B07CBABCB74861D16F7C25CFBA917B05463AD65391AF840D |

### Table 309a—Preamble modulation series per segment and IDcell for the 1K FFT mode *(continued)*

| Index | IDcell | Segment | Series to modulate (in hexadecimal format) |
|---|---|---|---|
| 40 | 8 | 1 | 0x23060ACC5A125DAB207EEEE47B4EEE1E8466BD17DDA2EB3CD90D2AB7A758C213E6D7FE5 |
| 41 | 9 | 1 | 0xCA55521667BDA8B6F1B205201A51B3A0C05DE9EA06BC73268730A81A992777021F46055 |
| 42 | 10 | 1 | 0x05ADFCA2F8207DC6FF8D1A85A1DD4694D4C48A838C4F833C532710021AC448A7B62B8DD |
| 43 | 11 | 1 | 0x218C951223D7B712DC98F8B5217388A830003C5F2A00F232DD3475D2FC78C25B8D88FF9 |
| 44 | 12 | 1 | 0x79B94D24D721121EF678B7156F8D2666DE712BBF3837C85A9518781903146A7B4D42A28 |
| 45 | 13 | 1 | 0x58AABEF6A6BDE4011CAC583C5104B2C6FC5A2980F856373E5931A3C690245327581FA13 |
| 46 | 14 | 1 | 0x427D1AD18E338E16FCE6E23B4AD6D82A2144D53048F2665AA94577AFABD26889FCB1F9F |
| 47 | 15 | 1 | 0x337FE0E4C15A22471AE0F6B6F91161A7DE2E1403D73587D5C8355105D2F70642B2CE425 |
| 48 | 16 | 1 | 0xA3FCAA311B536AC9DB39FED9F4E996506B3181C58D6B7E04157A3FD463F60468765BCFD |
| 49 | 17 | 1 | 0xF484FD1F57F53A4A749B86148E0B1D0653667CE1393198875DDB0AE9179BBBDAAD53A11 |
| 50 | 18 | 1 | 0xA3E9ECF1E6048562BC89DB6168E708855F0D4AD29F859EF36C9160DF407D85426233632 |
| 51 | 19 | 1 | 0x890519376D1FFAA2894EABCD6663B0A3C2411982C17B01270E0FB0B289D4BC8C3B83DA9 |
| 52 | 20 | 1 | 0x09847B6187BB5F6F6728B4ED610088FAD9DADFC00748E9DCD8A0CE320D6C991654ABE05 |
| 53 | 21 | 1 | 0x3285AE0A3D196313659C37BE1C94D61D20F11FD49D9FDF9D1026FF5763F02CB78AE135C |
| 54 | 22 | 1 | 0x0069D3F34D0D455AFB45FEFDF716333B785C6BDA90DA23F1CC68BC6A1DBC916C595DA3E |
| 55 | 23 | 1 | 0xAA977A8BCA39381E7C35A1ACC7C4F60421C0862BFD6106C7C025B0676EA0EF68972DD8F |
| 56 | 24 | 1 | 0xF310745C497094ABE56E0490C0800319DBE290553E696B6859635AF03B121F79D925D19 |
| 57 | 25 | 1 | 0x964DFD350B9C7DFDC7F6F7C43283A76F0D613E48A5520D1DAF761C6F47E389B43A023F5 |
| 58 | 26 | 1 | 0x6D767B88D28A455CC3B56C942BAFD8E465A50FD2C22FE6162E03A9AAC3C1CC899800610 |
| 59 | 27 | 1 | 0xC5491C6CA3D998906EC1482F815B74B7C2E3816B682ACC6009AB7EFF34BF0E9CE59C754 |
| 60 | 28 | 1 | 0x6D8EE32D30E19D93A0E5AD8226BAE9CF6FCBA17CF6E67FDC5A15A81ECB8908BEDD77C80 |

## Table 309a—Preamble modulation series per segment and IDcell for the 1K FFT mode *(continued)*

| Index | IDcell | Segment | Series to modulate (in hexadecimal format) |
|---|---|---|---|
| 61 | 29 | 1 | 0x98F8BFDF774C7A249418E6FF4723D6E6AB2F091CDE4DE1CE11D3BD463B509FB716940FD |
| 62 | 30 | 1 | 0x65300BAD8FFA21BC7DC2C1F79FA97A9F469CCC9E270A61759F34D6276F57CBEB009CD21 |
| 63 | 31 | 1 | 0x6F36BB6D5A7DC4FB720439E91FF0DE86DD6C4B93CFC4271F2BCC6169616E3AEAA19E360 |
| 64 | 0 | ~~1~~ 2 | 0xD27B00C70A8AA2C036ADD4E99D047A376B363FEDC287B8FD1A7794818C5873ECD0D3D56 |
| 65 | 1 | 2 | 0xE7FDDCEED8D31B2C0752D976DE92BEA241A713CF818C274AA1C2E3862C7EB7023AF35D4 |
| 66 | 2 | 2 | 0x87BF4954022D30549DF7348477EACB97AC3565B838460CC62F242883313B15C31370335 |
| 67 | 3 | 2 | 0x82DD830BEDE4F13C76E4CF9AEF5E42609F0BDDCB000A742B6372DD5225B0C3114494746 |
| 68 | 4 | 2 | 0x4E06E4CF46E1F5691938D7F40179D8F79A85216775384BD97966DB4BBF49FB6FAB8F945 |
| 69 | 5 | 2 | 0x64164534569A5E670FDB390D09C04802DD6A16B022CADC77EDD7464AFED43C773A8DC76 |
| 70 | 6 | 2 | 0xFB8769A81AA9DB607F14A6A95948401F83057CDC9C9C3996BA5821403A49F00A4E35191 |
| 71 | 7 | 2 | 0x77710D6F40B4F79CC63F678551C3EC18FA9DF2C82E6C8F415DADFD63264B7513180070E |
| 72 | 8 | 2 | 0x503F196BBF93C238BFD5E735E5AE52E0DAE64F5E2F4C3B92E553F51303C4A64C4403BF3 |
| 73 | 9 | 2 | 0x5FD4A6894566678C95B9D5A59DDE5366799045FEB03A2BAA74094140E9068C61C2E972C |
| 74 | 10 | 2 | 0x95B584DC40C8B5DEAD63D48FCE65B1E61BAB4C597D921DB12677141E2FFE7C0AA3DA0D5 |
| 75 | 11 | 2 | 0x985763AB6CC8934DB8A0BE738A7AF1D1FA3958C1F9E2D6A51A163E47A0A6E5FEB759FDD |
| 76 | 12 | 2 | 0xFD8D45F00D943AD986BD353D61C6746DBF8A309B6AE1C173B880D957B76DC031A957E8D |
| 77 | 13 | 2 | 0xAE4323534F6EFB1A20169328417885EF304FA220389FA9C2607E5A406F4CE4A7498A39F |
| 78 | 14 | 2 | 0xE5205579893BE184CB9948C28E2F9AAF699D47B6E5E0B219CBEAFE4BEC8D561BD809E34 |
| 79 | 15 | 2 | 0xAB11D6941478D36D5695CE813070DC1E32122A39083E53FE373660AEB125D83383FBDCA |
| 80 | 16 | 2 | 0x188A09C46F1F11206FF9F15CFB5F6CD2F26C4BF485EE37D3650A595064F76CE34E40EAD |
| 81 | 17 | 2 | 0x4B1CDE25539A56CEDC45FE7F54C38CF155F4FB1AE868F6C3952D07014BF828E810BDE2D |

## Table 309a—Preamble modulation series per segment and IDcell for the 1K FFT mode *(continued)*

| Index | IDcell | Segment | Series to modulate (in hexadecimal format) |
|---|---|---|---|
| 82 | 18 | 2 | 0x16CA8F8C6A879E865E3611EAC389D56AFA3E4E84CDBB73567BA4A160249C4B680A7D9BC |
| 83 | 19 | 2 | 0x39D2B08AA0E2E8781476027B41AD72F8D9838B7001AADFD33A92D81E56ECBB2C9378D58 |
| 84 | 20 | 2 | 0x8C258BC80D4AD125F335A5151EDF9E9A463E06C5C8D046F82E5DC3D73EF4D2231C5D14F |
| 85 | 21 | 2 | 0x41A029C6356C825585179C5348EDF07A3AC2022539AC28DC4CD3C1DFADC8EE9644CD939 |
| 86 | 22 | 2 | 0x0D70A77CBE9804913BFBEC4FBF917C5CD3580F6062BBAD3F99ECEBB4A9EBB87523AB722 |
| 87 | 23 | 2 | 0x6A00A30901F9FDE44B4F1ECED44E0BCB943B29519F313BE4496D34F39B154FC2384CB75 |
| 88 | 24 | 2 | 0x95351107A8BE6ABFC24C1292FE1A0FE677CBFD04F2E81178CAA9D294730EF9C946F676E |
| 89 | 25 | 2 | 0x01F21470FD9B1E0B3C6B2F7C0412A15764C277D61BA2EE3B3769DE7ADACB2BB29918FB7 |
| 90 | 26 | 2 | 0xA578ABFE155369440FA3D4DF757CCA596469B80A0E56BFE6010DD63E67CEDB86BB1EF39 |
| 91 | 27 | 2 | 0x1E1CFFAB031836777DE5D168A9246C559574C74CCC06405EB406B8DDB7C9A6EF54A66A5 |
| 92 | 28 | 2 | 0x354149C2CA19A735F9CD04AF4922E8ECE6509B978B951F946FD4AD36C7F9C83624205E7 |
| 93 | 29 | 2 | 0x5A27E60DEA547D0D41897A03199F28A967AC51728E3B38325B4FBECF1B85A7EE9B04182 |
| 94 | 30 | 2 | 0x784DA3B16B810FE3B851060AD7BD27D9D9457F6C8899A13D311E531B855C15ECE6D3A2F |
| 95 | 31 | 2 | 0xD7DFBC65797633A8C13D3EEC781D48952338136063B579D69437B28B744B5A4BE18AFA9 |
| 96 | 0 | 0 | 0x61AF26BD39A9FFF52826625E04ADA299385A373FA946D837D754E6CFEBB26F5C03B87CF |
| 97 | 1 | 1 | 0xD77D97CDB93DBEAA65CAFA146F40D72B5E80944F750E07325DC164ED60F32434BC7187D |
| 98 | 2 | 2 | 0x4529D9CA65AF49C1C39BDC18CFAB87E03FE4DAFC0A48FF1457D46B0DF66B414A23ACDDB |
| 99 | 3 | 0 | 0x33AC0261DAA57C1D611EBA1C730D50AFEE5BE3E849030A4E891BC8C5F4C78DCDDFEA263 |
| 100 | 4 | 1 | 0xBED48C704F02A84F03BCD299D919DA56F7B71EDF8A0F8A25E8F8496F95A44CE2B9F74C9 |
| 101 | 5 | 2 | 0x0ECCBE0902EBF4B4C29506014A3706622784B7B2D5153E10AD3112DC5E45277A32E79DE |
| 102 | 6 | 0 | 0x7CB4937889C7DFD9AA2D37235E06F993D3D4F5D515B39CA652F62397C08457D66BC5A36 |

### Table 309a—Preamble modulation series per segment and IDcell for the 1K FFT mode *(continued)*

| Index | IDcell | Segment | Series to modulate (in hexadecimal format) |
|---|---|---|---|
| 103 | 7 | 1 | 0x43F23F6CAC6C43896B3EDBF00E1CBD42E2CC75E2A996448F0FCF17F6779DD6E356FED11 |
| 104 | 8 | 2 | 0x72C8A209FBC4A568BEF03BCFE1B0D959F977B0963780B4E54E2B9A1016344ACB7EE3E3A |
| 105 | 9 | 0 | 0x77AEB9E50DC3727849A94FBFFCDB5B9589AF50ABD8A58808B9663058E17A2EBC496DF43 |
| 106 | 10 | 1 | 0x667123C89077FE4AAAEF15C635E976C6811682D478FFC7B721A76B5A38697DF4FB7D2CE |
| 107 | 11 | 2 | 0xCBD6C5C9BE55B0BE76AD03392E8A8AB9A86063DB31B79280B447980BB841FD7E9DC6B9B |
| 108 | 12 | 0 | 0xC7D7DEF8B3C9C8667D8D65063B4DAD1FF69445C87CA71DA955D0CA23970E988A6EA4C83 |
| 109 | 13 | 1 | 0xFB246ABD92F9E560CB2BEC2317204C9CE22AD3BD19EA02E90F5F3B7F4F65538D8ED098E |
| 110 | 14 | 2 | 0x29E74579472FDD8FFC2700B2BF33C649989DD8153093A7CA08B50F7A5E4BAED108A0F0D |
| 111 | 15 | 0 | 0xA27F29D8D6CCD7EB4BBE303C3E9E95802DB98BFD5B8ED03B88304359D92E3EC108CA3C8 |
| 112 | 16 | 1 | 0x3FE70E26FA00327FE3B2BE6BC5D5014F588F09C17D222C146DD68B4824692A651888C76 |
| 113 | 17 | 2 | 0x41E91307EC58801CFF2C7E9CFEFBEB71681FAE2BEAEC72D4E4556E99345D3BA4B369B59 |

### Table 309b—Preamble modulation series per segment and IDcell for the 512 FFT mode

| Index | IDcell | Segment | Series to modulate (in hexadecimal format) |
|---|---|---|---|
| 0 | 0 | 0 | 0x66C9CB4D1C8F31D60F5795886EE02FFF6BE4 |
| 1 | 1 | 0 | 0xD8C30DA58B5ED71056C5D79032B80E05522C |
| 2 | 2 | 0 | 0x8EB62664E3B2C5222DE18E9000561F25AAFC |
| 3 | 3 | 0 | 0x3B32299087C257CD31C67E4AA5DD697B0E08 |
| 4 | 4 | 0 | 0xC07E0B0C5DB44071EE6CEC40CA3135CB5DB8 |
| 5 | 5 | 0 | 0x89B08CD299A8AC757DB59107AF4E1EF1EE1C |
| 6 | 6 | 0 | 0x1B72E8C0ECFAABF050091382B411B45A718C |
| 7 | 7 | 0 | 0x5B33ED5A6303397EC3CCC35C8203A5A05178 |
| 8 | 8 | 0 | 0xAD1173C461254BF9181238319F93F86AF964 |
| 9 | 9 | 0 | 0x51E2005BBA69C858BCC741D84990B657271C |
| 10 | 10 | 0 | 0x21A03B607DD96F270CBC759B2A9BD6A84A34 |

### Table 309b—Preamble modulation series per segment and IDcell for the 512 FFT mode *(continued)*

| Index | IDcell | Segment | Series to modulate (in hexadecimal format) |
|---|---|---|---|
| 11 | 11 | 0 | 0x4518EC4C7AD645D24AD949B42A7881403C7C |
| 12 | 12 | 0 | 0xF8B70C595A37315D301D378A4D2848C821D4 |
| 13 | 13 | 0 | 0xFF42582005F8382C5CC6298D757155B36B24 |
| 14 | 14 | 0 | 0x599EF40107CBB3B30AF945365494A0D60570 |
| 15 | 15 | 0 | 0xC6D6BE87F0D88458ABD22DE822B64E450738 |
| 16 | 16 | 0 | 0xE043896829F236B10A35014D9E4F26ECB95C |
| 17 | 17 | 0 | 0x2347472A610FC084C71460393AEF36CBE928 |
| 18 | 18 | 0 | 0x5F4D880DC516DC0B3860DA948225D2BC6770 |
| 19 | 19 | 0 | 0x9EFEEA99631FAF0D9589E9640BCD56C5FF08 |
| 20 | 20 | 0 | 0xFE792EF83B235B3D4A6447BED27035454BC0 |
| 21 | 21 | 0 | 0xB3B1B868C121C4555A64161B654A4FE81D70 |
| 22 | 22 | 0 | 0xB7C2D44078510ADD2447D93E8A1231AE3910 |
| 23 | 23 | 0 | 0x16A9D8F71CC1CD0EFA0008AA343A7A4ADA4C |
| 24 | 24 | 0 | 0x7389FDE96166E7E40F7A6778AA02944937A4 |
| 25 | 25 | 0 | 0xA0598A0907798B3465DD8CBD08565F0FB5B8 |
| 26 | 26 | 0 | 0x0E75B3C128085C954A25E5808FC5833A8FB0 |
| 27 | 27 | 0 | 0xBBCDA362265B4D4D2BEE80F635E638316280 |
| 28 | 28 | 0 | 0x660047B06A1B5FAE6A9F0679DBCA9B1A2DF4 |
| 29 | 29 | 0 | 0x2594AE119CB87E802D67EF7EE0EAE99474CC |
| 30 | 30 | 0 | 0x8FB3FA462D2CFAF842BB5319D9786A997C10 |
| 31 | 31 | 0 | 0x599E199B609C0C654DB053E8C94F343AAFF8 |
| 32 | 0 | 1 | 0xE0187D89220D11B5F60DAC078A5E2EED6EF0 |
| 33 | 1 | 1 | 0x69F57E074F14A10FEC6144C26E98C4688330 |
| 34 | 2 | 1 | 0xD2C4067132528AA41BBE61A9C171A382F768 |
| 35 | 3 | 1 | 0xB027CB82594D3900700B541A99CCD5FD5870 |
| 36 | 4 | 1 | 0xE9B565C61F73EC6633A1F2D96EC409495B80 |
| 37 | 5 | 1 | 0xEBD7E29110582C5951233AB22B03DE709698 |
| 38 | 6 | 1 | 0x0CCA91DA1B42B0B55C924F32B08B1FAE0E18 |
| 39 | 7 | 1 | 0xA4213FFB85B56E27C74FC6ECBA359875438C |
| 40 | 8 | 1 | 0x1A37F92589686CFE5E4D4BFD8E2BC63AA8CC |
| 41 | 9 | 1 | 0x31531C7B2F7518BF59ACFB216FC74D09F2F4 |
| 42 | 10 | 1 | 0xCE026112DF00BB74E1B1F43B595112B16344 |

### Table 309b—Preamble modulation series per segment and IDcell for the 512 FFT mode *(continued)*

| Index | IDcell | Segment | Series to modulate (in hexadecimal format) |
|---|---|---|---|
| 43 | 11 | 1 | 0x503494DE054AE395883AEDD8CC7801B8F124 |
| 44 | 12 | 1 | 0x8447E25CA9A0EE1CFB9FADB6C42B8F565B3C |
| 45 | 13 | 1 | 0x757C45DA8F140FB6E71024294B2439CDACFC |
| 46 | 14 | 1 | 0xF2A59A32B51CE505E45E9B5C7C7DBE880DF4 |
| 47 | 15 | 1 | 0x8DFBF09479BC91E466A539E077D2B26A8B2C |
| 48 | 16 | 1 | 0x1C6FB87D76DB82FFA1E492166684CACEE560 |
| 49 | 17 | 1 | 0xA32CF584137FDF1D4CCE6A1CF40FEC1F4AE0 |
| 50 | 18 | 1 | 0xEC4D3AC52136FA468F28777078C8A82C0808 |
| 51 | 19 | 1 | 0x30CABB208C9D6C774814A163765E4ACBC540 |
| 52 | 20 | 1 | 0xCA3448C6716F6F8D15D7372A3A4F6E825A14 |
| 53 | 21 | 1 | 0xABD1526F4A510F820B689F30C1E7B88C8848 |
| 54 | 22 | 1 | 0x94E4E2AE2C4E47FD7D0A154C25BF40F759E0 |
| 55 | 23 | 1 | 0x43BFFD566D85BE162650670BE1A3CA523284 |
| 56 | 24 | 1 | 0xD7644475A2E5EDAD1AD184242E3C841A03E0 |
| 57 | 25 | 1 | 0xA61DDBA416D1D14358647C4ACEF2503001E4 |
| 58 | 26 | 1 | 0x1F9047A8651D4D4A7C582469DC8C41B68E08 |
| 59 | 27 | 1 | 0xE0EAC02D975263F36D4BEF70669CBDEE658C |
| 60 | 28 | 1 | 0xDFAE7334BD2B8FF1D2C7CB5922823B03F744 |
| 61 | 29 | 1 | 0xD44B2AD5842F1EEA1A39DBC64EC064FCCFBC |
| 62 | 30 | 1 | 0x08AD296C8D17ABD021E02E20DACC247673EC |
| 63 | 31 | 1 | 0x2FE66830D806B3F8DD38D5FE1CF12DEB9774 |
| 64 | 0 | 2 | 0xC6325F42597BD48A8914944C7DB973D83E64 |
| 65 | 1 | 2 | 0xE04B98E9254434D3F765A621752C0F1FEC54 |
| 66 | 2 | 2 | 0xA74B60D84CCB156B1B8AE015B8CE980868EC |
| 67 | 3 | 2 | 0x78E7405DCFDA1DFCDA6E54B3794B49A0F8B0 |
| 68 | 4 | 2 | F32F4CA1A154E746FE1C2D1E4A1251779804 |
| 69 | 5 | 2 | 0x5A2905A1CF5D06444C880ADC07EB3889E71C |
| 70 | 6 | 2 | 0x74290661C664DEB829569B7C4E6C32B2BE00 |
| 71 | 7 | 2 | 0xEBB53241F5D9CD87A612C0774ED2FED4679C |
| 72 | 8 | 2 | 0xE33B89ABA4ED020D558B833AF74072922164 |
| 73 | 9 | 2 | 0x3B7D2DEEF829E230718AA7996CD814A4DD88 |
| 74 | 10 | 2 | 0x373861E8993FC22E176F6DA6A46A10158EF4 |

### Table 309b—Preamble modulation series per segment and IDcell for the 512 FFT mode *(continued)*

| Index | IDcell | Segment | Series to modulate (in hexadecimal format) |
|---|---|---|---|
| 75 | 11 | 2 | 0x2BEA329B65DE1CD26ECDD382915AC40B1D0C |
| 76 | 12 | 2 | 0x7A8B131BD5D1270C30003DA472DD81D9A434 |
| 77 | 13 | 2 | 0x9D6A237940057479D30BE19AD719F8F9B47C |
| 78 | 14 | 2 | 0xC1FB9C3811B349E9F793A14C8AE8425A6218 |
| 79 | 15 | 2 | 0xDFFDE03D8C717A346B4B1D3C02693330A9B4 |
| 80 | 16 | 2 | 0x76254DEF89683CD7210898069E2CDA0EE144 |
| 81 | 17 | 2 | 0x09B9B69C132C4E2DC16A1438828147D65F94 |
| 82 | 18 | 2 | 0xB1CCE0D47DF246E9059CBC970168518206AC |
| 83 | 19 | 2 | 0x1017669D7990F3AB4378924C69E442F2BAD0 |
| 84 | 20 | 2 | 0x772407B19C5FA41D542C8A2DC9ADD2C2943C |
| 85 | 21 | 2 | 0x7A38C2889EB10D93F23EC75B212D327D18A8 |
| 86 | 22 | 2 | 0xD25A195D899BF6F531F5ECC228BE0678A438 |
| 87 | 23 | 2 | 0xA83FD1C33F4C6CAA5A0E8B062937AC310034 |
| 88 | 24 | 2 | 0xAA6DDD1A05ADF49F615BE9F9EBCA6630E440 |
| 89 | 25 | 2 | 0xB14990574937763EEBD71A12FEB0C673F878 |
| 90 | 26 | 2 | 0xDDF013D74BDDE5FBB621A32B54DE24AA1D60 |
| 91 | 27 | 2 | 0xD814295D387D2EE33F90C07CA493062B3054 |
| 92 | 28 | 2 | 0x89B93046231A786C3D74ABAEC6AFF42D037C |
| 93 | 29 | 2 | 0x5680E918BA19199E841B4D6A7D1DD1420E78 |
| 94 | 30 | 2 | 0x639CC821373B332F975817C0A1AC16A48150 |
| 95 | 31 | 2 | 0x06711D78BD8978D82DA58B7E494DDF77E994 |
| 96 | 0 | 0 | 0xC882DD8DBD23C796A1389DA4EAA9A4138640 |
| 97 | 1 | 1 | 0x038086D70895496BCABC404B1EC999F67AC0 |
| 98 | 2 | 2 | 0x8203073A335DB9E57B0CA2F07D5958176B50 |
| 99 | 3 | 0 | 0x3FF1CD3638EE6469A4A482AF834EF56A2340 |
| 100 | 4 | 1 | 0x69EA7871159D5099F900C6133C07DABF56F0 |
| 101 | 5 | 2 | 0x4D88ABB17FF855393EDBC070CF0439D5E94C |
| 102 | 6 | 0 | 0x01EFD43C87362B00E376A728BC597BEED978 |
| 103 | 7 | 1 | 0x7AE20D16F3CC6F947413518FDF6E1FCCCDE8 |

### Table 309b—Preamble modulation series per segment and IDcell for the 512 FFT mode *(continued)*

| Index | IDcell | Segment | Series to modulate (in hexadecimal format) |
|---|---|---|---|
| 104 | 8 | 2 | 0xBB852F9A90B0DE260BB67F45491B31DE3A74 |
| 105 | 9 | 0 | 0x088627544BDF971C1AC4F86F05A212EE9634 |
| 106 | 10 | 1 | 0x0C8A08A37C2B9D3C1812E9C116B4E6A6285C |
| 107 | 11 | 2 | 0xE74775CADDDDF0D2D808FE7FC1C177489284 |
| 108 | 12 | 0 | 0xE81ECC6AC393294E9B549A8B2BADE7FFF904 |
| 109 | 13 | 1 | 0x1C5FAE8CACE7A2CD13CAF4A34A440E909BF8 |
| 110 | 14 | 2 | 0x6EE7E42A292BDACC5C79B81CA6598274C940 |
| 111 | 15 | 0 | 0x407547BC0C961D9E9ADDE010F4990724E8DC |
| 112 | 16 | 1 | 0x46CE626ACD894F9650E6B7C3F9E3BFAE5B08 |
| 113 | 17 | 2 | 0xC59B894FBF170F44F4816750280AB8CB4E48 |

### Table 309c—Preamble modulation series per segment and IDcell for the 128 FFT mode

| Index | IDcell | Segment | Series to modulate (hexadecimal) | Index | IDcell | Segment | Series to modulate (hexadecimal) | Index | IDcell | Segment | Series to modulate (hexadecimal) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 | 0 | 0x01E52A9B3 | 38 | 6 | 1 | 0xD2DD02238 | 76 | 12 | 2 | 0xF69E451B1 |
| 1 | 1 | 0 | 0xC96FF8AB1 | 39 | 7 | 1 | 0xFEA763CB2 | 77 | 13 | 2 | 0x91BC72EBF |
| 2 | 2 | 0 | 0xA1F5CE648 | 40 | 8 | 1 | 0x8CE0D5FB6 | 78 | 14 | 2 | 0xF964A5447 |
| 3 | 3 | 0 | 0x1E2BF6919 | 41 | 9 | 1 | 0xCC25D7A7E | 79 | 15 | 2 | 0xF8CD36F4A |
| 4 | 4 | 0 | 0x051798B72 | 42 | 10 | 1 | 0x7019D3A92 | 80 | 16 | 2 | 0x726A3C802 |
| 5 | 5 | 0 | 0x932D7FA8E | 43 | 11 | 1 | 0x784CF7EAB | 81 | 17 | 2 | 0x118D1B682 |
| 6 | 6 | 0 | 0x2CBD50F73 | 44 | 12 | 1 | 0x07085DAC8 | 82 | 18 | 2 | 0xDED9E703A |
| 7 | 7 | 0 | 0xF86F6A451 | 45 | 13 | 1 | 0x4CEEB5E1F | 83 | 19 | 2 | 0x3E8929773 |
| 8 | 8 | 0 | 0x2BA44F7E7 | 46 | 14 | 1 | 0x9E5CD5B80 | 84 | 20 | 2 | 0x2C64AA7F9 |
| 9 | 9 | 0 | 0xEEFA172C3 | 47 | 15 | 1 | 0x63A76FD05 | 85 | 21 | 2 | 0x2249CEA0F |
| 10 | 10 | 0 | 0xFF46C729A | 48 | 16 | 1 | 0xAA276F96F | 86 | 22 | 2 | 0x01363A94E |
| 11 | 11 | 0 | 0x0362D5C61 | 49 | 17 | 1 | 0x3370F5082 | 87 | 23 | 2 | 0x69D77721F |
| 12 | 12 | 0 | 0x27DDC7CA5 | 50 | 18 | 1 | 0x35A644170 | 88 | 24 | 2 | 0xAE103C9B9 |
| 13 | 13 | 0 | 0x17EAEDAC6 | 51 | 19 | 1 | 0x16FD73B8B | 89 | 25 | 2 | 0x89E2A6940 |
| 14 | 14 | 0 | 0x94ACD9E03 | 52 | 20 | 1 | 0xEEE990E94 | 90 | 26 | 2 | 0xA7BC42645 |
| 15 | 15 | 0 | 0x1A1AC22DD | 53 | 21 | 1 | 0x28A3120FC | 91 | 27 | 2 | 0xBBB6B9C0F |
| 16 | 16 | 0 | 0xFD5E18DA6 | 54 | 22 | 1 | 0xC2FBC2993 | 92 | 28 | 2 | 0x5BF7598F8 |

**Table 309c—Preamble modulation series per segment and IDcell for the 128 FFT mode *(continued)***

| Index | IDcell | Segment | Series to modulate (hexadecimal) | Index | IDcell | Segment | Series to modulate (hexadecimal) | Index | IDcell | Segment | Series to modulate (hexadecimal) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | 17 | 0 | 0x35DEB6E0E | 55 | 23 | 1 | 0x880BCACD3 | 93 | 29 | 2 | 0x4AE4C79FE |
| 18 | 18 | 0 | 0xA0185E326 | 56 | 24 | 1 | 0xAFA4DB918 | 94 | 30 | 2 | 0x1FDC748C9 |
| 19 | 19 | 0 | 0x93B3F9C75 | 57 | 25 | 1 | 0xAE1E49884 | 95 | 31 | 2 | 0x877D5E6E4 |
| 20 | 20 | 0 | 0x632481EA8 | 58 | 26 | 1 | 0xF7945E264 | 96 | 0 | 0 | 0x0FE322452 |
| 21 | 21 | 0 | 0x8BB8104A5 | 59 | 27 | 1 | 0x38374CA42 | 97 | 1 | 1 | 0x4DC778B5F |
| 22 | 22 | 0 | 0x87C89EF75 | 60 | 28 | 1 | 0x5AAE39B00 | 98 | 2 | 2 | 0xADD9E3F88 |
| 23 | 23 | 0 | 0x207AA794C | 61 | 29 | 1 | 0x138069E54 | 99 | 3 | 0 | 0x2C1C857DC |
| 24 | 24 | 0 | 0x6A4D1C403 | 62 | 30 | 1 | 0x966707005 | 100 | 4 | 1 | 0xCFB4B5503 |
| 25 | 25 | 0 | 0x7761B4BD7 | 63 | 31 | 1 | 0xA5037759E | 101 | 5 | 2 | 0xCD8505E21 |
| 26 | 26 | 0 | 0x31ABBF06D | 64 | 0 | 2 | 0x3FE158D96 | 102 | 6 | 0 | 0x82892F4CE |
| 27 | 27 | 0 | 0x69C6E455F | 65 | 1 | 2 | 0xAED3B839F | 103 | 7 | 1 | 0x3979FD176 |
| 28 | 28 | 0 | 0xAB3B3CFF0 | 66 | 2 | 2 | 0xF5AE23268 | 104 | 8 | 2 | 0x5FA49C311 |
| 29 | 29 | 0 | 0x731412685 | 67 | 3 | 2 | 0x1895E68BE | 105 | 9 | 0 | 0xBA7857B19 |
| 30 | 30 | 0 | 0xA3135C034 | 68 | 4 | 2 | 0x1443C94EC | 106 | 10 | 1 | 0xBC030C4CA |
| 31 | 31 | 0 | 0xFECCB2B85 | 69 | 5 | 2 | 0x929547307 | 107 | 11 | 2 | 0x517F3CBD6 |
| 32 | 0 | 1 | 0xAA37BDA7C | 70 | 6 | 2 | 0xA17D3230C | 108 | 12 | 0 | 0x7E545BE73 |
| 33 | 1 | 1 | 0x90955CE1F | 71 | 7 | 2 | 0xD54FC0C33 | 109 | 13 | 1 | 0xDDCA69C3F |
| 34 | 2 | 1 | 0xADBC1B844 | 72 | 8 | 2 | 0xAB77F079C | 110 | 14 | 2 | 0xA01A2C8C7 |
| 35 | 3 | 1 | 0xA04A3B197 | 73 | 9 | 2 | 0xC3CA00A66 | 111 | 15 | 0 | 0x1C0B64435 |
| 36 | 4 | 1 | 0x015E56CB3 | 74 | 10 | 2 | 0x025519879 | 112 | 16 | 1 | 0x330282DF2 |
| 37 | 5 | 1 | 0x64D6F4038 | 75 | 11 | 2 | 0x6CF39F815 | 113 | 17 | 2 | 0x147FCCF4B |

***Insert new subclause 8.4.6.1.1.1:***

### 8.4.6.1.1.1 Common SYNC symbol (optional)

In every fourth downlink transmission frame, the last OFDM symbol is the common SYNC symbol; it can be transmitted by the BSs in the1024/512/128 FFT modes by antenna 0. The mapping of the common SYNC sequence to the common SYNC symbol subcarrier is defined by using the following formula:

$$Common\_SYNC\_Carrier\_Set = N_{LEFT-FFT} + 2k - 1$$

where

*k* is the number of the running index $1\ldots[(N_{FFT}\text{-} N_{LEFT\text{-}FFT} - N_{RIGHT\text{-}FFT} -1)/2]$, where $[x]$ denotes the smallest integer number greater than *x*.

$N_{\text{LEFT-FFT}}$ and $N_{\text{RIGHT-FFT}}$
are the numbers of guard subcarriers of the left band and right band of FTT size $N_{FFT}$, respectively. The values of $N_{LEFT\text{-}FFT}$ and $N_{RIGHT\text{-}FFT}$ for 1024/512/128 FFT modes are listed in Table 309a, Table 309b, and Table 309c, and the DC carrier shall always be zeroed.

The common SYNC symbol is defined by frequency domain as shown in Figure 233a, the time domain illustration is shown in Figure 233b.

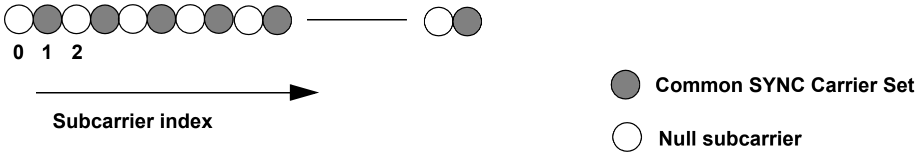


**Figure 233a—Common SYNC symbol structure (frequency domain)**

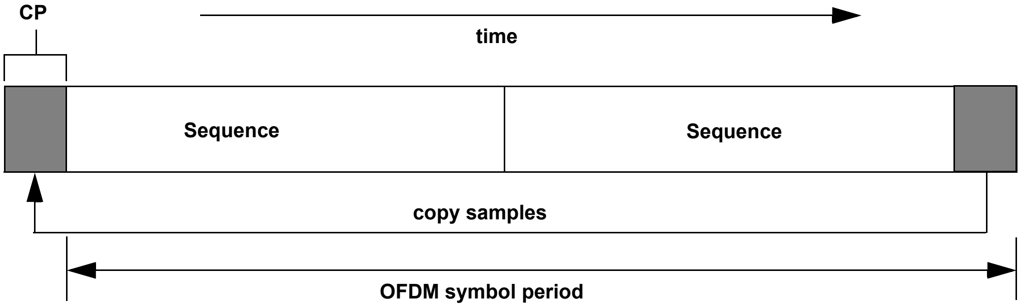


**Figure 233b—Common SYNC symbol structure (time domain)**

The same common SYNC symbol is transmitted by al BSs across the network synchronously.

***Insert new subclause 8.4.6.1.1.2:***

### 8.4.6.1.1.2 Common SYNC symbol sequence

The common SYNC sequences are listed in Table 309d. The defined sequences shall be mapped onto the common SYNC symbol subcarriers in ascending order. The sequences in Table 309a are in an hexidecimal format, and the value of the sequences should be converted to binary sequences (0 mapped to +1 and 1 mapped to –1). The converted binary sequences are mapped onto the corresponding subcarriers from the MSB to the LSB.

**Table 309d—Common SYNC sequence**

| $N_{FFT}$ | Sequence | PAPR (dB) | $N_{LEFT\text{-}FFT}$ | $N_{RIGHT\text{-}FFT}$ |
|---|---|---|---|---|
| 1024 | 0x473A0B21CE9537F3A0B20316AC873A0B21CE95378 C5F4DFCE9537F3A0B21CE9537F3A0B20316AC80C5F4 DE316AC873A0B20316AC800 | 3.32 | 87 | 86 |
| 512 | 0x5642862D90FE75642862A6F018B642862D90FE749BD 79D590FE740 | 3.17 | 43 | 43 |
| 128 | 0x590A18B643F9D0 | 2.89 | 11 | 11 |

### 8.4.6.1.2 Symbol structure

#### 8.4.6.1.2.1 Symbol structure for PUSC

***Change Table 310 as indicated:***

**Table 310—OFDMA downlink subcarrier allocations—PUSC**

| Parameter | Value | Comments |
|---|---|---|
| Number of DC subcarriers | 1 | Index 1024 (counting from 0) |
| Number of Guard subcarriers, Left | 184 | |
| Number of Guard subcarriers, Right | 183 | |
| Number of used subcarriers ($N_{used}$) | 1681 | Number of all subcarriers used within a symbol, including all possible allocated pilots and the DC carrier. |
| Number of subcarriers per cluster | 14 | |
| Number of clusters | 120 | |
| Renumbering sequence | 1 | Used to renumber clusters before allocation to subchannels:<br>6, 108, 37, 81, 31, 100, 42, 116, 32, 107, 30, 93, 54, 78, 10, 75, 50, 111, 58, 106, 23, 105, 16, 117, 39, 95, 7, 115, 25, 119, 53, 71, 22, 98, 28, 79, 17, 63, 27, 72, 29, 86, 5, 101, 49, 104, 9, 68, 1, 73, 36, 74, 43, 62, 20, 84, 52, 64, 34, 60, 66, 48, 97, 21, 91, 40, 102, 56, 92, 47, 90, 33, 114, 18, 70, 15, 110, 51, 118, 46, 83, 45, 76, 57, 99, 35, 67, 55, 85, 59, 113, 11, 82, 38, 88, 19, 77, 3, 87, 12, 89, 26, 65, 41, 109, 44, 69, 8, 61, 13, 96, 14, 103, 2, 80, 24, 112, 4, 94, 0 |
| Number of data subcarriers in each symbol per subchannel | 24 | |
| Number of subchannels | 60 | |
| ~~PermutationBase12~~Basic permutation sequence 12 (for 12 subchannels) | | 6,9,4,8,10,11,5,2,7,3,1,0 |
| ~~PermutationBase8~~Basic permutation sequence 8 (for 8 subchannels) | 4 | 7,4,0,2,1,5,3,6 |

***Insert the following tables into 8.4.6.1.2.1:***

### Table 310a—1024-FFT OFDMA downlink carrier allocations—PUSC

| Parameter | Value | Comments |
|---|---|---|
| Number of DC Subcarriers | 1 | Index 512 |
| Number of Guard Subcarriers, Left | ~~91~~ 92 | — |
| Number of Guard Subcarriers, Right | ~~92~~ 91 | — |
| Number of Used Subcarriers ($N_{used}$) including all possible allocated pilots and the DC subcarrier. | 841 | Number of all subcarriers used within a symbol. |
| renumbering sequence | 6, 48, 37, 21, 31, 40, 42, 56, 32, 47, 30, 33, 54, 18, 10, 15, 50, 51, 58, 46, 23, 45, 16, 57, 39, 35, 7, 55, 25, 59, 53, 11, 22, 38, 28, 19, 17, 3, 27, 12, 29, 26, 5, 41, 49, 44, 9, 8, 1, 13, 36, 14, 43, 2, 20, 24, 52, 4, 34, 0 | Used to renumber clusters before allocation to subchannels. |
| Number of carriers per cluster | 14 | — |
| Number of clusters | 60 | — |
| Number of data subcarriers in each symbol per subchannel | 24 | — |
| Number of subchannels | 30 | — |
| PermutationBase6 (for 6 subchannels) | 3,2,0,4,5,1 | — |
| PermutationBase4 (for 4 subchannels) | 3,0,2,1 | — |

### Table 310b—512-FFT OFDMA downlink carrier allocations—PUSC

| Parameter | Value | Comments |
|---|---|---|
| Number of DC Subcarriers | 1 | Index 256 |
| Number of Guard Subcarriers, Left | 46 | — |
| Number of Guard Subcarriers, Right | 45 | — |
| Number of Used Subcarriers ($N_{used}$) including all possible allocated pilots and the DC subcarrier. | 421 | Number of all subcarriers used within a symbol. |
| renumbering sequence | 12, 13, 26, 9, 5, 15, 21, 6, 28, 4, 2, 7, 10, 18, 29, 17, 16, 3, 20, 24, 14, 8, 23, 1, 25, 27, 22, 19, 11, 0 | Used to renumber clusters before allocation to subchannels. |
| Number of carriers per cluster | 14 | — |
| Number of clusters | 30 | — |
| Number of data subcarriers in each symbol per subchannel | 24 | — |
| Number of subchannels | 15 | — |
| PermutationBase5 (for 5 subchannels) | 4,2,3,1,0 | — |

**Table 310c—128-FFT OFDMA downlink carrier allocations—PUSC**

| Parameter | Value | Comments |
|---|---|---|
| Number of DC Subcarriers | 1 | Index 64 |
| Number of Guard Subcarriers, Left | 22 | — |
| Number of Guard Subcarriers, Right | 21 | — |
| Number of Used Subcarriers ($N_{used}$) including all possible allocated pilots and the DC subcarrier. | 85 | Number of all subcarriers used within a symbol. |
| renumbering sequence | 2, 3, 1, 5, 0, 4 | Used to renumber clusters before allocation to subchannels. |
| Number of carriers per cluster | 14 | — |
| Number of clusters | 6 | — |
| Number of data subcarriers in each symbol per subchannel | 24 | — |
| Number of subchannels | 3 | — |

***Change Figure 234 as indicated:***

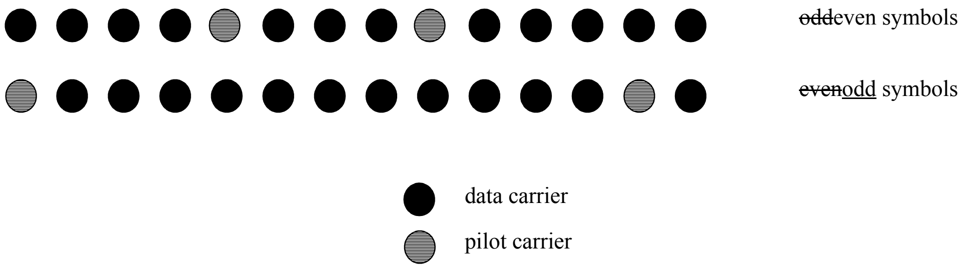


Figure 234—Cluster structure

***Insert the following sentence below Figure 234:***

Figure 234 shows subcarriers from left to right in order of increasing subcarrier index. For the purpose of determining PUSC pilot location, odd and even symbols are counted from the beginning of the current zone. The first symbol in the zone is even. The preamble shall not be counted as part of the first zone.

### 8.4.6.1.2.1.1 Downlink subchannels subcarrier allocation in PUSC

***Replace 8.4.6.1.2.1.1 with the following text:***

The carrier allocation to subchannels is performed using the following procedure:

1) Dividing the subcarriers into the number of clusters ($N_{clusters}$) physical clusters containing 14 adjacent subcarriers each (starting from carrier 0). The number of clusters, $N_{clusters}$, varies with FFT sizes. See Table 310, Table 310a, Table 310b and Table 310c for details.

2) Renumbering the physical clusters into logical clusters using the following formula:

   $$LogicalCluster = \begin{cases} RenumberingSequence(PhysicalCluster) & \text{First DL zone, or Use All SC indicator = 0} \\ & inSTC\_DL\_Zone\_IE \\ RenumberingSequence((PhysicalCluster) + 13 \cdot DL\_PermBase) \bmod Nclusters & otherwise \end{cases}$$

   In the first PUSC zone of the downlink (first downlink zone) and in a PUSC zone defined by STC_DL_ZONE_IE() with ‘use all SC indicator = 0’, the default re-numbering sequence is used for logical cluster definition. For All other cases DL_PermBase parameter in the STC_DL_Zone_IE() or AAS_DL_IE() shall be used.

3) Allocate logical clusters to groups. The allocation algorithm varies with FFT sizes.

   For FFT size=2048:
   Dividing the clusters into six major groups. Group 0 includes clusters 0-23, group 1 includes clusters 24-39, group 2 includes clusters 40-63, group 3 includes clusters 64-79, group 4 includes clusters 80-103, group 5 includes clusters 104-119. These groups may be allocated to segments, if a segment is being used, then at least one group shall be allocated to it (by default group 0 is allocated to sector 0, group 2 is allocated to sector 1, and group 4 to is allocated sector 2).
   For FFT size=1024:
   Dividing the clusters into six major groups. Group 0 includes clusters 0-11, group 1 includes clusters 12-19, group 2 includes clusters 20-31, group 3 includes clusters 32-39, group 4 includes clusters 40-51, group 5 includes clusters 52-59. These groups may be allocated to segments, if a segment is being used, then at least one group shall be allocated to it (by default group 0 is allocated to sector 0, group 2 is allocated to sector 1, and group 4 to is allocated sector 2).
   For FFT size=512:
   Dividing the clusters into six major groups. Group 0 includes clusters 0-9, group 2 includes clusters 10-19, group 4 includes clusters 20-29. These groups may be allocated to segments, if a segment is being used, then at least one group shall be allocated to it (by default group 0 is allocated to sector 0, group 2 is allocated to sector 1, and group 4 to is allocated sector 2).
   For FFT size=128:
   Dividing the clusters into six major groups. Group 0 includes clusters 0-1, group 2 includes clusters 2-3, group 4 includes clusters 4-5. These groups may be allocated to segments, if a segment is being used, then at least one group shall be allocated to it (by default group 0 is allocated to sector 0, group 2 is allocated to sector 1, and group 4 to is allocated sector 2).

4) Allocating subcarriers to subchannel in each major group is performed separately for each OFDMA symbol by first allocating the pilot carriers within each cluster, and then taking all remaining data carriers within the symbol and using the same procedure described in 8.4.6.1.2.2.2. The parameters vary with FFT sizes.

   For FFT size=2048:
   Use the parameters from Table 310, with basic permutation sequence 12 for even numbered major groups, and basic permutation sequence 8 for odd numbered major groups, to partition the subcarriers into subchannels containing 24 data subcarriers in each symbol.
   For FFT size=1024:
   Use the parameters from Table 310a, with basic permutation sequence 6 for even numbered major groups, and basic permutation sequence 4 for odd numbered major groups, to partition the subcarriers into subchannels containing 24 data subcarriers in each symbol.
   For FFT size=512:

Use the parameters from Table 310b, with basic permutation sequence 5 for even numbered major groups, to partition the subcarriers into subchannels containing 24 data subcarriers in each symbol.
For FFT size=128:
Use the parameters from Table 310c to partition the subcarriers into subchannels containing 24 data subcarriers in each symbol.
Note that the preamble IDcell is used for the first PUSC zone in Equation (111). 0therwise the DL_PermBase parameter in the STC_DL_Zone_IE() or AAS_DL_IE() shall be used in the equation. The subcarrier indexing within each group shall start from 0, where 0 is the lowest number subcarrier in the lowest numbered logical cluster belonging to the group.

### 8.4.6.1.2.2 Symbol structure for FUSC

***Change the relevant entries and title of Table 311 as indicated:***

**Table 311—OFDMA downlink subcarrier allocations**

| Parameter | Value | Comments |
|---|---|---|
| Number of DC Subcarriers | 1 | Index 1024 (counting from 0) |
| VariableSet #0 | ~~24~~71 | 0,72,144,216,288,360,432,504,576,648,720,792,864, 936,1008,1080,1152,1224,1296,1368,1440,1512,1584, 1656,48,120,192,264,336,408,480,552,624,696,768, 840,912,984,1056,1128,1200,1272,1344,1416,1488, 1560,1632,24,96,168,240,312,384,456,528,600,672, 744,816,888,960,1032,1104,1176,1248,1320,1392, 1464,1536,1608,1680 |
| ConstantSet #0 | ~~4~~12 | ~~39,645,1017,1407,330,726,1155,1461,351,855,1185, 1545~~9,153,297,441,585,729,873,1017,1161,1305,1449, 1593~~,~~ |
| VariableSet #1 | ~~24~~71 | 36,108,180,252,324,396,468,540,612,684,756,828, 900,972,1044,1116,1188,1260,1332,1404,1476,1548, 1620,1692,12,84,156,228,300,372,444,516,588,660, 732,804,876,948,1020,1092,1164,1236,1308,1380, 1452,1524,1596,1668,60,132,204,276,348,420,492, 564,636,708,780,852,924,996,1068,1140,1212,1284, 1356,1428,1500,1572,1644 |
| ConstantSet #1 | ~~4~~12 | ~~261,651,1143,1419,342,849,1158,1530,522,918,1206,1 701~~81,225,369,513,657,801,945,1089,1233,1377,1521, 1665 |
| ~~PermutationBase~~Basic permutation sequence |  | 3, 18, 2, 8, 16, 10, 11, 15, 26, 22, 6, 9, 27, 20, 25, 1, 29, 7, 21, 5, 28, 31, 23, 17, 4, 24, 0, 13, 12, 19, 14, 30 |

***Insert the following Tables into 8.4.6.1.2.2:***

**Table 311a—1024-FFT OFDMA downlink carrier allocations—FUSC**

| Parameter | Value | Comments |
|---|---|---|
| Number of DC Subcarriers | 1 | Index 512 |
| Number of Guard Subcarriers, Left | 87 | — |

**Table 311a—1024-FFT OFDMA downlink carrier allocations—FUSC**

| Parameter | Value | Comments |
|---|---|---|
| Number of Guard Subcarriers, Right | 86 | — |
| Number of Used Subcarriers ($N_{used}$) | 851 | Number of all subcarriers used within a symbol, including all possible allocated pilots and the DC subcarrier. |
| Pilots | — | — |
| VariableSet #0 | 12 | 0,24,48,72,96,120,144,168,192,216,240,264,288, 312,336,360,384,408,432,456,480,504,528,552, 576,600,624,648,672,696,720,744,768,792,816, 840 |
| ConstantSet #0 | 2 | $72*(2*n + k) + 9$ when $k$=0 and $n$=0..5<br>DC subcarrier shall be included when the pilot subcarrier index is calculated by the equation. |
| VariableSet #1 | 12 | 36,108,180,252,324,396,468,540,612,684,756, 828,12,84,156,228,300,372,444,516,588,660, 732,804,60,132,204,276,348,420,492,564,636, 708,780 |
| ConstantSet #1 | 2 | $72*(2*n + k) + 9$ when $k$=1 and $n$=0..4<br>DC subcarrier shall be included when the pilot subcarrier index is calculated by the equation. |
| Number of data subcarriers | 768 | — |
| Number of data subcarriers per sub-channel | 48 | — |
| Number of Subchannels | 16 | — |
| PermutationBase | — | 6, 14, 2, 3, 10, 8, 11, 15, 9, 1, 13, 12, 5, 7, 4, 0 |

### Table 311b—512-FFT OFDMA downlink carrier allocations—FUSC

| Parameter | Value | Comments |
|---|---|---|
| Number of DC Subcarriers | 1 | Index 256 |
| Number of Guard Subcarriers, Left | 43 | — |
| Number of Guard Subcarriers, Right | 42 | — |
| Number of Used Subcarriers ($N_{\text{used}}$) | 427 | Number of all subcarriers used within a symbol, including all possible allocated pilots and the DC subcarrier. |
| Pilots | — | — |
| VariableSet #0 | 18 | 0,24,48,72,96,120,144,168,192,216,240,264,288, 312,336,360,384,408 |
| ConstantSet #0 | 3 | 72*(2*n + k) + 9 when k=0 and n=0..2<br>DC subcarrier shall be included when the pilot subcarrier index is calculated by the equation. |
| VariableSet #1 | 18 | 12,36,60,84,108,132,156,180,204,228,252,276, 300,324,348,372,396, 420 |
| ConstantSet #1 | 3 | 72*(2*n + k) + 9 when k=1 and n=0..2<br>DC subcarrier shall be included when the pilot subcarrier index is calculated by the equation. |
| Number of subcarriers | 384 | — |
| Number of data subcarriers per subchannel | 48 | — |
| Number of Subchannels | 8 | — |
| PermutationBase | — | 2,0,1,6,4,3,5,7 |

### Table 311c—128-FFT OFDMA downlink carrier allocations—FUSC

| Parameter | Value | Comments |
|---|---|---|
| Number of DC Subcarriers | 1 | Index 64 |
| Number of Guard Subcarriers, Left | 11 | — |
| Number of Guard Subcarriers, Right | 10 | — |
| Number of Used Subcarriers ($N_{used}$) | 107 | Number of all subcarriers used within a symbol, including all allocated pilots and the DC subcarrier. |
| Pilots | 4 | — |
| VariableSet #0 | 5 | 0 24, 48, 72, 96 |
| VariableSet #1 | 4 | 12, 36, 60, 84 |
| ConstantSet #0 | 1 | 39<br>DC subcarrier shall be included when the pilot subcarrier index is calculated by the equation. |
| ConstantSet #1 | 0 | N/A<br>DC subcarrier shall be included when the pilot subcarrier index is calculated by the equation. |
| Number of data subcarriers | 96 | — |
| Number of data subcarriers per subchannel | 48 | — |
| Number of Subchannels | 2 | — |
| PermutationBase | — | 1, 0 |

***Change the sentence below Equation (110) as indicated:***

where *FUSC_SymbolNumber* counts the FUSC symbols used in the ~~transmission~~current zone starting from 0.

***Change the text above Figure 235 as indicated:***

Figure 235 depicts as an example of the symbol allocation for segment 0 on ~~symbol number 1~~ the first symbol.

***Change the caption of Figure 235 to read:***

Downlink symbol structure for segment 0 on ~~symbol number 1~~ the first symbol using FUSC.

#### 8.4.6.1.2.2.1 Downlink subchannels subcarrier allocation

***Change the second sentence of the first paragraph as indicated:***

The subchannel indices are formulated using a ~~RS~~Reed-Solomon series, and is allocated out of the data subcarriers domain.

#### 8.4.6.1.2.2.2 Partitioning of data subcarriers into subchannels in downlink FUSC

***Replace Equation (111) with the following equation:***

$$subcarrier(k, s) = N_{subchannels} \cdot n_k + \{p_s[n_k \; mod \; N_{subchannels}] + DL\_PermBase\} \; mod \; N_{subchannels} \qquad (111)$$

***Change the text of 'IDcell', '$X_{mod(k)}$', '$p_s[j]$' and '$N_{subchannels}$' parameters and insert new parameter '$N_{subcarriers}$' below Equation (111) as indicated:***

| | |
|---|---|
| ~~$N_{(subchannel)s}$~~ $N_{subchannels}$ | is the number of subchannels (for PUSC use number of subchannels in the currently partitioned Major group), |
| $p_s[j]$ | is the series obtained by rotating ~~$\{PermutationBase_0\}$~~ basic permutation sequence cyclically to the left $s$ times, |
| $N_{subcarriers}$ | number of data subcarriers allocated to a subchannel in each OFDMA symbol, |
| ~~*IDcell*~~*DL_PermBase* | is an integer ranging from 0 to 31, ~~which identifies the particular BS segment and is specified by MAC layer~~, which is set to preamble IDCell in the first zone and determined by the DL-MAP for other zones. |
| ~~$X_{mod(k)}$~~ | ~~is the remainder of the quotient X/k (which is at most $k - 1$).~~ |

#### 8.4.6.1.2.3 Additional optional symbol structure for FUSC

***Insert the following paragraph at the beginning of the subclause:***

The additional optional subchannel structure in the downlink supports 32 subchannels where each transmission uses 48 data carriers symbols as their minimal block of processing. In the downlink, all the pilot carriers are allocated first, and then the remaining carriers are used exclusively for data transmission. $N_{used}$ subcarriers except the DC subcarrier are divided into 9 contiguous subcarriers in which one pilot carrier is allocated. The position of the pilot carrier in 9 contiguous subcarriers varies according to the index of OFDMA symbol which contains the subcarriers. If the 9 contiguous subcarriers indexed as 0...8, the index of the pilot carrier shell be $3 \times l + 1$ where $l = m$ mod 3 ($m$ is the symbol index).

***Change Table 312 as indicated:***

**Table 312—OFDMA optional FUSC downlink subcarrier allocation**

| Parameter | Value | Comments |
|---|---|---|
| Number of DC subcarriers | 1 | Index 1024 (counting from 0) |
| $N_{used}$ | ~~1728~~1729 | Number of all subcarriers used within a symbol, including all possible allocated pilots and the DC carrier. |
| Guard subcarriers: Left, Right | ~~159, 160~~160, 159 | |
| Number of Pilot Subcarriers | 192 | |
| Pilot subcarrier index | $9k + 3m + 1$,<br>for $k = 0,...,191$ and<br>$m =$ [*symbol index*] *mod 3* | Symbol of index 0 in pilot subcarrier index ~~is~~ shall be the first symbol ~~from which the diversity subchannelization is applied~~ of the current zone. |
| Number of Data Subcarriers | 1536 | |

***Insert the following Tables at the end of 8.4.6.1.2.3:***

### Table 312a—1024-FFT OFDMA downlink carrier allocations—Optional FUSC

| **Parameters** | **Value** | **Comments** |
|---|---|---|
| Number of DC Subcarriers | 1 | — |
| Number of Guard Subcarriers, Left | 80 | — |
| Number of Guard Subcarriers, Right | 79 | — |
| Number of Used Subcarriers ($N_{used}$) (including all possible allocated pilots and the DC subcarrier). | 865 | — |
| Number of Pilot Subcarriers | 96 | — |
| Pilot Subcarrier Index | $9k+3m+1$<br>for $k=0,1,\ldots,95$, and<br>$m$=[symbol index] mod 3 | Symbol of index 0 in pilot subcarrier index should be the first symbol of the current zone.<br>*m* is incremented only for data symbols.<br>DC subcarrier is excluded when the pilot subcarrier index is calculated by the equation. |
| Number of Data Subcarriers | 768 | — |
| Number of Data Subcarriers per subchannel | 48 | — |

### Table 312b—512-FFT OFDMA downlink carrier allocations—Optional FUSC

| **Parameters** | **Value** | **Comments** |
|---|---|---|
| Number of DC Subcarriers | 1 | — |
| Number of Guard Subcarriers, Left | 40 | — |
| Number of Guard Subcarriers, Right | 39 | — |
| Number of Used Subcarriers ($N_{used}$) (including all possible allocated pilots and the DC subcarrier). | 433 | — |
| Number of Pilot Subcarriers | 48 | — |
| Pilot Subcarrier Index | $9k+3m+1$<br>for $k=0,1,\ldots,47$, and<br>$m$=[symbol index] mod 3 | Symbol of index 0 in pilot subcarrier index should be the first symbol of the current zone.<br>*m* is incremented only for data symbols.<br>DC subcarrier is excluded when the pilot subcarrier index is calculated by the equation. |
| Number of Data Subcarriers | 384 | — |
| Number of Data Subcarriers per subchannel | 48 | — |

**Table 312c—128-FFT OFDMA downlink carrier allocations—Optional FUSC**

| Parameters | Value | Comments |
|---|---|---|
| Number of DC Subcarriers | 1 | — |
| Number of Guard Subcarriers, Left | 10 | — |
| Number of Guard Subcarriers, Right | 9 | — |
| Number of Used Subcarriers ($N_{used}$) (including all possible allocated pilots and the DC subcarrier). | 109 | — |
| Number of Pilot Subcarriers | 12 | — |
| Pilot Subcarrier Index | $9k+3m+1$<br>for k=0,1,…,11, and<br>$m$=[symbol index] mod 3 | Symbol of index 0 in pilot subcarrier index should be the first symbol of the current zone.<br>$m$ is incremented only for data symbols.<br>DC subcarrier is excluded when the pilot subcarrier index is calculated by the equation. |
| Number of Data Subcarriers | 96 | — |
| Number of Data Subcarriers per subchannel | 48 | — |

NOTE— A “data symbol” is a symbol in which overlaps with at least one data slot (whether or not data is allocated on that slot).

In Equation (112), $P_1$, $P_2$-permutation sequences shall be taken from Table 312d. $k'$ shall be calculated as follows: $k' = k \text{ mod(length of permutation sequence)}$ .

### 8.4.6.1.2.3.1 Downlink subchannels subcarrier allocation

### 8.4.6.1.2.3.1 Downlink subchannels subcarrier allocation

***Replace the contents of 8.4.6.1.2.3.1 with the following text:***

To allocate the subchannels, the whole data tones in a symbol are partitioned into groups of contiguous data subcarriers. Each subchannel consists of one subcarrier from each of these groups. The number of groups is therefore equal to number of data subcarriers per subchannel, and its value is 48. The number of the subcarriers in a group is equal to the number of subchannels, say $N_s$. As shown in Table 313a, $N_s$ is determined by FFT size. The exact partitioning into subchannels is according to Equation (112), called DL permutation formula.

$$Carriers(s, m) = \begin{cases} N_s \times k + [s + P_{1, c_1}(k') + P_{2, c_2}(k')],\ 0 < c_1, c_2 < N_s \\ N_s \times k + [s + P_{1, c_1}(k')],\ c_1 \neq 0, c_2 = 0 \\ N_s \times k + [s + P_{2, c_2}(k')],\ c_1 = 0, c_2 \neq 0 \\ N_s \times k + s,\ c_1 = 0, c_2 = 0 \end{cases} \quad (112)$$

where

$Carriers(s, m)$ = subcarrier index of $m$-th subcarrier in subchannel s
$k=(m+s*23) mod\ 48,\ k'=k\ mod(N_s-1)$
$m$ = subcarrier-in-subchannel index from the set [0~47]
$s$ = index number of a subchannel from the set [0~$N_s$-1]
$P_{1,c1}(j)$ = $j$-th element of the sequence obtained by rotating basic permutation sequence $P_1$ cyclically to the left $c_1$ times. See Table 312d.
$P_{2,c2}(j)$ = $j$-th element of the sequence obtained by rotating basic permutation sequence $P_2$ cyclically to the left $c_2$ times. See Table 312d.
$c_1$ = DL_PermBase mod $N_s$, $c_2$ = floor(DL_PermBase / $N_s$)

In Equation (112), the operation in [ ] is done over GF($N_s$). In GF($2^n$), addition is binary XOR operation. For example, 13 + 4 in GF($2^n$) is [$(1101)_2$ XOR $(0100)_2$]= $(1001)_2$ = 9, where $(x)_2$ represents binary expansion of $x$.

**Table 312d—Basic permutation sequences for diversity subcarrier allocations**

| FFT size | $N_s$ | Basic permutation sequences | | |
|---|---|---|---|---|
| 128 | 2 | GF(2) | $P_1$ | 1 |
| | | | $P_2$ | 1 |
| 512 | 8 | GF(8) | $P_1$ | 1, 2, 4, 3, 6, 7, 5 |
| | | | $P_2$ | 1, 4, 6, 5, 2, 3, 7 |
| 1024 | 16 | GF(16) | $P_1$ | 1, 2, 4, 8, 3, 6, 12, 11, 5, 10, 7, 14, 15, 13, 9 |
| | | | $P_2$ | 1, 4, 3, 12, 5, 7, 15, 9, 2, 8, 6, 11, 10, 14, 13 |
| 2048 | 32 | GF(32) | $P_1$ | 1, 2, 4, 8, 16, 5, 10, 20, 13, 26, 17, 7, 14, 28, 29, 31, 27, 19, 3, 6, 12, 24, 21, 15, 30, 25, 23, 11, 22, 9, 18 |
| | | | $P_2$ | 1, 4, 16, 10, 13, 17, 14, 29, 27, 3, 12, 21, 30, 23, 22, 18, 2, 8, 5, 20, 26, 7, 28, 31, 19, 6, 24, 15, 25, 11, 9 |

***Insert new subclause 8.4.6.1.2.4:***

### 8.4.6.1.2.4 Optional downlink tile usage of subchannels—TUSC1

The optional downlink TUSC1 is similar in structure to the uplink PUSC structure defined in 8.4.6.2. Each transmission uses 48 data subcarriers as the minimal block of processing. The permutation properties are given in Table 313, Table 313a, Table 313b, and Table 313c. The active subchannels in the TUSC1 zone, as defined in the DCD message (see Table 356 in 11.4.1), shall be renumbered consecutively starting from 0.

The pilots in the TUSC1 permutation are regarded as part of the allocation, and as such shall be beamformed in a way that is consistent with the transmission of the allocation's data subcarriers.

The TUSC1 permutation shall only be used within an AAS zone.

***Insert new subclause 8.4.6.1.2.4.1:***

#### 8.4.6.1.2.4.1 Symbol structure for TUSC1 subchannels

The TUSC1 symbol structure corresponds to that of the uplink PUSC structure as defined in 8.4.6.2.1.

***Insert new subclause 8.4.6.1.2.4.2:***

#### 8.4.6.1.2.4.2 Partitioning of subcarriers into TUSC1 subchannels

The partitioning of subcarriers into tiles and tiles into subchannels corresponds to the definitions for the uplink PUSC structure as defined in 8.4.6.2.2 with *UL_Permbase* replaced by *IDcell*.

***Insert new subclause 8.4.6.1.2.5:***

#### 8.4.6.1.2.5 Optional downlink tile usage of subchannels—TUSC2

The TUSC2 is similar in structure to the uplink PUSC structure defined in 8.4.6.2.5. Each transmission uses 48 data subcarriers as the minimal block of processing. The permutation properties are given in Table 315, Table 315a, Table 315b, and Table 315c. The active subchannels in the TUSC2 zone, as defined in the DCD message (see Table 356 in 11.4.1), shall be renumbered consecutively starting from 0.

The pilots in the TUSC2 permutation are regarded as part of the allocation, and as such shall be beamformed in a way that is consistent with the transmission of the allocation's data subcarriers

The TUSC2 permutation shall only be used within an AAS zone.

***Insert new subclause 8.4.6.1.2.5.1:***

#### 8.4.6.1.2.5.1 Symbol structure for TUSC2 subchannels

The TUSC2 symbol structure corresponds to that of the uplink optional PUSC structure as defined in 8.4.6.2.5.1.

***Insert new subclause 8.4.6.1.2.5.2:***

#### 8.4.6.1.2.5.2 Partitioning of subcarriers into TUSC2 subchannels

The partitioning of subcarriers into tiles and tiles into subchannels corresponds to the definitions for the uplink optional PUSC structure as defined in 8.4.6.2.5.2.

***Insert new subclause 8.4.6.1.2.6***

#### 8.4.6.1.2.6 TUSC1/TUSC2 support for SDMA

The pilots in an AAS zone with TUSC1 or TUSC2 permutation are regarded as part of the allocation, and as such shall be beamformed in a way that is consistent with the transmission of the allocation's data subcarriers. In an SDMA region, the pilots of each allocation may correspond to a different pilot pattern. The pilot patterns for TUSC1 permutation are as depicted in Figure 249, and the patterns for the TUSC2 permutation are as depicted in Figure 251i.

### 8.4.6.2 Uplink

***Change the second paragraph as indicated:***

The uplink supports 70 subchannels for PUSC permutation, and 96 subchannels for optional PUSC permuation. ~~where e~~Each transmission uses 48 data carriers as the minimal block of processing. Each new transmission for the uplink commences with the parameters as given in Table 313 for PUSC permutation, and with the parameters as given in Table 315 for optional PUSC permutation.

***Change the text under the 'Value' column of the 'Number of DC subcarriers' field in Table 313 as indicated: "1 (Index 1024, counting from 0)".***

***Insert the following tables at the end of 8.4.6.2, immediately before 8.4.6.2.1:***

**Table 313a—1024-FFT OFDMA uplink subcarrier allocations for PUSC**

| Parameter | Value | Notes |
|---|---|---|
| Number of DC subcarriers | 1 | Index 512 |
| $N_{used}$ | 841 | Number of all subcarriers used within a symbol |
| Guard subcarriers: left, right | 92, 91 | — |
| TilePermutation | 11,19,12,32,33,9,30,7,4,2,13,8,17,23,27, 5,15,34,22,14,21,1,0,24,3,26,29,31,20,25, 16,10,6,28,18 | Used to allocate tiles to subchannels |
| $N_{subchannels}$ | 35 | — |
| $N_{tiles}$ | 210 | — |
| Number of subcarriers per tile | 4 | Number of all subcarriers used within tile |
| Tiles per subchannel | 6 | — |

**Table 313b—512-FFT OFDMA uplink subcarrier allocations for PUSC**

| Parameter | Value | Notes |
|---|---|---|
| Number of DC subcarriers | 1 | Index 256 |
| $N_{used}$ | 409 | Number of all subcarriers used within a symbol |
| Guard subcarriers: left, right | 52, 51 | — |
| TilePermutation | 11,15,10,2,12,9,8,14,16,4,0,5,13,3,6,7,1 | Used to allocate tiles to subchannels |
| $N_{subchannels}$ | 17 | — |
| $N_{tiles}$ | 102 | — |
| Number of subcarriers per tile | 4 | Number of all subcarriers used within tile |
| Tiles per subchannel | 6 | — |

**Table 313c—128-FFT OFDMA uplink subcarrier allocations for PUSC**

| Parameter | Value | Notes |
|---|---|---|
| Number of DC subchannel | 1 | Index 64 |
| $N_{used}$ | 97 | Number of all subcarriers used within a symbol |
| Guard subcarriers: left, right | 16, 15 | — |
| PermutationBase0 | 2, 0, 3, 1 | Used to allocate tiles to subchannels |
| $N_{subchannels}$ | 4 | — |
| $N_{tiles}$ | 24 | — |
| Number of subcarriers per tile | 4 | Number of all subcarriers used within tile |
| Tiles per subchannel | 6 | — |

### 8.4.6.2.1 Symbol structure for subchannel (PUSC)

***Change the first and second paragraphs as indicated:***

A ~~burst~~slot in the uplink is composed of three ~~time~~OFDMA symbols and one subchannel, within each ~~burst~~slot, there are 48 data subcarriers and 24 fixed-location pilots ~~subcarrier~~ as shown in Table 313.

The subchannel is constructed from six uplink tiles, each tile has four successive active subcarriers and its configuration is illustrated in Figure 236.

### 8.4.6.2.2 Partitioning of subcarriers into subchannels in the uplink

***Replace the contents of the subclause with the following text:***

The usable subcarriers in the allocated frequency band shall be divided into $N_{\text{tiles}}$ physical tiles as defined in Figure 236 with parameters from Table 314. The allocation of physical tiles to logical tiles in subchannels is performed in the following manner:

Logical tiles are mapped to physical tiles in the FFT using Equation (113); for an example refer to 8.4.6.2.3.

$$Tiles(s, n) = N_{subchannels} \cdot n + (Pt[(s + n) mod\ N_{subchannels}] + UL\_PermBase) mod\ N_{subchannels} \tag{113}$$

where

| | |
|---|---|
| $Tiles(s,n)$ | is the physical tile index in the FFT with tiles being ordered consecutively from the most negative to the most positive used subcarrier (0 is the starting tile index) |
| $n$ | is the tile index 0…5 in a subchannel |
| $Pt$ | is the tile permutation |
| $s$ | is the subchannel number in the range 0…$N_{subchannels}$-1 |
| UL_PermBase | is an integer value in the range 0…69, which is assigned by a management entity |
| $N_{subchannels}$ | is the number of subchannels for the FFT size given in Table 313a, Table 313b, and Table 313c. |

After mapping the physical tiles in the FFT to logical tiles for each subchannel, the data subcarriers per slot are enumerated by the following process:

1) After allocating the pilot carriers within each tile, indexing of the data subcarriers within each slot is performed starting from the first symbol at the lowest indexed subcarrier of the lowest indexed tile and continuing in an ascending manner through the subcarriers in the same symbol, then going to the next symbol at the lowest indexed data subcarrier, and so on. Data subcarriers shall be indexed from 0 to 47.
2) The mapping of data onto the subcarriers will follow Equation (114). This equation calculates the subcarrier index (as assigned in item 1) to which the data constellation point is to be mapped.

$$Subcarrier(n, s) = (n + 13 \cdot s) mod N_{subcarriers} \tag{114}$$

where

$Subcarrier(n,s)$ is the permutated subcarrier index corresponding to data subcarrier $n$ is subchannel $s$,
$n$ is a running index 0…47, indicating the data constellation point,
$s$ is the subchannel number,
$N_{subcarriers}$ is the number of subcarriers per slot.

For example, for subchannel 1 ($s$ = 1), the first data constellation point ($n$ = 0) is mapped onto subcarrier (0,1) = 13, where 13 is the subcarrier with index 13 according to item 1) above. Considering the PUSC tile structure, it can be seen that this is the second indexed subcarrier on the second symbol within the slot. Similarly, for subchannel 3, the ninth data constellation point ($n$ = 8) is mapped onto subcarrier (8, 3) = 47. According to item 1), this is the last indexed subcarrier of the third symbol within the slot.

Subcarrier enumeration shall not be applied to the slots in the UL-MAP indicated by either UIUC = 0 or UIUC = 12.

### 8.4.6.2.3 Uplink permutation example

***Change the second paragraph as indicated:***

The tiles used for subchannel $s$ = 3 in *UL_~~IDcell~~PermBase* = 2 are computed.

***Change the third paragraph as indicated:***

The relevant parameters characterizing the uplink are therefore taken from Table 313.

- Number of subchannels: $N_{subchannels}$ = 70
- Number of subcarriers in each OFDMA symbol~~: $N_{subcarriers}$~~ = 24
- Number of data subcarriers in each subchannel: $N_{subcarriers}$ = 48
- TilePermutation = {6, 48, 58, 57, 50, 1, 13, 26, 46, 44, 30, 3, 27, 53, 22, 18, 61, 7, 55, 36, 45, 37, 52, 15, 40, 2, 20, 4, 34, 31, 10, 5, 41, 9, 69, 63, 21, 11, 12, 19, 68, 56, 43, 23, 25, 39, 66, 42, 16, 47, 51, 8, 62, 14, 33, 24, 32, 17, 54, 29, 67, 49, 65, 35, 38, 59, 64, 28, 60, 0}

***Change the third bullet of the last paragraph as indicated:***

3) Take the first six numbers, add the *UL_~~IDcell~~PermBase* (perform modulo operation if needed): {59, 52, 3, 15, 28, 48}

### 8.4.6.2.4 Partition a subchannel to mini-subchannels

***Change every instance of "subchannel", including Table 314, to "slot" in the subclause.***

***Change the first sentence of the first paragraph as indicated:***

Mini-subchannels can be applied to PUSC or optional-PUSC uplink permutations, in which an ~~An~~ uplink subchannel is composed of six tiles.

***Replace the paragraph below Table 314 with the following text:***

When mini subchannels of order *M* are indicated in the map, the allocation shall be a multiple of *M* slots, and shall not exceed one full subchannel, i.e., at most one slot will be allocated in each OFDMA symbol.

Allocating tiles to mini-subchannels shall be done as follows: The slots in the allocation shall be numbered in time-first order in the same order as the slots are allocated in the map. The number of slot modulu *M* is used as index to Table 314, and determines which tiles are allocated to the SS.

Mapping data to mini-subchannels shall be done as follows: The FEC, repetition and constellation mapping shall be applied as if the allocation was of duration/*M* slots (where duration is the number of slots specified in the map). The resulting data subcarriers shall be enumerated in the tiles allocated to each SS in a frequency-first order beginning from the tile with the smallest symbol number and smallest frequency. The subcarrier rotation defined in Equation (114) [item 2) of 8.4.6.2.2] shall not be applied to mini-subchannels, instead enumeration of the data subcarriers shall be performed as indicated by Equation (114a) which sets the order to which the mapping of the data onto the subcarriers shall be performed:

$$P(n) = \left(n + 13 \cdot \left\lfloor \frac{n}{48} \right\rfloor\right) mod\ 48 + 48 \cdot \left\lfloor \frac{n}{48} \right\rfloor \tag{114a}$$

where

$P(n)$ physical data subcarrier index ($n$),
$n$ is a running index 0… used data subcarriers, which represents the logical subcarrier index.

### 8.4.6.2.5 Additional optional symbol structure for PUSC

***Change Table 315 as indicated:***

**Table 315—OFDMA uplink subcarrier allocations**

| Parameter | Value |
|---|---|
| Number of DC subcarriers | 1 (Index 1024, counting from 0) |
| $N_{used}$ | ~~1728~~1729 |
| Guard subcarriers: Left, Right | ~~159, 160~~160, 159 |
| $N_{subchannels}$ | 96 |
| $N_{tiles}$ | 576 |
| Number of subcarriers per tile | 3 |
| Tiles per subchannel | 6 |
| Number of data subcarriers per subchannel | 48 |

***Insert the following tables at the end of 8.4.6.2.5:***

**Table 315a—Optional 1024-FFT OFDMA uplink subcarrier allocations**

| Parameters | Value | Notes |
|---|---|---|
| Number of DC subcarriers | 1 | — |
| Number of guard subcarriers, left | 80 | — |
| Number of guard subcarriers, right | 79 | — |
| Number of used subcarriers ($N_{used}$) (including all possible allocated pilots and the DC subcarrier) | 865 | — |
| Number of subchannels ($N_{subchannels}$) | 48 | — |
| Number of tiles ($N_{tiles}$) | 288 | — |
| Number of subcarriers per tile | 3 | — |
| Tiles per subchannel | 6 | — |
| Number of data subcarriers per subchannel | 48 | — |

**Table 315b—Optional 512-FFT OFDMA uplink subcarrier allocations**

| Parameters | Value | Notes |
|---|---|---|
| Number of DC subcarriers | 1 | — |
| Number of guard subcarriers, left | 40 | — |
| Number of guard subcarriers, right | 39 | — |
| Number of used subcarriers ($N_{used}$) (including all possible allocated pilots and the DC subcarrier) | 433 | — |
| Number of subchannels ($N_{\mathrm{subchannels}}$) | 24 | — |
| Number of tiles ($N_{tiles}$) | 144 | — |
| Number of subcarriers per tile | 3 | — |
| Tiles per subchannel | 6 | — |
| Number of data subcarriers per subchannel | 48 | — |

**Table 315c—Optional 128-FFT OFDMA uplink subcarrier allocations**

| Parameters | Value | Notes |
|---|---|---|
| Number of DC subcarriers | 1 | — |
| Number of guard subcarriers, left | 10 | — |
| Number of guard subcarriers, right | 9 | — |
| Number of used subcarriers ($N_{used}$) (including all possible allocated pilots and the DC subcarrier) | 109 | — |
| Number of subchannels ($N_{\text{subchannels}}$) | 6 | — |
| Number of tiles ($N_{\text{tiles}}$) | 36 | — |
| Number of subcarriers per tile | 3 | — |
| Tiles per subchannel | 6 | — |
| Number of data subcarriers per subchannel | 48 | — |

### 8.4.6.2.5.1 Symbol structure for subchannel

***Change the first paragraph as indicated:***

A ~~burst~~slot in the uplink is composed of three ~~time~~OFDMA symbols and one subchannel, within each ~~burst~~slot, there are 48 data subcarriers and six fixed-location pilots ~~subcarrier~~. The subchannel is constructed from six uplink tiles~~,~~. ~~e~~Each tile has three successive active subcarriers, and its configuration is illustrated in Figure 237.

### 8.4.6.2.5.2 Partitioning of subcarriers into subchannels in the uplink

***Change 8.4.6.2.5.2 as indicated:***

To allocate the subchannels, $N_{used}$ subcarriers excluding DC subcarrier are partitioned into tiles, which is 3x3 frequency-time block containing 9 tones(1 pilot tone~~s~~ and 8 data tones). The whole frequency band~~s are~~ is partitioned into groups of contiguous tiles. Each subchannel consists of 6 tiles each of which is chosen from different groups. The value of $N_{\text{s}}$ is equal to $N_{\text{tiles}}$/18. $N_{\text{tiles}}$ is the number of tiles in the whole frequency band for each FFT size, which is specified in Table 315, Table 315a, Table 315b, and Table 315c.

~~For the parameters defined in Table 313, the number of tiles in a group is 32 and there are 18 groups in the whole frequency band. Since a subchannel consists of 6 tiles, 6 groups at equal distance (3 groups away from each) are chosen and each tile is selected from each group.~~

~~The exact partitioning into subchannels is according to Equation (111), called UL permutation formula.~~

***Delete Equation (115) and the variable descriptions below it. Replace with the following:***

There are 18 groups in the whole frequency band and the number of tiles in a group is $N_{\text{s}}$. In order to make a subchannel, 6 groups at equal distance (3 groups away from each) are chosen and each of 6 tiles is selected from each group.

The exact partitioning into subchannels is according to Equation (115), called UL permutation formula.

***Insert the following new formula 115:***

$$Tiles(s, m) = \begin{cases} 3N_s \cdot m + N_s \cdot S + \lfloor s' + P_{1,c_1}(m') + P_{2,c_2}(m') \rfloor, 0 < c_1, c_2 < N_s \\ 3N_s \cdot m + N_s \cdot S + \lfloor s' + P_{1,c_1}(m') \rfloor, c_1 \neq 0, c_2 = 0 \\ 3N_s \cdot m + N_s \cdot S + \lfloor s' + P_{2,c_2}(m') \rfloor, c_1 = 0, c_2 \neq 0 \\ 3N_s \cdot m + N_s \cdot S + s', c1=0, c2=0 \end{cases} \tag{115}$$

where

$Tile(s, m)$ = tile index of the $m$-th tile in subchannel $s$.
$S = \lfloor s/N_s \rfloor, s' = s \cdot mod(N_s)$
$m$ = tile-in-subchannel index from the set [0~5], $m' = m$ mod($N_s$-1)
$s$ = index number of a subchannel from the set [0~$3N_s$-1]
$P_{1,c1}(j)$ = $j$-th element of the sequence obtained by rotating basic permutation sequence $P_1$ cyclically to the left $c_1$ times. See Table 313a.
$P_{2,c2}(j)$ = $j$-th element of the sequence obtained by rotating basic permutation sequence $P_2$ cyclically to the left $c_2$ times. See Table 313a.
$c_1 = UL\_PermBase\ mod(N_s), c_2 = \lfloor UL\_PermBase/N_s \rfloor$

In Equation (115), the operation in [ ] is over GF($2^n$). In GF($2^n$), addition is binary XOR operation. For example, 13 + 4 in GF($2^n$) is [$(1101)_2$ XOR $(0100)_2$]= $(1001)_2$ = 9, where $(x)_2$ represents binary expansion of $x$.

After allocating the tiles for each subchannel the data subcarriers of each subchannel are enumerated by the same procedure used for UL PUSC in 8.4.6.2.2.

### 8.4.6.2.6 Data subchannel rotation scheme

***Change the first paragraph as indicated:***

A rotation scheme shall be applied per each OFDMA slot-duration in any zone, except zones marked as AAS zone, optional PUSC zone (8.4.6.2.5) or zone using the adjacent-subcarriers permutations (8.4.6.3). Slot-duration is defined in 8.4.3.1. On each slot-duration, the rotation scheme shall be applied to all UL subchannels that belong to the segment (see 8.4.4.5), except those subchannels indicated in the UL-MAP by UIUC = 0, UIUC = 13 or UIUC = 12. The rotation scheme is defined by applying the following rules:

***Change the first, third, and last items of the numerated list following the first paragraph as indicated:***

1) Per OFDMA slot duration, pick only subchannels that are not indicated by either UIUC = 0, UIUC = 12 or UIUC = 13 (as defined above). Renumber these subchannels contiguously, such that the lowest numbered physical subchannel is renumbered with 0. The total number of subchannels picked shall be designated $N_{subchn}$.
3) Mark the first UL OFDMA slot-duration for each permutation zone with the slot index $S_{idx} = 0$. Within the permutation zone, ~~I~~increase $S_{idx}$ by 1 in every slot duration, such that subsequent slots are numbered 1,2,3... etc.
6) For subchannels in the UL-MAP indicated by either UIUC = 0, UIUC=12, or UIUC=13, *new_subchannel_number = old_subchannel_number*

***Insert new numerated item 7):***

7) The *new_subchannel_number* will replace the *old_subchannel_number* in each allocation defined by 8.4.3.4. Where the *new_subchannel_number* is the output of the rotation scheme, and the *old_subchannel_number* is the input of the rotation scheme.

***Insert new subclause 8.4.6.2.7:***

### 8.4.6.2.7 Optional uplink channel sounding in TDD systems

***Insert new subclause 8.4.6.2.7.1:***

#### 8.4.6.2.7.1 Channel sounding

This subclause describes a signaling mechanism where an MS transmits channel sounding waveforms on the uplink to enable the BS to determine the BS-to-MS channel response under the assumption of TDD reciprocity. Only CSIT capable MSs (as indicated by the SBC-REQ message, see 11.8.3.7.6) shall support this signaling. This signaling methodology enables the use of closed-loop transmission strategies. Closed-Loop transmission strategies use knowledge of the channel at the transmitter to improve link performance, reliability, and range. This methodology also provides a means for the BS to determine the quality of the channel response across the signal bandwidth for the purpose of selecting the best portion of the band on which to transmit. The signaling described in this subclause enables the BS to measure the uplink channel response and translate the measured uplink channel response to an estimated downlink channel response when the transmit and receive hardware are appropriately calibrated. To support downlink channel estimation in a mobile environment, an MS may be instructed to transmit sounding signals periodically. The first sounding symbol is transmitted in the frame containing the relevant sounding instruction if Sounding_Relevance is set to 0. The Sounding_Relevance_Flag indicates whether the Sounding relevance applies to all CIDs in the sounding command or whether a different Sounding Relevance can be applied individually for each CID in the sounding command. For each sounding assignment being made in this IE, the Sounding Relevance cannot be set to 0 unless the respective SS has a sounding response time capability less than or equal to the time between the completion of the transmission of the UL_Sounding_Command_IE and the beginning of its respective sounding assignment.

In order to enable uplink sounding, in UL-MAP, a BS transmits UIUC=13 with the PAPR_Reduction_Safety_and_Sounding_Zone_Allocation_IE() (see Table 287) to indicate the allocation of an UL sounding zone within the frame. The Sounding Zone is a region of one or more OFDMA symbol intervals in the UL frame that is used by the MS to transmit sounding signals to enable the BS to rapidly determine the channel response between the BS and the MS. The BS may command an MS to transmit a sounding signal (defined below) at one or more OFDMA symbols within the sounding zone by transmitting the UL-MAP message UL_Sounding_Command_IE()to provide detailed sounding instructions to the MS. If periodic sounding is instructed by the BS, it is the responsibility of the BS to continue to signal the PAPR_Reduction_Safety_and_Sounding_Zone_Allocation_IE() in every appropriate frame. The UL_Sounding_Command_IE() of type A instructs the MS to transmit the specific sounding signal(s) at one or more specific symbol interval(s) within the sounding zone and specifies the specific sounding frequency band(s) to be occupied within each of these sounding symbol(s). The UL_Sounding_Command_IE() of type B is similar to the UL_Sounding_Command_IE() of type A except the frequency band(s) are allocated according to a specified downlink subcarrier permutation.

For the purposes of sounding the uplink of a CSIT capable MS of type A, the OFDMA frequency bandwidth within the Sounding Zone is partitioned into non-overlapping sounding frequency bands, where each sounding frequency band contains 18 consecutive OFDMA subcarriers. For the 2048 FFT size, the Sounding Zone, therefore, contains maximum of 1728/18=96 sounding frequency bands, where 1728 is the number of usable subcarriers ($N_{used}$). For other FFT sizes, the sounding bands are also 18 subcarriers wide, and the number of possible sounding bands across the signal bandwidth varies accordingly.

As shown in Table 316a, the sounding instructions for CSIT type A include an assigned set of contiguous sounding frequency bands (called the sounding allocation). The sounding frequency bands are non-distributed for CSIT capability type A and are distributed according to a specified downlink permutation (for example, PUSC) for CSIT capability type B. For CSIT capability B, distributing the sounding frequency bands according to the optional FUSC is supported only for MSs that support the optional FUSC permutation.

Additionally, for CSIT capability A, the sounding instructions in UL_Sounding_Command_IE() contain two alternate methods of maintaining signal orthogonality between multiple multiplexed MS sounding transmissions. The first methodology is called "cyclic shift separability" and involves the MS occupying all subcarriers within the sounding allocation. With this methodology, multiple MSs use the same sounding sequence (defined below), but each uses a different frequency-domain phase shift to multiply that underlying sounding sequence. In the second methodology, the MS occupies a decimated set of subcarriers (e.g., every 16th subcarrier). Multiple MSs can occupy the same sounding allocation, but each MS would use a set of non-overlapping subcarriers within the sounding allocation.

The sounding instructions in UL_Sounding_Command_IE() of type B does not allow for multiplexing of sounding transmissions of multiple MSs over the same bands.

### Table 315d—UL_Sounding_Command_IE()

| Syntax | Size | Notes |
|---|---|---|
| UL_Sounding_Command_IE(){ | — | — |
| **Extended-2 UIUC** | 4 bits | UL_sounding_command_IE()=0x04 |
| **Length** | 8 bits | *variable* |
| **Sounding_Type** | 1 bit | 0 = Type A<br>1 = Type B |
| **Send Sounding Report Flag** | 1 bit | — |
| **Sounding_Relevance_Flag** | 1 bit | 0 = Sounding relevance is the same for all CIDs<br>1 = Sounding relevance is specified for each CID |
| if(Sounding_Relevance_Flag==0) { | — | — |
| **Sounding_Relevance** | 1 bit | 0 = All CIDs respond in the frame carrying the instruction<br>1 = All CIDs respond in next frame |
| *Reserved* | 2 bits | Shall be set to zero. |
| } else { | — | — |
| *Reserved* | 3 bits | Shall be set to zero. |
| } | — | — |
| **Include additional feedback** | 2 bits | 0b00 = No additional feedback<br>0b01 = include channel coefficients (see 8.4.6.2.7.3)<br>0b10 = include received pilot coefficients<br>0b11 = include feedback message |
| if (Sounding_Type == 0) { | — | — |
| **Num_Sounding_symbols** | 3 bits | Total number of sounding symbols being allocated, from 1 (0b000) to $2^3$=8 (0b111) |

### Table 315d—UL_Sounding_Command_IE() *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Separability Type** | 1 bit | 0: occupy all subcarriers in the assigned bands;<br>1: occupy decimated subcarriers |
| if (Separability type==0) { | — | (using cyclic shift separability) |
| **Max Cyclic Shift Index P** | 3 bits | 0b000: P=4;<br>0b001: P=8;<br>0b010: P=16,<br>0b011: P=32<br>0b100: P=9;<br>0b101: P=18;<br>0b110-0b111: *Reserved* |
| *Reserved* | 1 bit | Shall be set to zero. |
| } else { | — | (using decimation separability) |
| **Decimation Value *D*** | 3 bits | Sound every $D^{th}$ subcarrier within the sounding allocation. Decimation value *D* is 2 to the power of (1 plus this value), hence 2,4,8,… up to maximum of 128, and 0b111 means decimation of 5. |
| **Decimation offset randomization** | 1 bit | 0= no randomization of decimation offset<br>1= decimation offset pseudo-randomly determined |
| } | — | — |
| for (i=0;i<Num_Sounding_symbols;i++){ | — | — |
| **Sounding symbol index** | 3 bits | Symbol index within the Sounding Zone, from 1 (value 0b000) to $2^3$=8 (value 0b111) |
| **Number of CIDs** | 6 bits | Number of CIDs sharing this sounding allocation |
| *Reserved* | 3 bits | Shall be set to zero. |
| for (j = 0; j<Num. of CIDs; j++) { | — | — |
| **Shorted basic CID** | 12 bits | 12 LSBs of the MS basic CID value |
| **Power Assignment Method** | 2 bits | 0b00 = equal power;<br>0b01 = Reserved;<br>0b10 = Interference dependent. Per subcarrier power limit;<br>0b11 = Interference dependent. Total power limit. |
| **Power boost** | 1 bit | 0 = no power boost<br>1 = power boost |
| **Multi-Antenna Flag** | 1 bit | 0 = MS sounds first antenna only<br>1 = MS sounds all antennas |
| **Allocation Mode** | 1 bit | 0: Normal<br>1: Band AMC |
| If (Allocation Mode == 1) { | — | — |
| **Band bit Map** | 12 bits | See logical band defined in 6.3.18. |
| *Reserved* | 2 bits | Shall be set to zero. |
| } Else { | — | — |

### Table 315d—UL_Sounding_Command_IE() *(continued)*

| Syntax | Size | Notes |
|---|---|---|
| **Starting Frequency Band** | 7 bits | Out of 96 bands at most (FFT size dependent) |
| **Number of frequency bands** | 7 bits | Contiguous bands used for sounding |
| } | — | — |
| If (Sounding Relevance Flag == 1) { | — | — |
| **Sounding_Relevance** | 1 bit | — |
| } else { | — | — |
| *Reserved* | 1 bit | Shall be set to zero |
| } | — | — |
| if (Separability Type==0) { | — | — |
| **Cyclic time shift index m** | 5 bits | Cyclically shifts the time domain symbol by multiples (from 0 to P –1) of N/P where N=FFT size, and P=Max Cyclic Shift Index. |
| } else { | — | — |
| **Decimation Offset d** | 6 bits | Relative starting offset position for the first sounding occupied subcarrier in the sounding allocation |
| If (Include additional feedback == 0b01) { | — | — |
| **Use same symbol for additional feedback** | 1 bit | 0 = the additional feedback is sent in the symbol(s) following the allocated sounding symbol<br>1 = the additional feedback is sent in the same symbol as the allocated sounding symbol |
| *Reserved* | 2 bits | Shall be set to zero |
| } else { | — | — |
| *Reserved* | 3 bits | Shall be set to zero. |
| } | — | — |
| } | — | — |
| **Periodicity** | 3 bits | 0b000 = single command, not periodic, or terminate periodicity. Otherwise, repeat sounding once per *r* frames, where $r = 2^{(n-1),}$ where n is the decimal equivalent of the periodicity field |
| } | — | — |
| } | — | — |
| } else { | — | — |
| **Permutation** | 3 bits | 0b000 = PUSC perm.<br>0b001 = FUSC perm<br>0b010 = Optional FUSC perm.<br>0b011 = PUSC-ASCA<br>0b100 = TUSC1<br>0b101 = TUSC2<br>0b110 = AMC (2x3)<br>0b111 = *Reserved* |

**Table 315d—UL_Sounding_Command_IE() *(continued)***

| Syntax | Size | Notes |
|---|---|---|
| **DL_PermBase** | 6 bits | — |
| **Num_Sounding_symbols** | 3 bits | — |
| for (i=0;i<Num_Sounding_symbols;i++){ | — | — |
| **Number of CIDs** | 7 bits | — |
| *Reserved* | 1 bit | Shall be set to zero. |
| for (j=0; j<Number of CIDs; j++) { | — | — |
| **Shortened basic CID** | 12 bits | 12 LSBs of the MS basic CID value |
| If(Sounding_Relevance_Flag==1){ | — | — |
| **Sounding_Relevance** | 1 bit | 0 = Respond in the frame carrying the instruction<br>1 = Respond in next frame |
| *Reserved* | 3 bits | Shall be set to zero |
| } | — | — |
| **Subchannel offset** | 7 bits | The lowest index subchannel used for carrying the burst, starting from subchannel 0 |
| **Power boost** | 1 bit | 0 = no power boost<br>1 = power boost |
| **Number of subchannels** | 3 bits | The number subchannels with subsequent indexes, used to carry the burst. |
| **Periodicity** | 3 bits | 0b000 = single command, not periodic, or terminate periodicity. Otherwise, repeat sounding once per $r$ frames, where $r = 2^{(n-1)}$, where n is the decimal equivalent of the periodicity field |
| **Power Assignment Method** | 2 bits | 0b00 = equal power;<br>0b01 = *Reserved*;<br>0b10 = Interference dependent. Per subcarrier power limit;<br>0b11 = Interference dependent. Total power limit. |
| } | — | — |
| } | — | — |
| } | — | — |
| *Padding* | *variable* | Pad IE to octet boundary. Bits shall be set to 0 |
| } | — | — |

If the field "Include Channel Coefficients" is enabled, then the UL Sounding Command IE() enables the MS to perform the direct transmission of DL channel coefficients to the BS along with the UL sounding waveform. For the description of the direct channel coefficient encoding method, see 8.4.6.2.7.3.

For CSIT capability A, the indices d or m are associated with the first antenna of the MS. If Multi-Antenna Flag equals 1 then the $i$-th antenna of the MS corresponds to index $d + i - 1$ or to $m + i - 1$ respectively. If Multi-Antenna Flag equals 0 then only the first antenna performs sounding. The BS shall assign indices to different CIDs such that overlapping of indices is avoided. Optional permutations for AAS and AMC subchannels

For CSIT capability A, if the separability type is zero, then the sequence used by a transmit device (MS or MS antenna) associated with the *n*-th index is determined according to:

$$s_{un}(k) = s_u(k)e^{-j\frac{2\pi kn}{P}}$$

where

$k$ is the index of the occupied subcarrier ( $0 \le k \le L_s - 1$ , $L_s$ is the number of occupied subcarriers),
$P$ is the max cyclic shift index (from the sounding instructions),
$n$ is the assigned cyclic time shift index (also from the sounding instructions), which ranges from 0 to $P$-1.

The sequence $s_u(k)$ whose length is equal to $L_s$ (a multiple of 18), is obtained as a cyclic shift of the sequence $S(k)$ by an offset equal to $u$ such that the variable $u$ stands for the decimal value of the number represented by the binary digits b5…b0 and

b5..b3 = three least significant bits of UL_Permbase,
b2..b0 = three least significant bits of the frame number.

The sequence $s(k)$ is the binary subsequence of the Golay sequence given in Table 316b, starting from location $Offset(L_s)$, the latter given by Table 316c. The PAPR for any of these subsequences is approximately 5 dB.

### Table 315e—Golay sequence of length 2048 bits

0xdbc5, 0xda3b, 0xdbc5, 0x25c5, 0xdbc5, 0xda3b, 0x243b, 0xda3b, 0xdbc5, 0xda3b, 0xdbc5, 0x25c5, 0x243b, 0x25c5, 0xdbc5, 0x25c5, 0xdbc5, 0xda3b, 0xdbc5, 0x25c5, 0xdbc5, 0xda3b, 0x243b, 0xda3b, 0x243b, 0x25c5, 0x243b, 0xda3b, 0xdbc5, 0xda3b, 0x243b, 0xda3b, 0xdbc5, 0xda3b, 0xdbc5, 0x25c5, 0xdbc5, 0xda3b, 0x243b, 0xda3b, 0xdbc5, 0xda3b, 0xdbc5, 0x25c5, 0x243b, 0x25c5, 0xdbc5, 0x25c5, 0x243b, 0x25c5, 0x243b, 0xda3b, 0x243b, 0x25c5, 0xdbc5, 0x25c5, 0xdbc5, 0xda3b, 0xdbc5, 0x25c5, 0x243b, 0x25c5, 0xdbc5, 0x25c5, 0xdbc5, 0xda3b, 0xdbc5, 0x25c5, 0xdbc5, 0xda3b, 0x243b, 0xda3b, 0xdbc5, 0xda3b, 0xdbc5, 0x25c5, 0x243b, 0x25c5, 0xdbc5, 0x25c5, 0xdbc5, 0xda3b, 0xdbc5, 0x25c5, 0xdbc5, 0xda3b, 0x243b, 0xda3b, 0x243b, 0x25c5, 0x243b, 0xda3b, 0xdbc5, 0xda3b, 0x243b, 0xda3b, 0x243b, 0x25c5, 0x243b, 0xda3b, 0x243b, 0x25c5, 0xdbc5, 0x25c5, 0x243b, 0x25c5, 0x243b, 0xda3b, 0xdbc5, 0xda3b, 0x243b, 0xda3b, 0xdbc5, 0xda3b, 0xdbc5, 0x25c5, 0xdbc5, 0xda3b, 0x243b, 0xda3b, 0x243b, 0x25c5, 0x243b, 0xda3b, 0xdbc5, 0xda3b, 0x243b, 0xda3b

### Table 315f—Length dependent offsets in the Golay sequence of Table 316b

| Length | Offset | Length | Offset | Length | Offset | Length | Offset | Length | Offset | Length | Offset |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 18 | 44 | 306 | 1512 | 594 | 264 | 882 | 1426 | 1170 | 961 | 1458 | 352 |
| 36 | 119 | 324 | 446 | 612 | 767 | 900 | 639 | 1188 | 542 | 1476 | 369 |
| 54 | 140 | 342 | 424 | 630 | 423 | 918 | 314 | 1206 | 1727 | 1494 | 354 |
| 72 | 3 | 360 | 1502 | 648 | 1667 | 936 | 313 | 1224 | 1720 | 1512 | 342 |
| 90 | 376 | 378 | 340 | 666 | 1171 | 954 | 561 | 1242 | 1541 | 1530 | 1350 |
| 108 | 478 | 396 | 799 | 684 | 1154 | 972 | 1170 | 1260 | 1537 | 1548 | 1343 |
| 126 | 32 | 414 | 1473 | 702 | 1153 | 990 | 1557 | 1278 | 384 | 1566 | 1344 |
| 144 | 478 | 432 | 96 | 720 | 1151 | 1008 | 1295 | 1296 | 882 | 1584 | 1347 |
| 162 | 102 | 450 | 28 | 738 | 1135 | 1026 | 509 | 1314 | 800 | 1602 | 1342 |
| 180 | 191 | 468 | 1423 | 756 | 682 | 1044 | 377 | 1332 | 442 | 1620 | 1322 |
| 198 | 744 | 486 | 587 | 774 | 671 | 1062 | 1264 | 1350 | 407 | 1638 | 1300 |
| 216 | 764 | 504 | 519 | 792 | 671 | 1080 | 1270 | 1368 | 406 | 1656 | 1289 |
| 234 | 98 | 522 | 1536 | 810 | 641 | 1098 | 1183 | 1386 | 410 | 1674 | 1277 |
| 252 | 324 | 540 | 187 | 828 | 640 | 1116 | 164 | 1404 | 387 | 1692 | 1279 |
| 270 | 505 | 558 | 1510 | 846 | 639 | 1134 | 959 | 1422 | 376 | 1710 | 1261 |
| 288 | 16 | 576 | 736 | 864 | 1407 | 1152 | 1537 | 1440 | 367 | 1728 | 1600 |

For CSIT type A, if the separability type is one, then a spacing of $D$ subcarriers (where $D$ is the Decimation value) is maintained between every two occupied subcarriers associated with the same transmit device. The occupied subcarriers for each transmit device shall be modulated by BPSK symbols in the same manner as done in 8.4.9.4.3, Equation (130). The relevant value of $w_k$ is taken from the Golay sequence in Table 316b with offset given according to Table 316d. Let $\hat{d}$ be the value of the decimation offset $d$ plus the relative offset according to the MS antenna number (when Multi-Antenna Flag equals 0, then only the first antenna does sounding). If Decimation Offset Randomization equals 0, then $g = \hat{d}$, otherwise $g=((p((baseID + Frame\ Number) \bmod 32) + \hat{d}) \bmod D$, where $p(x)$ is the value in PermutationBase as defined by Table 311 (“OFDMA downlink carrier allocations for FUSC in 2048 FFT mode”) at the location $x$. The first subcarrier to be occupied is located at the $g^{th}$ subcarrier. The pseudo-random cyclic shift of the decimation offset may be used to combat inter-cell interference. On the other hand, when this pseudo-random cyclic shift is not used, then an alternative strategy for combating inter-cell interference involves assigning each neighboring cell/sector a set of decimation offsets that is different from those used by neighboring cells/sectors.

**Table 315g—Offsets for the decimated pilots method**

| FFT size | Offset | PAPR |
|---|---|---|
| 2048 | 1922 | 6.3 |
| 1024 | 393 | 6.1 |
| 512 | 140 | 5.8 |
| 128 | 15 | 5.1 |

The two periodicity bits indicate whether the MS is to periodically repeat the sounding waveforms in subsequent sounding zone without having to receive a subsequent UL_Sounding_Command_IE(). Setting the periodicity bits to 0b00 has two meanings: Ordinarily, the 0b00 setting means a single sounding command with no periodicity. However, if periodic sounding is being performed by a specified MS, then the 0b00 setting means the specified MS must stop all sounding over the specified OFDMA symbol.

When the MS is sounding with CSIT capability B, the pilot subcarriers shall be BPSK modulated with their values corresponding to the sequence $s_u(k)$, where $k$=0 is associated with the first occupied subcarrier.

Sequence to subcarrier mapping is done in physical order after collecting all subcarrier index belonging to the allocated subchannels.

If Send Sounding Report Flag is set to one, then any sounding IE (type A or B) encompasses an additional implicit instruction, according to which the MS shall report the average of the downlink SINR at the neighborhood of the pilot subcarriers. This instruction is equivalent to a Report command with parameter Channel Type request equal to 0b11. A CSIT capable MS (of type A or type B) shall respond with the appropriate REP-RSP() message on the uplink (see also 11.11 and 11.12) within the same frame used to convey the relevant sounding IE. It is the responsibility of the BS to allocate enough bandwidth to support the proper transmission of this REP-RSP() message. In case a periodic sounding is required, a periodic REP-RSP() shall be sent.

For each occupied subcarrier in a sounding symbol, the SINR at the MS is estimated based on a non-beamformed transmission that corresponds to the downlink preamble at the first symbol of the frame. The average SINR reported is the average of those estimates. An MS that transmits over multiple sounding symbols shall address the last symbol in the region for that matter.

If Send Sounding Report Flag is set to zero, then no reports are required to be sent by the specified MSs.

***Insert new subclause 8.4.6.2.7.2:***

### 8.4.6.2.7.2 Power assignment

If inside UL_Sounding_Command_IE() the power assignment method field is set to 0b00 then the mobile shall transmit all pilots with equal power. In general, the transmission power is according to previous commands of the power control mechanism (see 8.4.10.3).

If the power assignment method is 0b10, then the power allocated to each pilot shall be proportional to $Q = \frac{1}{\sigma_k^2}$ where $\sigma_k^2$ is the estimated absolute interference level at the vicinity of the $k$-th pilot subcarrier (without normalization to received signal strength at each OFDMA tone). The transmit power shall be normalized so that the maximal power over all tones is the same as the power density of regular data transmission.

If the power assignment method is set to 0b11, then the power allocated to each pilot is set proportional to $Q = max\{10, min\{0.1, \frac{\hat{\sigma}^2}{\sigma_k^2}\}\}$ where $\hat{\sigma}^2$ is the average interference level over the entire spectrum associated with the channel sounding command. The transmit power shall be normalized so that the average power per tone is the same as the power density of regular data.

In both cases, an additional power boost of 3 dB will be applied if the field power boost is set on.

***Insert new subclause 8.4.6.2.7.3:***

### 8.4.6.2.7.3 Direct transmission of DL channel coefficients

If the “Include additional feedback” field is set to 0b01, then the UL Sounding Command IE() enables the MS to perform the direct transmission of DL channel coefficients to the BS along with the UL sounding waveform. This functionality provides downlink channel state information to the BS in both FDD systems and TDD systems in which BS array transceiver calibration is not implemented. With this functionality enabled, DL channel coefficients are encoded as described below and are transmitted in one or more sounding zone symbols that immediately follow each symbol being used to transmit UL sounding waveforms. In this case, the UL sounding waveform is used by the BS to estimate the UL channel so that the DL channel coefficients transmitted by the MSs can be estimated by the BS. The channel coefficients can then be used to enable closed-loop transmission on the downlink.

There are two cases depending on the value of the separability type field. First, if separability type is 0 (cyclic shift separability in the sounding waveform), then a single additional symbol follows each sounding symbol being allocated with the UL_Sounding_command_IE(). In that additional symbol, an MS antenna that transmits sounding in the sounding symbol will transmit an encoded channel coefficient waveform that occupies the same sounding bands allocated for the sounding waveform. The encoded waveform for the u$^{th}$ MS (where *u* is the cyclic shift index in the UL Sounding Command) is defined for two cases: The first case is for where the MS has a single transmit antenna, but multiple receive antennas, and is told with the sounding command IE to sound all antennas (multi-antenna flag set to 1). In this case, the single transmit antenna transmits the sounding waveform appropriate for the single transmit antenna on the sounding symbol and transmits the following encoded waveform in the next symbol interval:

$$Z_u(k) = \beta_u \cdot \sum_{l=1}^{M_b} \sum_{m=1}^{M_{m,u}} \hat{H}_{u,m,l}(k) \cdot s_{p(u)}(k) \cdot \exp\{-j2\pi k((m-1+(l-1) \cdot M_{m,u})/\alpha_u)\} \tag{115a}$$

where

| | |
|---|---|
| $\tilde{H}_{u,m,l}(k)$ | is the estimated DL channel coefficient between the $l^{th}$ BS transmit antenna and the $m^{th}$ receive antenna of the $u^{th}$ MS for subcarrier *k*, |
| $\beta_u$ | is a scaling to make the average transmit power of the feedback waveform (averaged across all frequency) of $Z_u(k)$ be one, |
| $s_{p(u)}(k)$ | is the sounding sequence of 8.4.6.2.7.1, |
| $M_{m,u}$ | is the number of receive antennas on the $u^{th}$ MS, |

| | |
|---|---|
| $\alpha_u$ | is $M_{m,u}M_b$, |
| $M_b$ | is the number of BS transmit antennas, |
| $p(u)$ in $s_{p(u)}(k)$ | is equal to $u-j$, where $u$ is formed from the UL_Permbase and frame number as described in 8.4.6.2.7.1 and $j$ is the CID loop index. |

The second case for a separability type of 0 is for when the MS has a number of transmit antennas equal to the number of receive antennas. In this case, if the multi-antenna flag is false, then the first antenna of the MS shall transmit the waveform of the preceding equation. If the multi-antenna flag is true, then the encoded waveform to be transmitted by the MS antenna assigned to cyclic shift index of *u* in the UL Sounding Command is

$$Z_u(k) = \beta_u \cdot \sum_{l=1}^{M_b} \hat{H}_{u,l}(k) \cdot s_{p(u)}(k) \cdot \exp\{-j2\pi k(l-1)/\alpha_u\} \tag{115b}$$

where

| | |
|---|---|
| $\hat{H}_{u,l}(k)$ | is the estimated DL channel coefficient between the $l^{th}$ BS transmit antenna and the MS antenna assigned to the cyclic shift index of $u$ in the UL Sounding Command for subcarrier $k$, |
| $\beta_u$ | is a scaling to make the average transmit power of the feedback waveform (averaged across all frequency) of $Z_u(k)$ be one, |
| $s_{p(u)}(k)$ | is the sounding sequence of 8.4.6.2.7.1, |
| $\alpha_u$ | is $M_b$, |
| $M_b$ | is the number of BS transmit antennas, |
| $p(u)$ in $s_{p(u)}(k)$ | is equal to $u$-$j$, where $u$ is formed from the UL_Permbase and frame number as described in 8.4.6.2.7.1 and $j$ is the CID loop index. |

When separability type is 1 in the UL Sounding Command (decimation separability in the sounding waveform), then the "use same symbol for additional feedback" bit specifies whether the additional feedback is sent in the symbol(s) following the allocated sounding symbol, or in the same symbol as the allocated sounding symbol. These two cases are described as follows. If separability type is 1 and "use same symbol for additional feedback bit" is true, then a number of additional sequential decimation offset indices equal to the number of MS receive antennas is used for the encoded feedback waveform (e.g., if a decimation offset of 1 is used for the uplink sounding, then decimation offsets 2 and 3 are the additional decimation offsets used for the additional feedback for a two receive antenna MS). On the *i*-th additional decimation offset, the first MS transmit antenna transmits the following waveform:

$$Z_l(k) = \beta_u \cdot \sum_{l=1}^{M_b} \hat{H}_{i,l}(k) \cdot s_{p(u)}(k) \cdot \exp\{-j2\pi k(l-1)/\alpha_u\} \tag{115c}$$

where

| | |
|---|---|
| $\hat{H}_{i,l}(k)$ | is the estimated DL channel coefficient between the $l^{th}$ BS transmit antenna and the $i^{th}$ receive MS antenna, |
| $\beta_u$ | is a scaling to make the average transmit power of the feedback waveform (averaged across all frequency) of $Z_u(k)$ be one, |

$s_{p(u)}(k)$ is the sounding sequence of 8.4.6.2.7.1,

$\alpha_u$ is $M_b$,

$M_b$ is the number of BS transmit antennas,

$p(u)$ in $s_{p(u)}(k)$ is equal to $u$-$j$, where $u$ is formed from the UL_Permbase and frame number as described in 8.4.6.2.7.1 and $j$ is the CID loop index.

For this type of feedback, the multi-antenna flag in the sounding command should be set to zero so that only the first antenna of the MS transmits the required sounding waveform and only the first antenna of the MS transmits the feedback waveform.

If separability type is 1 and "use same symbol for additional feedback bit" is false, then every allocated sounding symbol is followed by a number of additional symbols equal to the number of BS antennas. When an MS has a number of receive antennas equal to its number of transmit antennas, then an MS antenna that transmits on subcarrier $k$ of the sounding symbol shall transmit the DL channel coefficient for the $i$-th base antenna to the corresponding MS receive antenna for the $k$-th subcarrier on subcarrier $k$ of the $i$-th additional symbol following the allocated sounding symbol. In equation form, the MS that transmits a sounding signal on subcarrier $k$ of the sounding symbol shall transmit $\hat{H}_l(k)$ on the $l$-th symbol following the sounding symbol, where $\hat{H}_l(k)$ is the DL channel coefficient from the $l$-th BS antenna to the corresponding MS receive antenna. When the MS has a single transmit antenna and multiple receive antennas, then the first MS transmit antenna transmits any sounding and feedback requested in the sounding command.

***Insert new subclause 8.4.6.2.7.4:***

### 8.4.6.2.7.4 Feedback of Received Pilot Coefficients

If the "Include additional feedback" field is set to 0b10, the UL Sounding Command IE() enables the MS to transmit additional feedback based on the downlink received pilot signal values in the frequency domain. In this case, a single additional symbol is used to transmit a subset of the received pilot values back to the BS. For the case of a MIMO midamble being used as the source of the received pilots, the midamble received by each SS antenna is decimated in a blockwise fashion, block interlaced to reconstruct the feedback symbol, and sent back on the additional symbol interval. (Blockwise decimation by $p$ with a block size of $q$ means to retain one block of $q$ consecutive samples out of every $pq$ consecutive samples, and a block decimation offset of $r$ means that the $r^{th}$ block of length $q$ is the first one to be retained.) For the received MIMO midamble, the blockwise decimation factor $p$ shall be set equal to the number of SS receive antennas, the block size $q$ shall be set equal to the number of BS antennas, and the blockwise decimation offset value depends on the receive antenna number of the SS. The blockwise decimation offset for SS receive antenna $m$ ($m = 1, 2, \ldots$) is $m-1$. Before being transmitted, the power of this additional symbol shall be normalized to the same level as the sounding symbol that precedes it.

***Change the title of 8.4.6.3 as indicated:***

### 8.4.6.3 Optional adjacent subcarrier permutations for ~~AAS and~~ AMC

***Change the second sentence of the first paragraph as indicated:***

Alternatively, the adjacent subcarrier permutation can be used to take advantage of the structure of the adjacent subcarrier permutation in parts of DL subframe that are indicated accordingly by the DL-MAP and UL sub-frame that are indicated accordingly by the UL-MAP.

***Delete the second and third paragraph as indicated:***

~~While the BS does not have any SSs registered that are not capable of using the adjacent subcarrier permutation selected by the BS, the BS may employ the AAS superframe structure. Otherwise, it shall always return to the distributed subcarrier permutation at the end of each frame and provision broadcast traffic at the start of each frame.~~

~~The AAS superframe shall have the following structure:~~

~~1) The BS shall start each superframe with no less than 20 consecutive frames, which contain both downlink and uplink broadcast OFDMA symbols. Each of these frames shall provision DCD, UCD, DL-MAP, and UL-MAP messages, and at least one initial ranging opportunity. The frame duration code in each frame (except the last one) shall be set to the actual frame duration used. The frame duration code in the last frame shall be set to 0x00.~~

~~2) Subsequently, the BS shall transmit up to 200 ms of AAS only frames, followed by a minimum of one frame containing at least one downlink broadcast OFDMA symbol, which shall provision DCD, UCD, and DL-MAP messages. The frame duration code shall be set to 0x00.~~

~~3) The BS shall repeat Step 2) of this subclause, up to the AAS superframe duration, which shall be no more than 1 s.~~

***Change the fourth paragraph as indicated:***

With the adjacent subcarrier permutation, symbol data within a subchannel is assigned to adjacent subcarriers and the pilot and data subcarriers are assigned fixed positions in the frequency domain within an OFDMA symbol. This permutation is the same for both uplink and downlink. Within each frame, the BS shall indicate the switch to the optional permutation ~~in the AAS_DL_IE() and AAS_UL_IE() when switching to AAS traffic. (See 8.4.5.3 and 8.4.5.4.)~~ using one of the zone switch IEs specified in 8.4.5.3.3, 8.4.5.3.4, 8.4.5.4.6 and 8.4.5.4.7. To define adjacent subcarrier permutation, a bin, which is ~~the~~a set of nine contiguous subcarriers within an OFDMA symbol, is a basic allocation unit both in downlink and uplink. A bin structure is shown in Figure 238.

***Change the paragraph below Figure 238 as indicated:***

AMC allocations can be made by two mechanisms—by subchannel index reference in UL-MAP and DL-MAP, or by subchannel allocation in a band using HARQ map (defined in 6.3.2.3.43). Each UL or DL zone may include allocations from HARQ and normal map. For regular AMC allocations made by the DL-MAP or UL-MAP, an AMC subchannel of type $N \times M$ (where $N \times M = 6$ ) is defined as six contiguous bins (a slot consists of $N$ bins by $M$ symbols). The subchannels are numbered from the lowest (0) to the highest frequency, such that subchannel $k$ ( $k = 0 - 192/N$ ) consists of bins $N \times k$ to $N \times k + N - 1$ .

A group of four rows of bins is called a physical band. ~~AMC subchannel consists of six contiguous bins in a same band.~~ For band-AMC allocations made by HARQ map message, an AMC slot consists of six contiguous bins in a same logical band defined in format configuration IE (6.3.2.3.43.2). There are four types of AMC subchannels which are different in the collection of six bins in a band. In the first type(default type), the available bins in a band are enumerated by starting from the lowest bin in the first symbol to the last bin in the symbol and then going to the lowest bin in the next symbol and so on. In the first type of AMC subchannel, a slot consists of six consecutive bins in this enumeration. In the second type of AMC subchannel, a slot is defined as two bins by three symbols. In the third type, a slot is defined as three bins by two symbols and in the fourth type a slot is defined as one bin by six symbols. In the last three types of AMC subchannel, enumeration of bins in a slot is the same as in the first type.

***Change Table 316 as indicated:***

### Table 316—OFDMA AAS subcarrier allocations

| Parameter | Value |
|---|---|
| Number of DC subcarriers | 1 (Index 1024, counting from 0) |
| Number of guard subcarriers, left | 160 |
| Number of guard subcarriers, right | 159 |
| $N_{\text{used}}$, Number of used subcarriers (which includes the DC subcarrier) | 1729 |
| Total number of subcarriers | 2048 |
| Number of pilots | 192 |
| Number of data subcarriers | 1536 |
| Number of physical bands | 48 |
| Number of bins per physical band | 4 |
| Number of data subcarriers per ~~subchannel~~ slot | 48 |

***Change the paragraph below Table 316 as indicated:***

Let the index of the traffic subcarriers be numbered from 0 to 47 within an AMC ~~subchannel~~slot. The index of first traffic subcarrier in the first bin is ~~1~~0, next one is ~~2~~1 and so on. The index of the subcarriers increases along the subcarriers first, then the bin. The $j$-th symbol of the 48 symbols where a band AMC ~~subchannel~~slot is allocated is mapped onto the $(S_{per}^{off}(j) - 1)$ -th subcarrier of a ~~subchannel~~slot. $j$ is [0, 47].

***Change the definition of the 'off' and 'per' parameters below Equation (116) as indicated:***

*per* = ~~*IDcell*~~PermBase mod 48,
*off* = ~~$(\lceil IDcell \div 48 \rceil)\ mod\ 49$~~ $(\lfloor PermBase/48 \rfloor)\ mod\ 49$. This field is an element of GF($7^2$).

***Insert the following sentence at the end of the subclause:***

In the downlink, PermBase shall be set to DL_PermBase specified in preceding STC_DL_Zone IE and in the uplink, it shall be set to UL_PermBase specified in preceding UL_Zone IE.

***Insert new subclause 8.4.6.3.1:***

#### 8.4.6.3.1 AMC optional permutation

**Table 316a—1024-FFT OFDMA AMC subcarrier allocations**

| Parameter | Value | Notes |
|---|---|---|
| Number of DC Subcarriers | 1 | — |
| Number of Guard Subcarriers, Left | 80 | — |
| Number of Guard Subcarriers, Right | 79 | — |
| Number of Used Subcarriers ($N_{used}$) (including all possible allocated pilots and the DC subcarrier) | 865 | — |
| Number of Pilot Subcarriers | 96 | — |
| Pilot Subcarrier Index | $9k+3m+1$, for $k=0,1…95$, and<br>$m$=[symbol index] mod 3 | Symbol of index 0 in pilot subcarrier index should be the first symbol of the current zone. $m$ is incremented only for data symbols, excluding preambles, Safety zones, Sounding symbols, midambles, etc.<br>DC subcarrier is excluded when the pilot subcarrier index is calculated by the equation. |
| Number of Data Subcarriers | 768 | — |
| Number of Bands | 24 | — |
| Number of Bins per Band | 4 | — |
| Number of Data Subcarriers per Subchannel | 48 | — |

### Table 316b—512-FFT OFDMA AMC subcarrier allocations

| Parameter | Value | Notes |
|---|---|---|
| Number of DC Subcarriers | 1 | — |
| Number of Guard Subcarriers, Left | 40 | — |
| Number of Guard Subcarriers, Right | 39 | — |
| Number of Used Subcarriers ($N_{used}$) (including all possible allocated pilots and the DC subcarrier) | 433 | — |
| Number of Pilot Subcarriers | 48 | — |
| Pilot Subcarrier Index | $9k+3m+1$, for $k=0,1\ldots47$, and $m$=[symbol index] mod 3 | Symbol of index 0 in pilot subcarrier index should be the first symbol of the current zone. $m$ is incremented only for data symbols, excluding preambles, Safety zones, Sounding symbols, midambles, etc. DC subcarrier is excluded when the pilot subcarrier index is calculated by the equation. |
| Number of Data Subcarriers | 384 | — |
| Number of Bands | 12 | — |
| Number of Bins per Band | 4 | — |
| Number of Data Subcarriers per Subchannel | 48 | — |

### Table 316c—128-FFT OFDMA AMC subcarrier allocations

| Parameter | Value | Notes |
|---|---|---|
| Number of DC Subcarriers | 1 | — |
| Number of Guard Subcarriers, Left | 10 | — |
| Number of Guard Subcarriers, Right | 9 | — |
| Number of Used Subcarriers ($N_{used}$) (including all possible allocated pilots and the DC subcarrier) | 109 | — |
| Number of Pilot Subcarriers | 12 | — |
| Pilot Subcarrier Index | $9k+3m+1$, for $k=0,1\ldots11$ and $m$=[symbol index] mod 3 | Symbol of index 0 in pilot subcarrier index should be the first symbol of the current zone. $m$ is incremented only for data symbols, excluding preambles, Safety zones, Sounding symbols, midambles, etc. |
| Number of Data Subcarriers | 96 | — |
| Number of Bands | 3 | — |
| Number of Bins per Band | 4 | — |
| Number of Data Subcarriers per Subchannel | 48 | — |

NOTE—A "data symbol" is a symbol in which overlaps with at least one data slot (whether or not data is allocated on that slot).

In the region mapped according to HARQ MAP in 6.3.2.3.43, there are four types of AMC subchannels which are different in the collection of six bins in a band. In the first type(default type), the available bins in a band are enumerated by starting from the lowest bin in the first symbol to the last bin in the symbol and then going to the lowest bin in the next symbol and so on. A subchannel consists of six consecutive bins in this enumeration. The second type is two bins by three symbols, the third type is three bins by two symbols and the last type is one bin by six symbols. In the last three types, enumeration of bins in a subchannel is the same as in the first type.

In the region mapped according to normal DL/UL-MAP in 8.4.5.3 and 8.4.5.4, there is only one type of AMC subchannel, which consists of two bins by three symbols.

In all the types, data mapping follows 8.4.3.4 except for region mapped according to 6.3.2.3.43. Slots for downlink AMC zone in a region mapped according to 6.3.2.3.43 are allocated along the subchannel index first within a band. The direction of data mapping for downlink AMC slots shall be frequency first (across bands when multiple bands are allocated).

Slots for uplink AMC zone in a region mapped according to 6.3.2.3.43 are allocated along the symbol index first within a band. The direction of data mapping for uplink AMC slots shall be frequency first (across bands when multiple bands are allocated).

***Insert new subclause 8.4.6.3.2:***

### 8.4.6.3.2 Band-AMC operation in normal DL/UL-MAP

This subclause describes the band-AMC operation, which is designed for band-AMC enabled SS using normal DL/UL-MAP. The SS sends the REP-RSP message in an unsolicited fashion to BS to trigger Band AMC operation. The triggering conditions are given by TLV encodings in UCD messages. The REP-RSP (see 11.12 for the TLV encodings) includes the CINR measurements of five best bands.

For FFT sizes of 2048 and 1024, the number of Max Logical Bands is defined as 12. For FFT sizes of 512 and 128, the number of Max Logical Bands is the same as the number of physical AMC bands defined in 8.4.6.3. A logical band is a grouping of the physical AMC bands. For example, 12 logical bands for 1024-FFT imply that logical band 0 is composed of AMC bands (0,1), logical band 1 is composed of AMC bands (2,3), and logical band 2 is composed of AMC bands (4,5). In general, if $K$ = Max Logical Bands, then logical band $J = [0\ldots(K-1)]$ contains physical bands $M/K*J$, $M/K*J+1,\ldots M/K*(J+1)-1$, where $M$ is the number of physical AMC bands.

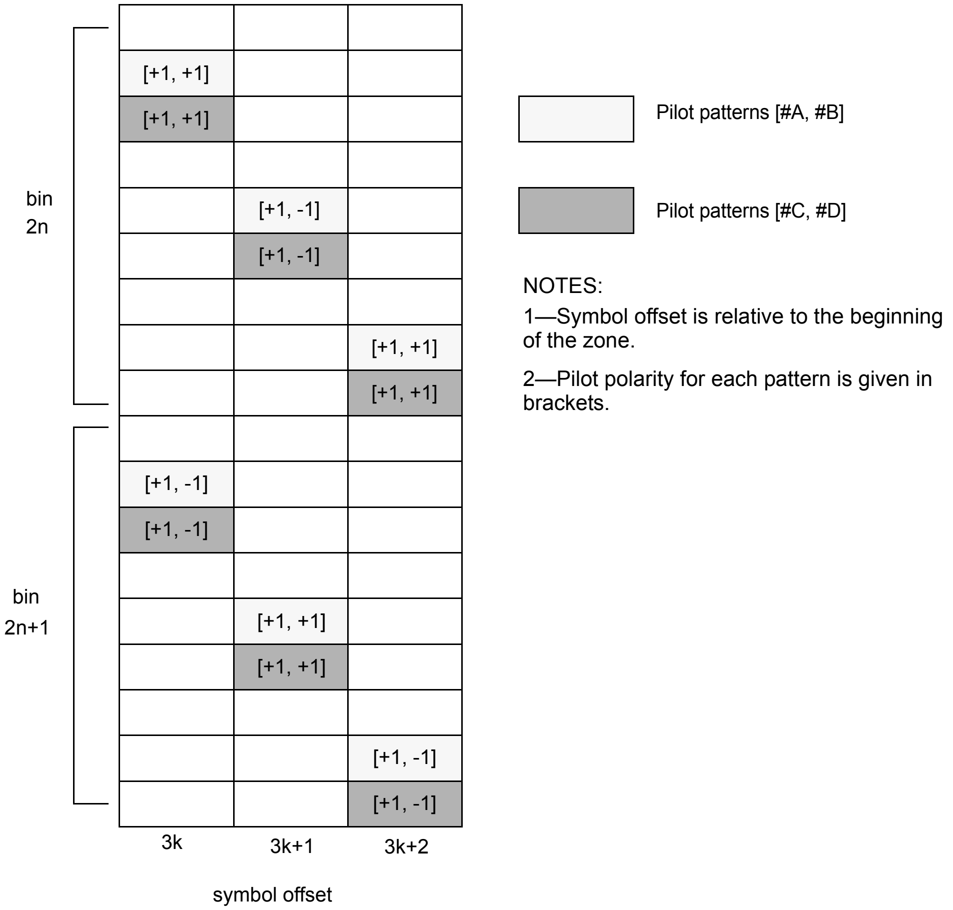
The BS acknowledges the trigger by allocating Band AMC subchannels. From the next frame when the SS/MS sends the REP-RSP, the SS starts reporting the differential of CINR for four selected bands, and the MS starts reporting the differential of CINR for four or five selected bands (increment: 1 and decrement: 0 with a step of 1 dB) on its allocated fast-feedback channel (CQICH). If the BS does not allocate the Band AMC subchannels within the specified delay (CQICH Band AMC Transition Delay) in the UCD message, the SS reports the updated average CINR for the allocation of subchannel with distributed subcarrier permutation.

When the BS wants to trigger the transition to Band AMC mode or update the CINR reports, it sends the REP-REQ message (see 11.11 for the TLV encodings). When the SS receives the message, it replies with REP-RSP. When the BS receives the REP-RSP, it should synchronize the selection of bands reported and their CINR. Unless the BS allocates subchannels with distributed subcarrier permutation, the SS reports the differential increment/decrement compared to the most up-to-date report from the next CQI reporting frame.

*Insert new subclause 8.4.6.3.3:*

### 8.4.6.3.3 AMC support for SDMA

The pilots in an AMC AAS zone are regarded as part of the allocation, and as such shall be beamformed in a way that is consistent with the transmission of the allocation's data subcarriers. In an SDMA region, the pilots of each allocation may correspond to a different pilot pattern. A pilot pattern consists of location and polarity. The pilot patterns are depicted in Figure 238a. Data subcarriers shall be punctured to obtain patterns #2 and #3. Subcarriers shall only be punctured if there is an allocation associated with the corresponding pattern, as described in the AAS_SDMA_DL_IE(), AAS_SDMA_UL_IE(), PHYMOD_DL_IE(), PHYMOD_UL_IE(), Reduced_AAS_Private_DL-MAP() or Reduced_AAS_Private_UL-MAP(). Only MSs that support all four pilot patterns, as indicated by their capability in 11.8.3.7.16, shall be assigned allocations in an SDMA region where pilot patterns #2 and #3 are used. Data subcarriers shall be punctured after constellation mapping in the case of CC encoding, and prior to constellation mapping in the case of CTC encoding. In the latter case, the FEC block shall be truncated to accommodate the punctured subchannel structure, and the data subcarrier enumeration of Equation (116) shall not be applied. Instead, data subcarriers within a slot shall be enumerated starting from the first OFDMA symbol at the data subcarrier that is lowest in frequency, continuing in ascending frequency order throughout the slot's subcarriers in the same symbol, then going to the next symbol at the subcarrier lowest in frequency, and so on.


[+1, +1]
[+1, +1]
[+1, -1]
[+1, -1]
[+1, +1]
[+1, +1]
[+1, -1]
[+1, -1]
[+1, +1]
[+1, +1]
[+1, -1]
[+1, -1]
bin
2n
bin
2n+1
3k
3k+1
3k+2
symbol offset
Pilot patterns [#A, #B]
Pilot patterns [#C, #D]

NOTES:

1—Symbol offset is relative to the beginning of the zone.

2—Pilot polarity for each pattern is given in brackets.

Figure 238a—Pilot patterns for AAS mode in AMC zone

*Insert new subclause 8.4.6.4:*

### 8.4.6.4 Optional permutations for PUSC

*Insert new subclause 8.4.6.4.1:*

#### 8.4.6.4.1 Optional permutation for PUSC adjacent subcarrier allocation (PUSC-ASCA)

The following subclause defines two ways to use an adjacent subcarrier allocation for the PUSC mode.

*Insert new subclause 8.4.6.4.1.1:*

##### 8.4.6.4.1.1 Allocation using adjacent clusters

The following definition will allow defining an adjacent subcarrier allocation using adjacent clusters for the PUSC mode.

Symbol structure shall use the parameters from Table 310, Table 310a, Table 310b, and Table 310c (as the regular PUSC), the same cluster structure shall be maintained.

***Insert new subclause 8.4.6.4.1.1.1:***

#### 8.4.6.4.1.1.1Allocation of subcarriers to subchannels

Allocation of subcarriers to subchannels shall be performed in the following manner:

1) Dividing the subcarriers into physical clusters each containing 14 adjacent subcarriers (starting from data subcarrier 0), number of clusters are defined in Table 308.
2) Clusters to be used for a specific DL allocation shall be the first 2*(Allocated Subchannels) after the first 2*(SubchannelOffset)
3) Concatenate the clusters into blocks using the rules from Table 316d
   — *n*: number of allocated subchannels
   — *k*: floor (*n* / 12)
   — *m*: *n* modulo 12

**Table 316d—Allocation of subcarriers to subchannels**

| Number of subchannels | Clusters concatenated |
|---|---|
| $n \leqq 12$ | 1 block of $2 \times n$ clusters |
| $n = 12 \times k$ | *k* blocks of 24 clusters |
| $n > 12$, $n != 12 \times k$ | (*k*-1) blocks of 24 clusters<br>1 block of $2 \times \text{ceil}((m+12)/2)$ clusters<br>1 block of $2 \times \text{floor}((m+12)/2)$ clusters |

4) Per block, remove from the clusters associated with the section the pilot carriers, take the remaining data subcarriers and using the same procedure described in 8.4.6.1.2.2.2 (with the parameter $N_{subcarriers}$ = 24, PermutationBase taken from Table 317e and Cell_Id as defined in message PUSC_Directed_MIMO_Alloc_IE) partition the subcarriers into subchannels containing 24 data subcarriers in each OFDMA symbol.

**Table 316e—Cluster permutation base**

| Permutation ID | Number of clusters in the section | Permutation Base |
|---|---|---|
| 12 | 24 | [6,9,4,8,10,11,5,2,7,3,1,0] |
| 11 | 22 | [6,9,2,8,10,5,0,4,3,1,7] |
| 10 | 20 | [6,4,1,2,9,3,5,8,7,0] |
| 9 | 18 | [7,4,0,2,1,5,3,8,6] |
| 8 | 16 | [7,4,0,2,1,5,3,6] |
| 7 | 14 | [2,1,5,3,4,6,0] |
| 6 | 12 | [2,1,5,3,4,0] |
| 5 | 10 | [4,2,3,1,0] |

**Table 316e—Cluster permutation base *(continued)***

| Permutation ID | Number of clusters in the section | Permutation Base |
|---|---|---|
| 4 | 8 | [2,3,1,0] |
| 3 | 6 | [2,0,1] |
| 2 | 4 | [0,1] |
| 1 | 2 | [0] |

***Insert new subclause 8.4.6.4.1.2:***

### 8.4.6.4.1.2 Allocation using distributed clusters

The following definition will allow defining an adjacent subcarrier allocation using distributed clusters for the PUSC mode.

Symbol structure shall use the parameters from Table 308 (as the regular PUSC), the same cluster structure shall be maintained.

***Insert new subclause 8.4.6.4.1.2.1:***

### 8.4.6.4.1.2.1 Allocation of subcarriers to subchannels

1) Dividing the subcarriers into 120 physical clusters containing 14 adjunct subcarriers each (starting from carrier 0).
2) Renumbering the physical clusters into logical clusters using the following formula:
LogicalCluster = RenumberingSequence( (PhysicalCluster+13*IDcell) mod 120).
3) Dividing the clusters into six major groups (number of clusters per Major group is set using parameters from Table 308).
4) Allocating carriers to subchannel in each major group depends on the specific allocation performed. per major group determine the number of clusters which are to be used in the specific allocation (clusters to be used for a specific DL allocation shall be the first 2*(Allocated Subchannels) after the first 2*(SubchannelOffset)), determine the number of clusters to be used in every major group. Per major group (which includes allocated clusters) remove from the associated clusters the pilot carriers, take the remaining data subcarriers and using the same procedure described in 8.4.6.1.2.2.2 (with the parameter Nsubcarriers =24, PermutationBase taken from Table 317e and Cell_Id as defined in message PUSC_Directed_MIMO_Alloc_IE) partition the subcarriers into subchannels containing 24 data subcarriers in each OFDMA symbol.

***Insert new subclause 8.4.6.8:***

### 8.4.6.8 Optional reduced AAS private maps

Reduced AAS private maps are based upon the compressed map format, however they are specifically designed to support a single unicast IE per map. Their use is identical to compressed private maps, however, fields have been removed that are not require to support a single IE. The reduced AAS private map will be pointed to by a broadcast map or private compressed map, which will define the values of several fields that will be constant for the duration of the private map chain. The behavior of the compressed map fields that are not present in the reduced AAS private map are described below:

1) Frame Duration – Acquired by the map that initiated the private map chain. Assumed constant for the duration of the private map chain.
2) Frame Number – Acquired by the map that initiated the private map chain. Counted by the SS for the duration of the private map chain.
3) DCD Count – Optionally included. Only required if DCD count changes
4) Operator ID – Acquired by the map that initiated the private map chain. Assumed constant for the duration of the private map chain.
5) Sector ID – Acquired by the map that initiated the private map chain. Assumed constant for the duration of the private map chain.
6) CID – Only required in first map of private map chain.
7) UCD Count – Optionally included. May be sent in the first UL map of private map chain. If not included, the last received UCD Count shall be used.
8) Allocation Start Time – Optionally defined by Private Map Allocation Start Time which may be sent in the first UL map of private map chain. If not included, the UL subframe start time is assumed to be static and defined by the last received Allocation Start Time in an UL map.

### 8.4.7 OFDMA ranging

***Change the first paragraph as indicated:***

~~When used with the WirelessMAN-OFDMA PHY, the MAC layer shall define a single ranging channel. This~~ A ranging channel is composed of one or more groups of six adjacent subchannels, using the symbol structure defined in 8.4.6.2.1, where the groups are defined starting from the first subchannel. Optionally, ranging channel can be composed of one or more groups of eight adjacent subchannels using the symbol structure defined in 8.4.6.2.5 or 8.4.6.3. Subchannels are considered adjacent if they have successive logical subchannel numbers. The indices of the subchannels that compose the ranging channel are specified in the UL-MAP message. Users are allowed to collide on this ranging channel. To effect a ranging transmission, each user randomly chooses one ranging code from a bank of specified binary codes. These codes are then BPSK modulated onto the subcarriers in the ranging channel, one bit per subcarrier (subcarriers used for ranging shall be modulated with the waveform specified in 8.4.7.1/8.4.7.2 and are not restricted to any time grid specified for the data subchannels).

***Insert the following text immediately after the paragraph in 8.4.7:***

An MS at some circumstance such as trying network re-entry to another new BS in the drop situation, location update in idle mode or fast call recovery (which needs more UL resources for RNG-REQ because of additional 21 bytes long HMAC Tuple) may use the HO ranging code. The BS receiving HO ranging code shall allocate more bandwidth to the MS, enough to send RNG-REQ with HMAC Tuple.

For the 128-point and 512-point FFT, the BS may allocate less than 6 (or 8 in case of optional PUSC or AMC) subchannels for a ranging/BW-request allocation. In this case the MS shall produce the ranging code as defined below (as if 6/8 subchannels were allocated), but modulate only the tones in the subchannels allocated (so that the last bits of the ranging code are not transmitted). For the 512-point FFT, the minimum allocation shall be 5 subchannels (or 7 for the optional PUSC).

***Change the title of subclause 8.4.7.1 as indicated:***

#### 8.4.7.1 Initial-ranging/handover-ranging transmissions

***Change the text in 8.4.7.1 as indicated:***

~~The initial-ranging transmission shall be used by any SS that wants to synchronize to the system channel for the first time.~~ The initial ranging codes shall be used for initial network entry and association. Handover ranging codes shall be used for ranging against a Target BS during handover. An initial-ranging transmission shall be performed during two or four consecutive symbols. The same ranging code is transmitted on the ranging channel during each symbol, with no phase discontinuity between the two symbols. A time-domain illustration of the initial-ranging/handover-ranging transmission is shown in Figure 239.

***Replace Figure 239 with the following figure:***

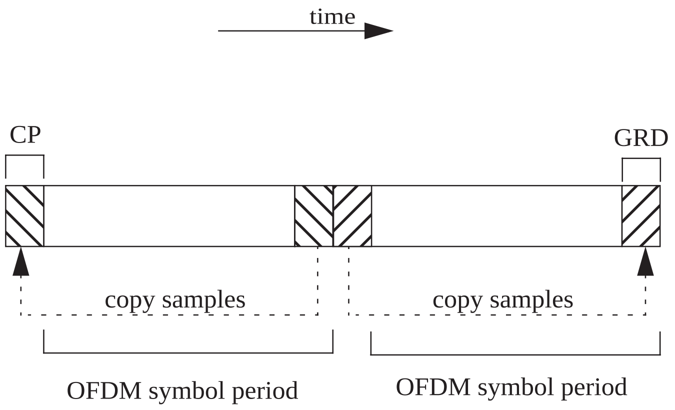

time
CP
GRD
copy samples
copy samples
OFDM symbol period
OFDM symbol period

**Figure 239—I-Initial-ranging/handover-ranging transmission for OFDMA**

***Insert the following sentence below Figure 239:***

The transmitted signal is according to 8.4.2.5, Equation (100), except that $0 \le t \le 2T_S$ .

***Change the text above Figure 240 as indicated:***

The BS can allocate two consecutive initial-ranging/handover-ranging slots, onto those the MS shall transmit the two consecutive initial-ranging/handover-ranging codes (starting code shall always be a multiple of 2), as illustrated in Figure 240:

***Replace Figure 240 with the following figure:***

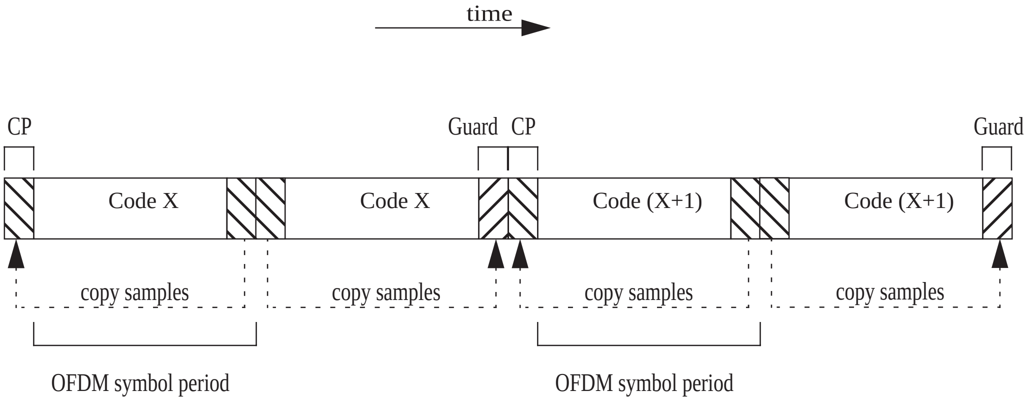

time
CP
Guard
CP
Guard
Code X
Code X
Code (X+1)
Code (X+1)
copy samples
copy samples
copy samples
copy samples
OFDM symbol period
OFDM symbol period

**Figure 240—Initial-ranging handover-ranging transmission for OFDMA, using two consecutive initial ranging codes**

### 8.4.7.3 Ranging codes

***Change the second sentence of the first paragraph as indicated:***

The PRBS generator shall be initialized by the seed ~~b0...b15~~b14...b0 = 0,0,1,0,1,0,1,1,s0,s1,s2,s3,s4,s5,s6 where s6 is the ~~MSB~~ LSB of the PRBS seed, and s6:s0 = UL_~~IDcell~~PermBase, where s6 is the MSB of UL_IDcellPermBase.

***Replace Figure 243 with the following figure:***

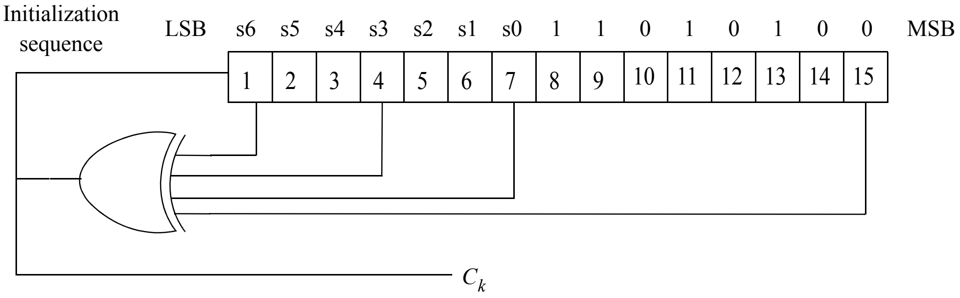


**Figure 243—PRBS generator for ranging code generation**

***Change the second paragraph as indicated:***

The binary ranging codes are subsequences of the pseudonoise sequence appearing at its output $C_k$. The length of each ranging code is 144 bits. These bits are used to modulate the subcarriers in a group of six (eight for the permutation defined in 8.4.6.2.5 or 8.4.6.3) adjacent subchannels, where subchannels are considered adjacent if they have successive logical subchannel numbers. The bits are mapped to the subcarriers in increasing frequency order of the subcarriers, such that the lowest indexed bit modulates the subcarrier with the lowest frequency index and the highest indexed bit modulates the subcarrier with the highest frequency index. The index of the lowest numbered subchannel in the six (eight for the permutation defined in 8.4.6.2.5 or 8.4.6.3) shall be an integer multiple of six (eight for the permutation defined in 8.4.6.2.5 or 8.4.6.3). The six (eight for the permutation defined in 8.4.6.2.5 or 8.4.6.3) subchannels are called a ranging subchannel. The ranging subchannel is referenced in the ranging and Bandwidth Request messages by the index of lowest numbered subchannel.

***Change the third and fourth paragraphs as indicated:***

For example, the first 144 bit code obtained by clocking the PN generator as specified, with UL_~~IDcell~~PermBase = 0, the first code shall be ~~011110000011111...~~00110000010001... The next ranging code is produced by taking the output of the 145th to 288th clock of the PRBS generator, etc.

The number of available codes is 256, numbered 0..255. Each BS uses a subgroup of these codes, where the subgroup is defined by a number $S$, $0 <= S <= 255$. The group of codes will be between $S$ and $((S+O+N+M+L) \mathit{mod}\ 256)$.

- The first $N$ codes produced are for initial-ranging. ~~For example, for the default case of two subchannels in the ranging channel,~~ ~~c~~Clock the PRBS generator ~~120~~144 × ($S$ *mod* 256) times to ~~120~~144 × (($S + N$) *mod* 256) – 1 times.
- The next $M$ codes produced are for periodic-ranging. ~~For example, for the default case of two subchannels in the ranging channel,~~ ~~c~~Clock the PRBS generator ~~120~~144 × (($N + S$) *mod* 256) times to ~~120~~144 × (($N + M + S$) *mod* 256) – 1 times.

— The next $L$ codes produced are for bandwidth-requests. ~~For example, for the default case of two sub-channels in the ranging channel,~~ ~~c~~Clock the PRBS generator ~~120~~144 $\times ((N + M + S)\ mod\ 256)$ times to ~~120~~144 $\times ((N + M + L + S)\ mod\ 256)$ -1 times.

— The next $O$ codes produced are for handover-ranging. Clock the PRBS generator 144 $\times ((N + M + L + S)$ mod 256) times to 144 x $((N + M + L + O + S)\ mod\ 256) - 1$ times.

***Insert new subclause 8.4.7.4:***

### 8.4.7.4 Ranging and BW request opportunity size

For CDMA ranging and BW request, the ranging opportunity size is the number of symbols required to transmit the appropriate ranging/BW request code (1,2,3 or 4 symbols), and is denoted $N_1$. $N_2$ denotes the number of subchannels required to transmit a ranging code (6 or 8, see 8.3.7.3). In each ranging/BW request allocation, the opportunity size ($N_1$) is fixed and conveyed by the corresponding UL_MAP_IE that defines the allocation.

The ranging allocation is subdivided into slots of $N_1$ OFDMA symbols by $N_2$ subchannels, in a time first order, i.e. the first opportunity begins on the first symbol of the first subchannel of the ranging allocation, the next opportunities appear in ascending order in the same subchannel, until the end of the ranging/BW request allocation (or until there are less than $N_1$ symbols in the current subchannel), and then the number of subchannel is incremented by $N_2$. The ranging allocation is not required to be a whole multiple of $N_1$ symbols, so a gap may be formed (that can be used to mitigate interference between ranging and data transmissions). Each CDMA code will be transmitted at the beginning of the corresponding slot. See Figure 243a.

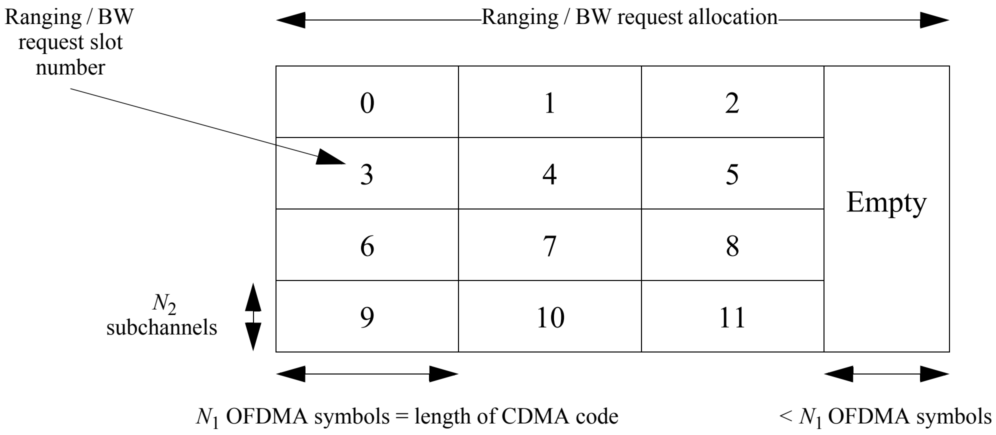

Ranging / BW request slot number
Ranging / BW request allocation
0
1
2
3
4
5
6
7
8
9
10
11
Empty
$N_2$ subchannels
$N_1$ OFDMA symbols = length of CDMA code
< $N_1$ OFDMA symbols

**Figure 243a—Ranging/BW request opportunities**

***Change the title of 8.4.8 as indicated:***

### 8.4.8 ~~Transmit diversity~~Space-Time Coding (optional)

***Change the title of 8.4.8.1 as indicated:***

#### 8.4.8.1 ~~Transmit diversity~~STC using two antennas

***Change the first paragraph as indicated:***

~~Space-Time Coding (STC) (see Alamouti [B1])~~ STC [B1] (in some cases also termed STTD) or ~~frequency hopping diversity coding (~~FHDC~~)~~ may be used on the downlink to provide ~~second~~higher order (Space) transmit diversity.

***Change the last paragraph as indicated:***

The regular subchannel and preamble transmission in the downlink shall be performed from only one antenna (Antenna 0) while the transmit diversity Subchannels transmission shall be performed from both antennas obeying the formulas in 8.4.8.1.2.1 ~~and 8.4.8.1.2.1~~.

### 8.4.8.1.1 Multiple input single output channel estimation and synchronization

***Change the last sentence of the paragraph as indicated:***

The scheme requires multiple input single output channel estimation, which is allowed by splitting some pilots between the 2 Tx antennas, as described in 8.4.8.1.2.~~1 and 8.4.8.1.2.1.~~

### 8.4.8.1.2 Space time coding using two antennas

### 8.4.8.1.2.1 STC encoding

***Insert the following text at the beginning of the subclause:***

Two antenna rate 1 scheme is a basic STC scheme, enabled by matrix A as defined in 8.4.8.1.4. Other STC schemes are defined in a matrix notation in 8.4.8.1.4.

***Insert the following text before the last paragraph:***

STC rate 1 encoding shall be performed after constellation mapping and before subcarrier randomization defined in 8.4.9.4.1. s1 and s2 represent two subcarriers at the same frequency in two consecutive OFDMA symbols (each OFDMA subcarrier is referred to as a channel use). The STC rate 1 coding is done on all data subcarriers that belong to an STC coded burst in the two OFDMA symbols. Pilot subcarriers are not encoded and are transmitted from either antenna 0 or antenna 1.

### 8.4.8.1.2.1.1 STC using two antennas in PUSC

***Replace the second paragraph with the following paragraph***

Figure 245 replaces Figure 234 in the definition of PUSC permutation when STC is enabled. The pilot locations change in period of 4 symbols.

***Replace Figure 245 with the following figure:***

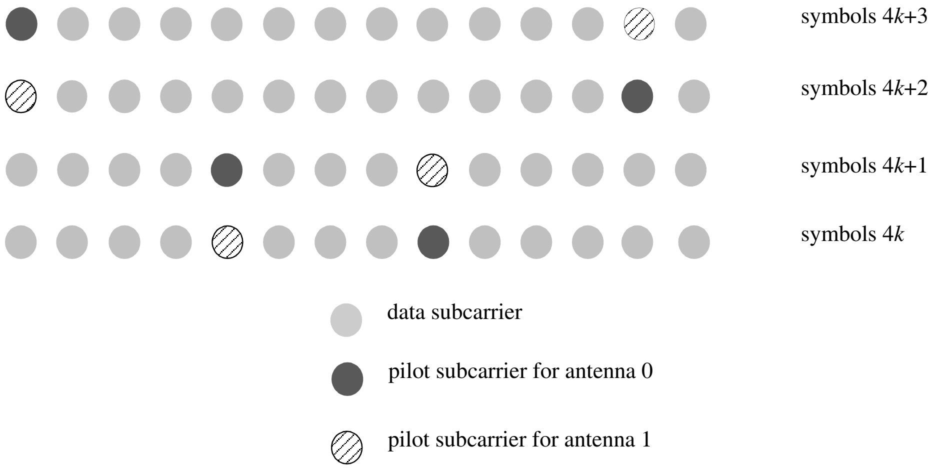


**Figure 245—Cluster structure for STC PUSC using 2 Antennas**

***Insert the following sentence below Figure 245:***

Symbols are counted from the beginning of the current zone. The first symbol in the zone is even. STC encoding is done on each pair of symbols $2n$, $2n+1$ ($n = 0,1,..$).

***Delete Figure 246.***

***Change the title of subclause 8.4.8.1.2.1.2 as indicated:***

### 8.4.8.1.2.1.2 STC ~~using~~ using two antennas in FUSC

***Change the first paragraph as indicated:***

In FUSC, ~~all subchannels shall be used for STC transmission.~~ ~~T~~the pilots within the symbols shall be divided between the antennas—antenna 0 uses VariableSet#0 and ConstantSet#0 for even symbols while antenna 1 uses VariableSet#1 and ConstantSet#1 for even symbols, antenna 0 uses VariableSet#1 and ConstantSet#0 for odd symbols while antenna 1 uses VariableSet#0 and ConstantSet#1 for odd symbols (symbol counting starts at the starting point of the relevant STC zone), defined in 8.4.6.1.2.2. In STC transmission, the *FUSC_SymbolNumber* in Equation (110) is replaced with *floor*(*FUSC_SymbolNumber/2*), so that variable pilots shall move every second symbol. The transmission of the data shall be performed in pairs of symbols as illustrated in Figure 247.

***Replace Figure 247 with the following figure:***

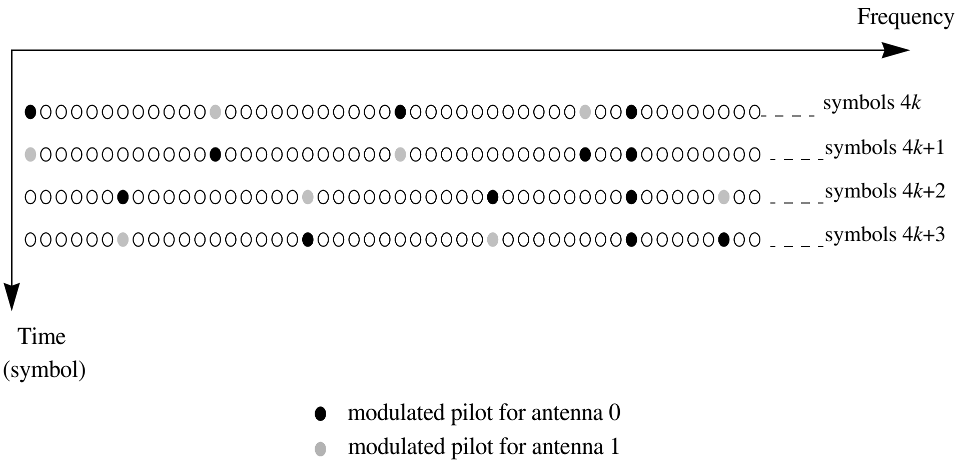


**Figure 247—STC usage with FUSC**

### 8.4.8.1.3 Frequency hopping diversity coding (FHDC)

***Change the second sentence of the first paragraph below Equation (119) as indicated:***

The downlink preamble ~~will~~shall be transmitted for the duration of one OFDMA symbol from ~~both antennas~~Antenna 0 as shown in Figure 248, and subchannels used for FHDC are transmitted in adjunct pairs of subchannels.

### 8.4.8.1.4 STC/FHDC configurations

***Change the second sentence of the first paragraph as indicated:***

The following matrices defines the transmission format with the row index indicating the antenna number and column index indicating the ~~subchannel symbol time (two symbols per entry)~~ OFDMA symbol.

### 8.4.8.1.5 Uplink using STC

***Change the subclause as indicated:***

A user-supporting transmission using STC configuration in the uplink, shall use a modified uplink tile~~,~~, 2-transmit diversity data (‘STTD mode’)~~,~~ or 2-transmit spatial multiplexing (‘SM mode’) data that can be mapped onto each subcarrier. The mandatory tile shall be modified to accommodate those configurations. ~~Figure 249 depicts the UL title for STC transmission.~~

In STTD mode, the tiles shall be allocated to subchannels and the data subcarriers enumerated as defined in 8.4.6.2. The pilots in each tile shall be split between the two antennas and the data subcarriers shall be encoded in pairs after constellation mapping, as depicted in Figure 249. The data subcarriers transmitted from Antenna #0 follow the original mapping defined in 8.4.6.2.

***Replace Figure 249 with the following figure:***

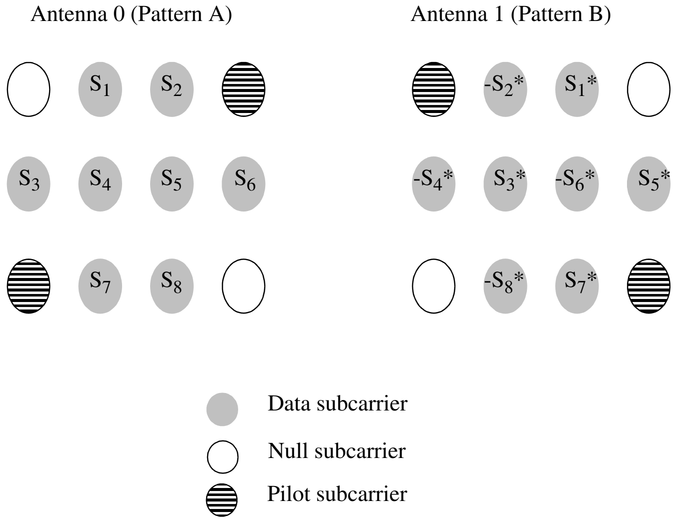


**Figure 249—Mapping of data subcarriers in STTD mode**

Two single transmit antenna SS's can perform collaborative spatial multiplexing onto the same subcarrier. In this case, ~~the~~ one SS ~~should~~shall use the uplink tile with pattern-A, and the other SS ~~should~~shall use the uplink tile with pattern-B. The pilot patterns are depicted in Figure 249. Transmit data shall be coded, interleaved, modulated and mapped to time/frequency as in the non-MIMO case. A single user having two antennas may do UL spatial multiplexing either using horizontal coding or vertical coding. For horizontal coding two bursts are first individually modulated, and then transmitted one per antenna (first burst on antenna #0, the second burst on antenna #1). For vertical coding a single burst is modulated and then transmitted according to the mapping order defined in 8.4.3.4 with the modification that on each subchannel, 2 consecutive slots are mapped instead of a single slot. The first slot of each slot pair is transmitted using antenna #0, while the second slot is transmitted using antenna #1.

To do spatial multiplexing with either vertical or horizontal coding a subscriber needs to signal both its antennas. In order to signal both antennas, the subscriber uses both pilot patterns A and B. Antenna #0 shall be signaled using pattern A and antenna #1 using pattern B. For non-MIMO transmissions, only antenna #0 shall be used.

*Insert Figure 249a and the included text at the end of 8.4.8.1.5:*

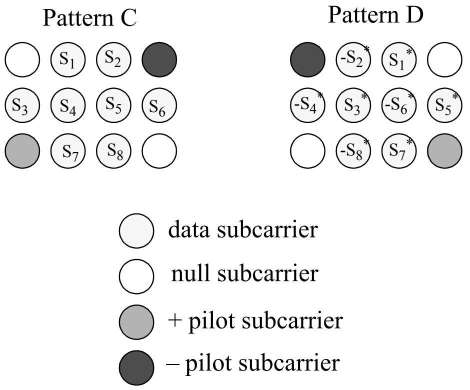


**Figure 249a—Pilot Patterns in UL PUSC tile**

Two single transmit antenna SS's can perform collaborative spatial multiplexing onto the same subchannel. In this case, the one SS should use the uplink tile with pattern-A and the other SS should use the uplink tile with pattern-B. Also, two dual transmit antenna SS's can perform collaborative spatial multiplexing onto the same subchannel. In this case, the one SS should use the uplink tile with the pilot pattern A, B and the other SS should use the uplink tile with the pilot pattern C, D through MIMO_UL_Enhanced_IE. Pilot patterns are illustrated in the Figure 249 and Figure 249a.

*Change the title of subclause 8.4.8.2 as indicated:*

### 8.4.8.2 ~~Transmit diversity~~STC for four antennas

*Change the first sentence of the paragraph as indicated:*

The ~~Transmit diversity~~STC schemes could be further enhanced by using four antennas at the transmission site.

### 8.4.8.2.1 STC for four antennas using PUSC

*Change the subclause as indicated:*

For this configuration, the basic cluster structure is changed (as indicated in Figure 251) to accommodate the transmission from four antennas. (Pilots for antennas 2/3 override data subcarriers. ~~in the even symbols. Switching and erasing of the data subcarriers shall be performed after constellation mapping; therefore, maintaining all the encoding scheme and the subchannel allocation scheme~~ The data puncturing for CC or the data truncation for CTC shall be performed after STC encoding and before IFFT packet mapping).

***Replace Figure 251 with the following figure:***

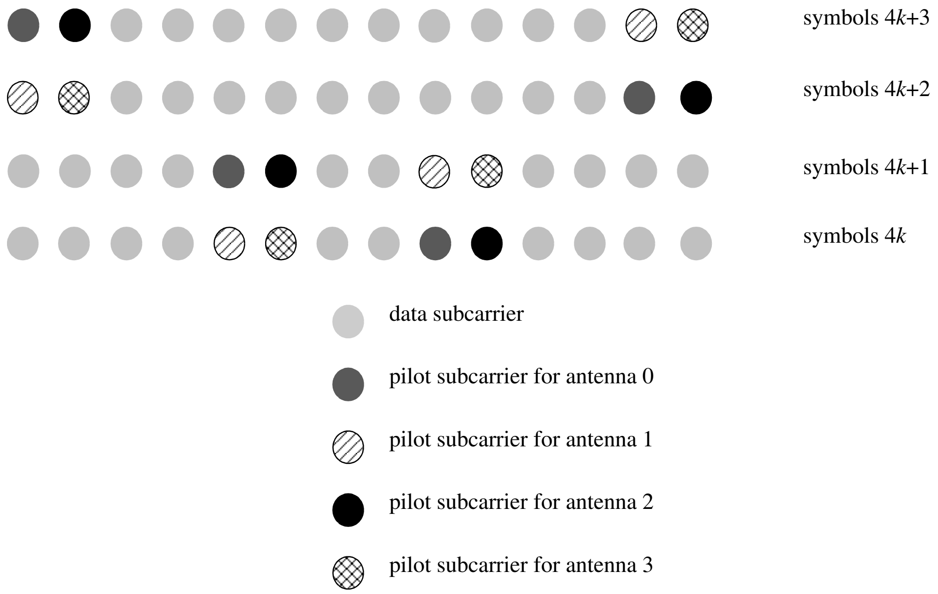

symbols 4k+3
symbols 4k+2
symbols 4k+1
symbols 4k
data subcarrier
pilot subcarrier for antenna 0
pilot subcarrier for antenna 1
pilot subcarrier for antenna 2
pilot subcarrier for antenna 3

**Figure 251—Cluster structure for STC PUSC using 4 antennas**

### 8.4.8.2.2 STC for four antennas using FUSC

***Change the subclause as indicated:***

For the FUSC configuration, the pilots embedded within the symbol shall be further divided. The pilots shall be transmitted with a structure including four time symbols (repeating itself every four symbols) as follows:

Even ~~S~~symbols ~~0~~:antenna 0 uses VariableSet#0 and ConstantSet#0, antenna 1 uses VariableSet#1 and ConstantSet#1, antenna 2 uses indices of (VariableSet#0+1), antenna 3 uses indices of (VariableSet#1+1)
~~Symbol 1: antenna 2 uses VariableSet#0 and ConstantSet#0, antenna 3 uses VariableSet#1 and ConstantSet#1~~
Odd ~~S~~symbols ~~2~~:antenna 0 uses VariableSet#1 ~~and ConstantSet#0~~, antenna 1 uses VariableSet#0 ~~and ConstantSet#1~~, antenna 2 uses indices of (VariableSet#1+1) and (ConstantSet#0), antenna 3 uses indices of (VariableSet#0+1) and (Constant-Set#1)
~~Symbol 3: antenna 2 uses VariableSet#1 and ConstantSet#0, antenna 3 uses VariableSet#0 and ConstantSet#1~~

In STC transmission the *FUSC_SymbolNumber* in Equation (110) is replaced with *floor*(*FUSC_SymbolNumber/2*), so that variable pilots shall move every second symbol. The FUSC permutation is performed on the data subcarriers remaining after allocating the pilots for antennas 0,1 and the Constant pilots. The data subcarriers ~~which~~ that overlap with variable pilots allocated to antennas 2,3 are ~~punctured~~ replaced with pilots. The data puncturing for CC or the data truncation for CTC shall be performed after STC encoding and before IFFT subcarrier mapping.

***Insert new Figure 251a:***

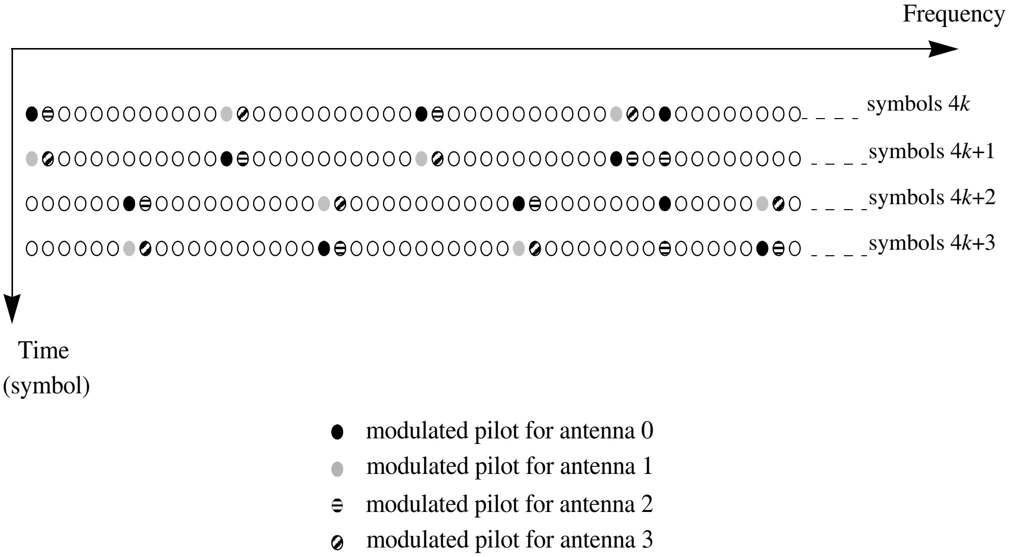

Frequency
symbols 4k
symbols 4k+1
symbols 4k+2
symbols 4k+3
Time
(symbol)
● modulated pilot for antenna 0
● modulated pilot for antenna 1
⊖ modulated pilot for antenna 2
⊘ modulated pilot for antenna 3

**Figure 251a—STC usage with FUSC**

### 8.4.8.2.3 STC configurations

***Change first sentence of the second paragraph as indicated:***

The following matrices define the transmission format with the row index indicating the antenna number and column index indicating the ~~subchannel symbol time (two symbols per entry)~~OFDMA symbol.

***Insert new subclause 8.4.8.2.4:***

### 8.4.8.2.4 MIMO Macro diversity handover based macro-diversity transmission

A macro diversity handover (MDHO) zone may be defined by the OFDMA downlink STC_ZONE_IE by setting the IDcell=0. For the MDHO-BSs joint transmission, for the STC capable MS, the total *N* antennas of MDHO-BSs constitute an antenna pool. A pre-determined antenna selection formula can be used. The MIMO transmit formats are specified in 8.4.8.1.4 for two-transmit-antenna case and 8.4.8.2.3 for four-transmit-antenna case. The MIMO pilot transmission is two-antenna transmission for PUSC and FUSC will follow the arrangement of the Figure 245 and 8.4.8.1.2.1.2 respectively (see Figure 207 for the optional FUSC and AMC permutations). The MIMO pilot transmission is four-antenna transmission for PUSC and FUSC will follow the arrangement of the Figure 251 and 8.4.8.2.2 respectively (see Figure 208 for the optional FUSC and AMC permutations). The un-selected antennas are set to the null transmission.

MS shall demodulate signal in the same procedure as in non-MDHO mode if it does not receive MIMO_in_another_BS_IE() or Macro_MIMO DL Basic IE(). The same data are transmitted from multiple BSs in the same data regions. MS performs RF or diversity combining.

MS shall perform soft data combining when it receives MIMO_in_another_BS_IE(). In this case, the same data are transmitted in the same or different data region.

MS will demodulate signal in the same procedure as in non-MDHO mode, then it will perform soft combining for those data regions with the same packet index when it receives Macro_MIMO DL Basic IE(). This scheme benefits from combination of RF, diversity combining, and soft data combining.

***Insert new subclause 8.4.8.3:***

### 8.4.8.3 STC for the optional zones in the downlink

Three optional zones for the downlink—the optional FUSC, optional AMC, and the optional PUSC-ASCA zones—are described in 8.4.6.1.2.3, 8.4.6.3, and 8.4.6.4.1, respectively. STC may be used to improve system performance for these zones and an example of transmit diversity (TD) with multiple transmitters and multiple receivers is shown in Figure 251b.

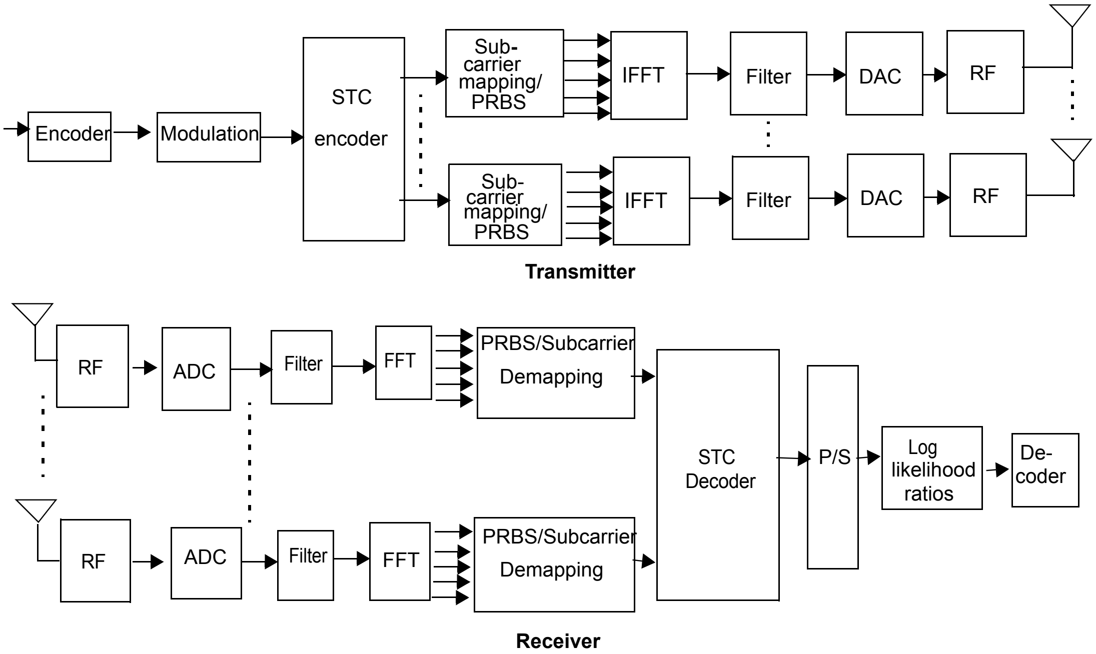

Encoder
Modulation
STC encoder
Sub-carrier mapping/ PRBS
IFFT
Filter
DAC
RF
Sub-carrier mapping/ PRBS
IFFT
Filter
DAC
RF
Transmitter
RF
ADC
Filter
FFT
PRBS/Subcarrier Demapping
RF
ADC
Filter
FFT
PRBS/Subcarrier Demapping
STC Decoder
P/S
Log likelihood ratios
De-coder
Receiver

**Figure 251b—Example of STC for optional zones in DL (matrix A for 2, 3, or 4 Tx and matrix B for 3 or 4 Tx)**

In Figure 251b, the STC encoder operates on input data symbols sequentially and distributes the antenna specific data symbols to each antenna path. The block of subcarrier mapping and PRBS function denotes data truncation or puncturing, if needed, pilot insertion, IFFT input packing and each subcarrier multiplied by the factor $2*(1/2-w_k)$ according to the subcarrier index $k$ in 8.4.9.4.1. The data truncation for CTC or the puncturing of CC encoder shall be required for 3 Tx and 4 Tx BS for the optional AMC and the optional FUSC zones in the downlink, and required for 2 Tx for the optional PUSC in the uplink.

This figure also represents the usage of matrix B with vertical encoding for 3 or 4 Tx BS.

For the usage of matrix B with horizontal encoding for 3 or 4 Tx BS, an exemplary figure is shown in Figure 251c.

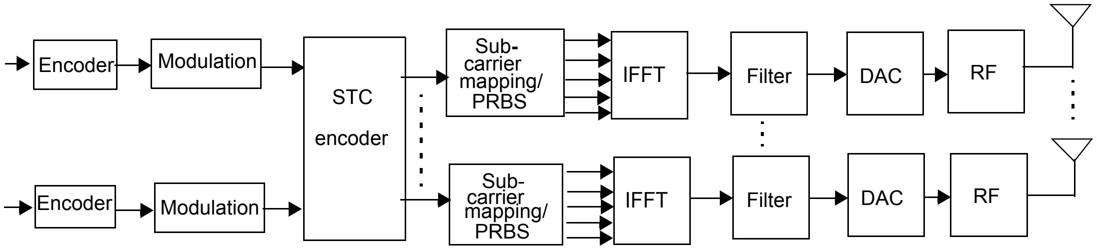

Encoder
Modulation
STC
encoder
Sub-
carrier
mapping/
PRBS
IFFT
Filter
DAC
RF
Encoder
Modulation
Sub-
carrier
mapping/
PRBS
IFFT
Filter
DAC
RF

Figure 251c—Example of matrix B with horizontal encoding for 3 or 4 Tx BS for optional zones in DL

Figure 251d illustrates the usage of matrix C with vertical encoding. The modulated symbols are distributed sequentially from the top to the bottom output paths.

A "layer" is defined as an information path fed to the STC encoder as an input, and a "Stream" is defined as each information path encoded by the STC encoder that is passed to subcarrier mapping and sent through one antenna, or passed to the beamformer. Therefore, the number of layers in a system with vertical encoding is one, but in case of horizontal encoding it depends on the number of encoding/modulation paths. The number of streams in both vertical and horizontal encoding systems is the same as the number of output paths of the STC encoder.

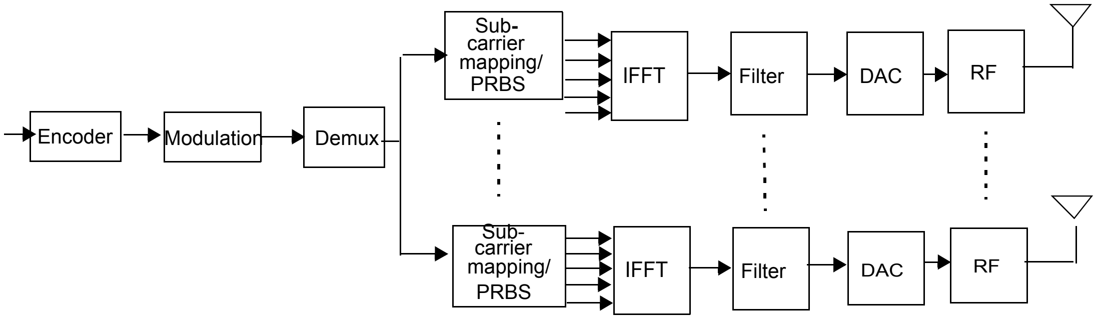

Encoder
Modulation
Demux
Sub-
carrier
mapping/
PRBS
IFFT
Filter
DAC
RF
Sub-
carrier
mapping/
PRBS
IFFT
Filter
DAC
RF

Figure 251d—Example of matrix C with vertical encoding for 2, 3, or 4 Tx BS for optional zones in DL

An exemplary figure for matrix C with horizontal encoding is provided in Figure 251e.

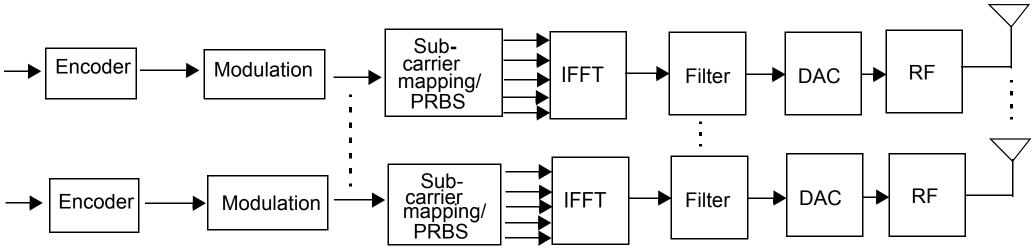


**Figure 251e—Example of matrix C with horizontal encoding for 2, 3 or 4 Tx BS for optional zones in DL**

*Insert new subclause 8.4.8.3.1:*

### 8.4.8.3.1 Symbol structure for optional AMC and optional FUSC

*Insert new subclause 8.4.8.3.1.1:*

#### 8.4.8.3.1.1 Allocation of pilot subcarriers

For 2-antenna BS, all pilots in the even symbols shall be allocated for antenna 0; whereas, all pilots in the odd symbols shall be allocated for antenna 1. The positions of pilots in the odd symbols are further switched with those of data subcarriers whose locations coincide with pilots in the previous symbol. This is shown in Figure 251f.

Pilot Location for Antenna #0 = $9k+3[m \bmod 3]+1$ ($m$=even)
Pilot Location for Antenna #1 = $9k+3[(m-1) \bmod 3]+1$ ($m$=odd)
for m=[symbol index], symbol index 0 is the first symbol (except midamble) in which the STC Zone is applied, $k$ is defined in 8.4.6.1.2.3.

In other words, symbol index shall be reset to ‘0’ when a new STC Zone is applied.

For 3-antenna BS, pilot allocation pattern shall first be changed as in the 2-antenna BS case, and then the neighboring two subcarriers shall be further allocated as pilots. This is shown in Figure 251g.

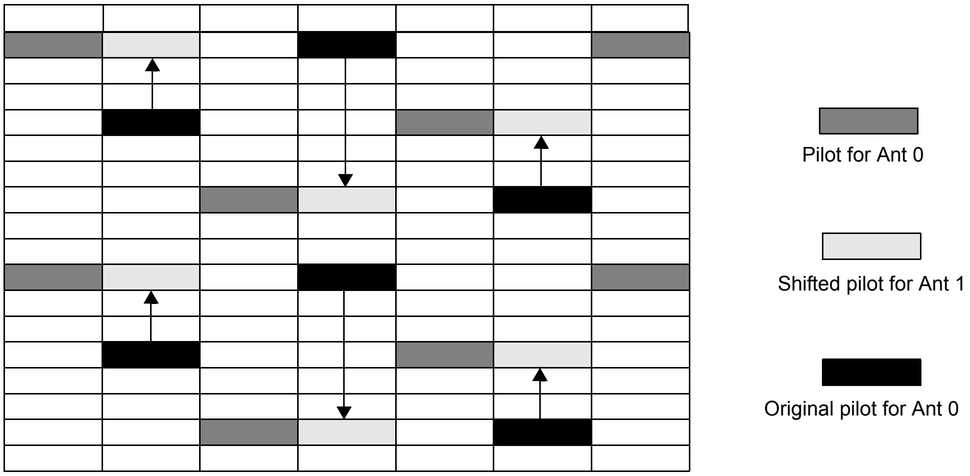

Pilot for Ant 0
Shifted pilot for Ant 1
Original pilot for Ant 0

Figure 251f—Pilot allocation for 2-antenna BS for the optional FUSC and the optional AMC zones

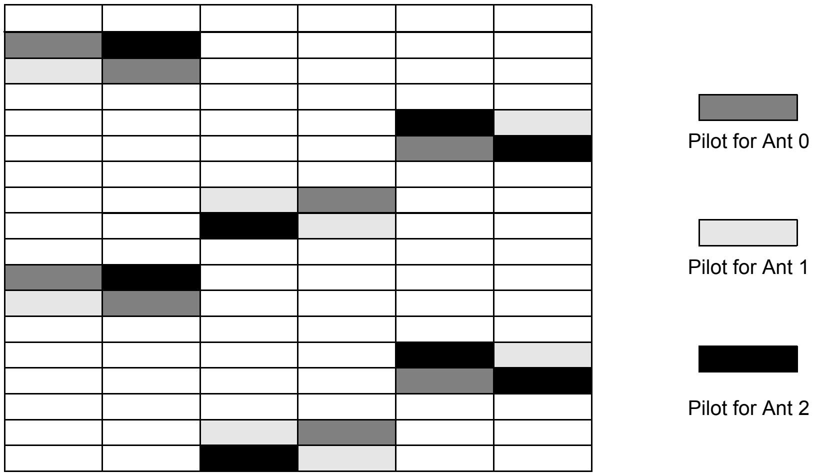

Pilot for Ant 0
Pilot for Ant 1
Pilot for Ant 2

Figure 251g—Pilot allocation for 3-antenna BS for the optional FUSC and the optional AMC zones

For 4-antenna BS, pilot pattern shall first be changed as in the 2-antenna BS case, and then the neighboring two subcarriers shall be further punctured for antenna 2 and 3 as is shown in Figure 251h.

Pilot Location for Antenna #0 = 9k+3[m mod 3]+1 (m=even)
Pilot Location for Antenna #1 = 9k+3[(m–1) mod 3]+1 (m=odd)
Pilot Location for Antenna #2 = 9k+3[m mod 3]+2 (m=even)
Pilot Location for Antenna #3 = 9k+3[(m–1) mod 3]+2 (m=odd)
for m=[symbol index], symbol index 0 is the first symbol (except midamble) in which the STC Zone is applied, k is defined in 8.4.6.1.2.3.

In other words, symbol index shall be reset to ‘0’ when a new STC Zone is applied

.

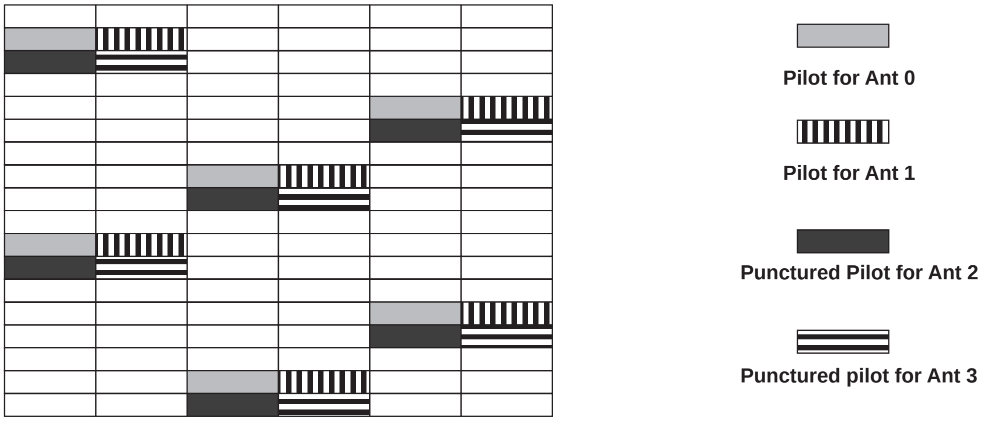


Figure 251h—Pilot allocation for 4-antenna BS for the optional FUSC and the optional AMC zones

*Insert new subclause 8.4.8.3.1.2:*

### 8.4.8.3.1.2 Allocation of data subchannels

#### 8.4.8.3.1.2.1 STC Mapping for optional AMC permutation

For the optional AMC permutation in STC zone, the data subchannels shall take 2x6 (2 bins for 6 symbols) format. The subcarrier permutation represented by Equation (112) in 8.4.6.3 shall not be applied for the optional AMC permutation within STC zones.

For 2-antenna matrix A in 8.4.8.3.3, STC encoded data symbols shall be time mapped starting over the first 2 OFDMA symbols. The mapping starts at the lowest numbered subcarriers of lowest slot and continues in an ascending manner in subchannels first and then proceeds to the next two symbols in time. An illustration of the mapping rule for the antenna #0 is shown in Figure 251i, assuming 2 Tx with Matrix A for a block of 2 slots.

**Antenna #0**

| | | | | | |
|---|---|---|---|---|---|
| $s_0$ | $-s_1^*$ | $s_{32}$ | $-s_{33}^*$ | $s_{64}$ | $-s_{65}^*$ |
| PILOT | NULL | $s_{34}$ | $-s_{35}^*$ | $s_{66}$ | $-s_{67}^*$ |
| $s_2$ | $-s_3^*$ | $s_{36}$ | $-s_{37}^*$ | $s_{68}$ | $-s_{69}^*$ |
| $s_4$ | $-s_5^*$ | $s_{38}$ | $-s_{39}^*$ | $s_{70}$ | $-s_{71}^*$ |
| $s_6$ | $-s_7^*$ | $s_{40}$ | $-s_{41}^*$ | PILOT | NULL |
| $s_8$ | $-s_9^*$ | $s_{42}$ | $-s_{43}^*$ | $s_{72}$ | $-s_{73}^*$ |
| $s_{10}$ | $-s_{11}^*$ | $s_{44}$ | $-s_{45}^*$ | $s_{74}$ | $-s_{75}^*$ |
| $s_{12}$ | $-s_{13}^*$ | PILOT | NULL | $s_{76}$ | $-s_{77}^*$ |
| $s_{14}$ | $-s_{15}^*$ | $s_{46}$ | $-s_{47}^*$ | $s_{78}$ | $-s_{79}^*$ |
| $s_{16}$ | $-s_{17}^*$ | $s_{48}$ | $-s_{49}^*$ | $s_{80}$ | $-s_{81}^*$ |
| PILOT | NULL | $s_{50}$ | $-s_{51}^*$ | $s_{82}$ | $-s_{83}^*$ |
| $s_{18}$ | $-s_{19}^*$ | $s_{52}$ | $-s_{53}^*$ | $s_{84}$ | $-s_{85}^*$ |
| $s_{20}$ | $-s_{21}^*$ | $s_{54}$ | $-s_{55}^*$ | $s_{86}$ | $-s_{87}^*$ |
| $s_{22}$ | $-s_{23}^*$ | $s_{56}$ | $-s_{57}^*$ | PILOT | NULL |
| $s_{24}$ | $-s_{25}^*$ | $s_{58}$ | $-s_{59}^*$ | $s_{88}$ | $-s_{89}^*$ |
| $s_{26}$ | $-s_{27}^*$ | $s_{60}$ | $-s_{61}^*$ | $s_{90}$ | $-s_{91}^*$ |
| $s_{28}$ | $-s_{29}^*$ | PILOT | NULL | $s_{92}$ | $-s_{93}^*$ |
| $s_{30}$ | $-s_{31}^*$ | $s_{62}$ | $-s_{63}^*$ | $s_{94}$ | $-s_{95}^*$ |

| | |
|---|---|
| s | Data subcarrier |
| PILOT | Pilot subcarrier |
| NULL | Null subcarrier reserved for Ant #1 Pilot |

**Figure 251i—Data mapping in the optional AMC Zone with 2 Tx antenna and matrix A**

For 2-antenna vertically encoded matrix B in the optional AMC permutation, modulated data symbols shall be sequentially mapped for two transmit antennas along the subcarriers of the first symbol. The mapping continues in an ascending manner in subchannels first and then proceeds to the next symbol in time. An illustration of the mapping rule for the antenna #0 is shown in Figure 251j, assuming 2 Tx with vertically encoded matrix B for a block of 2 slots. Figure 251j also shows the mapping rule for 2-antenna horizontally encoded matrix B in the optional AMC permutation, where each encoded stream is separately mapped to the corresponding antenna.

**Antenna #0
with vertical encoding**

| | | | | | |
|---|---|---|---|---|---|
| $s_{0}$ | $s_{32}$ | $s_{64}$ | $s_{96}$ | $s_{128}$ | $s_{160}$ |
| PILOT | NULL | $s_{66}$ | $s_{98}$ | $s_{130}$ | $s_{162}$ |
| $s_{2}$ | $s_{34}$ | $s_{68}$ | $s_{100}$ | $s_{132}$ | $s_{164}$ |
| $s_{4}$ | $s_{36}$ | $s_{70}$ | $s_{102}$ | $s_{134}$ | $s_{166}$ |
| $s_{6}$ | $s_{38}$ | $s_{72}$ | $s_{104}$ | PILOT | NULL |
| $s_{8}$ | $s_{40}$ | $s_{74}$ | $s_{106}$ | $s_{136}$ | $s_{168}$ |
| $s_{10}$ | $s_{42}$ | $s_{76}$ | $s_{108}$ | $s_{138}$ | $s_{170}$ |
| $s_{12}$ | $s_{44}$ | PILOT | NULL | $s_{140}$ | $s_{172}$ |
| $s_{14}$ | $s_{46}$ | $s_{78}$ | $s_{110}$ | $s_{142}$ | $s_{174}$ |
| $s_{16}$ | $s_{48}$ | $s_{80}$ | $s_{112}$ | $s_{144}$ | $s_{176}$ |
| PILOT | NULL | $s_{82}$ | $s_{114}$ | $s_{146}$ | $s_{178}$ |
| $s_{18}$ | $s_{50}$ | $s_{84}$ | $s_{116}$ | $s_{148}$ | $s_{180}$ |
| $s_{20}$ | $s_{52}$ | $s_{86}$ | $s_{118}$ | $s_{150}$ | $s_{182}$ |
| $s_{22}$ | $s_{54}$ | $s_{88}$ | $s_{120}$ | PILOT | NULL |
| $s_{24}$ | $s_{56}$ | $s_{90}$ | $s_{122}$ | $s_{152}$ | $s_{184}$ |
| $s_{26}$ | $s_{58}$ | $s_{92}$ | $s_{124}$ | $s_{154}$ | $s_{186}$ |
| $s_{28}$ | $s_{60}$ | PILOT | NULL | $s_{156}$ | $s_{188}$ |
| $s_{30}$ | $s_{62}$ | $s_{94}$ | $s_{126}$ | $s_{158}$ | $s_{190}$ |

**Antenna #0
with horizontal encoding**

| | | | | | |
|---|---|---|---|---|---|
| $s_{0}^{0}$ | $s_{16}^{0}$ | $s_{32}^{0}$ | $s_{48}^{0}$ | $s_{64}^{0}$ | $s_{80}^{0}$ |
| PILOT | NULL | $s_{33}^{0}$ | $s_{49}^{0}$ | $s_{65}^{0}$ | $s_{81}^{0}$ |
| $s_{1}^{0}$ | $s_{17}^{0}$ | $s_{34}^{0}$ | $s_{50}^{0}$ | $s_{66}^{0}$ | $s_{82}^{0}$ |
| $s_{2}^{0}$ | $s_{18}^{0}$ | $s_{35}^{0}$ | $s_{51}^{0}$ | $s_{67}^{0}$ | $s_{83}^{0}$ |
| $s_{3}^{0}$ | $s_{19}^{0}$ | $s_{36}^{0}$ | $s_{52}^{0}$ | PILOT | NULL |
| $s_{4}^{0}$ | $s_{20}^{0}$ | $s_{37}^{0}$ | $s_{53}^{0}$ | $s_{68}^{0}$ | $s_{84}^{0}$ |
| $s_{5}^{0}$ | $s_{21}^{0}$ | $s_{38}^{0}$ | $s_{54}^{0}$ | $s_{69}^{0}$ | $s_{85}^{0}$ |
| $s_{6}^{0}$ | $s_{22}^{0}$ | PILOT | NULL | $s_{70}^{0}$ | $s_{86}^{0}$ |
| $s_{7}^{0}$ | $s_{23}^{0}$ | $s_{39}^{0}$ | $s_{55}^{0}$ | $s_{71}^{0}$ | $s_{87}^{0}$ |
| $s_{8}^{0}$ | $s_{24}^{0}$ | $s_{40}^{0}$ | $s_{56}^{0}$ | $s_{72}^{0}$ | $s_{88}^{0}$ |
| PILOT | NULL | $s_{41}^{0}$ | $s_{57}^{0}$ | $s_{73}^{0}$ | $s_{89}^{0}$ |
| $s_{9}^{0}$ | $s_{25}^{0}$ | $s_{42}^{0}$ | $s_{58}^{0}$ | $s_{74}^{0}$ | $s_{90}^{0}$ |
| $s_{10}^{0}$ | $s_{26}^{0}$ | $s_{43}^{0}$ | $s_{59}^{0}$ | $s_{75}^{0}$ | $s_{91}^{0}$ |
| $s_{11}^{0}$ | $s_{27}^{0}$ | $s_{44}^{0}$ | $s_{60}^{0}$ | PILOT | NULL |
| $s_{12}^{0}$ | $s_{28}^{0}$ | $s_{45}^{0}$ | $s_{61}^{0}$ | $s_{76}^{0}$ | $s_{92}^{0}$ |
| $s_{13}^{0}$ | $s_{29}^{0}$ | $s_{46}^{0}$ | $s_{62}^{0}$ | $s_{77}^{0}$ | $s_{93}^{0}$ |
| $s_{14}^{0}$ | $s_{30}^{0}$ | PILOT | NULL | $s_{78}^{0}$ | $s_{94}^{0}$ |
| $s_{15}^{0}$ | $s_{31}^{0}$ | $s_{47}^{0}$ | $s_{63}^{0}$ | $s_{79}^{0}$ | $s_{95}^{0}$ |

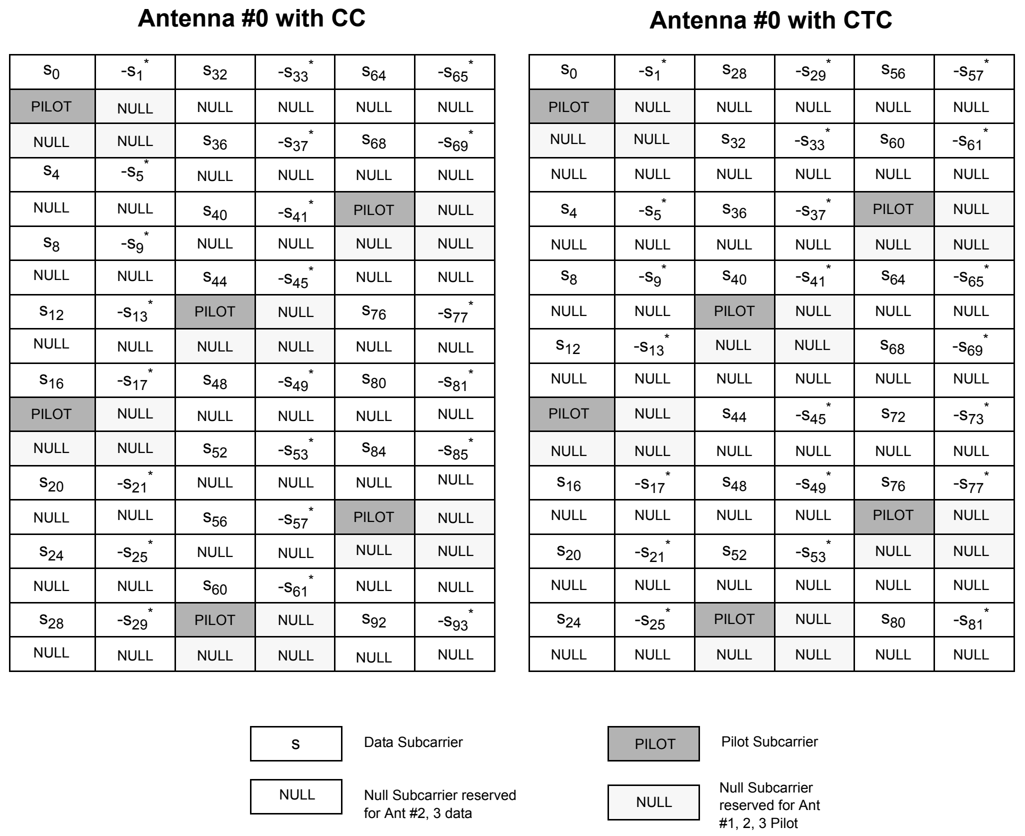
| | | | | | |
|---|---|---|---|---|---|
| s | Data subcarrier | PILOT | Pilot subcarrier | NULL | Null subcarrier reserved for Ant #1 Pilot |

($s_{x}^{0}$ : 0th stream, STC coded Symbol)

**Figure 251j—Data mapping in the optional AMC zone with 2 Tx antenna and matrix B**

For a 3- or 4-antenna matrix A and matrix B in 8.4.8.3.4 and 8.4.8.3.5, STC encoded data symbols shall be mapped at two adjacent subcarriers over two OFDMA symbols. When the subcarrier pair (over two symbols) at frequency $k$+1 is allocated to pilots for antenna #0 or #1 and the pair at frequency $k$+2 is allocated to pilots for antenna #2 or #3, then the pair at frequency $k$+3 shall be jointly encoded with the pair at frequency $k$. This is illustrated in Figure 251k, where blocks of 2 convolutional coded (CC) slots and convolutional turbo coded (CTC) slots are separately shown. The mapping starts at the lowest numbered subcarriers of the lowest slot and continues in an ascending manner in subchannels first and then proceeds to the next two symbols in time.

For a 3- and 4-antenna vertically/horizontally encoded matrix C in the optional AMC permutation, the same mapping rule for 2-antenna vertically/horizontally encoded matrix B shall be applied on the same frequency-time block with the 3- or 4-antenna pilot pattern.



**Antenna #0 with CC**

| | | | | | |
|---|---|---|---|---|---|
| $s_0$ | $-s_1^*$ | $s_{32}$ | $-s_{33}^*$ | $s_{64}$ | $-s_{65}^*$ |
| PILOT | NULL | NULL | NULL | NULL | NULL |
| NULL | NULL | $s_{36}$ | $-s_{37}^*$ | $s_{68}$ | $-s_{69}^*$ |
| $s_4$ | $-s_5^*$ | NULL | NULL | NULL | NULL |
| NULL | NULL | $s_{40}$ | $-s_{41}^*$ | PILOT | NULL |
| $s_8$ | $-s_9^*$ | NULL | NULL | NULL | NULL |
| NULL | NULL | $s_{44}$ | $-s_{45}^*$ | NULL | NULL |
| $s_{12}$ | $-s_{13}^*$ | PILOT | NULL | $s_{76}$ | $-s_{77}^*$ |
| NULL | NULL | NULL | NULL | NULL | NULL |
| $s_{16}$ | $-s_{17}^*$ | $s_{48}$ | $-s_{49}^*$ | $s_{80}$ | $-s_{81}^*$ |
| PILOT | NULL | NULL | NULL | NULL | NULL |
| NULL | NULL | $s_{52}$ | $-s_{53}^*$ | $s_{84}$ | $-s_{85}^*$ |
| $s_{20}$ | $-s_{21}^*$ | NULL | NULL | NULL | NULL |
| NULL | NULL | $s_{56}$ | $-s_{57}^*$ | PILOT | NULL |
| $s_{24}$ | $-s_{25}^*$ | NULL | NULL | NULL | NULL |
| NULL | NULL | $s_{60}$ | $-s_{61}^*$ | NULL | NULL |
| $s_{28}$ | $-s_{29}^*$ | PILOT | NULL | $s_{92}$ | $-s_{93}^*$ |
| NULL | NULL | NULL | NULL | NULL | NULL |

**Antenna #0 with CTC**

| | | | | | |
|---|---|---|---|---|---|
| $s_0$ | $-s_1^*$ | $s_{28}$ | $-s_{29}^*$ | $s_{56}$ | $-s_{57}^*$ |
| PILOT | NULL | NULL | NULL | NULL | NULL |
| NULL | NULL | $s_{32}$ | $-s_{33}^*$ | $s_{60}$ | $-s_{61}^*$ |
| NULL | NULL | NULL | NULL | NULL | NULL |
| $s_4$ | $-s_5^*$ | $s_{36}$ | $-s_{37}^*$ | PILOT | NULL |
| NULL | NULL | NULL | NULL | NULL | NULL |
| $s_8$ | $-s_9^*$ | $s_{40}$ | $-s_{41}^*$ | $s_{64}$ | $-s_{65}^*$ |
| NULL | NULL | PILOT | NULL | NULL | NULL |
| $s_{12}$ | $-s_{13}^*$ | NULL | NULL | $s_{68}$ | $-s_{69}^*$ |
| NULL | NULL | NULL | NULL | NULL | NULL |
| PILOT | NULL | $s_{44}$ | $-s_{45}^*$ | $s_{72}$ | $-s_{73}^*$ |
| NULL | NULL | NULL | NULL | NULL | NULL |
| $s_{16}$ | $-s_{17}^*$ | $s_{48}$ | $-s_{49}^*$ | $s_{76}$ | $-s_{77}^*$ |
| NULL | NULL | NULL | NULL | PILOT | NULL |
| $s_{20}$ | $-s_{21}^*$ | $s_{52}$ | $-s_{53}^*$ | NULL | NULL |
| NULL | NULL | NULL | NULL | NULL | NULL |
| $s_{24}$ | $-s_{25}^*$ | PILOT | NULL | $s_{80}$ | $-s_{81}^*$ |
| NULL | NULL | NULL | NULL | NULL | NULL |

| | | | |
|---|---|---|---|
| s | Data Subcarrier | PILOT | Pilot Subcarrier |
| NULL | Null Subcarrier reserved for Ant #2, 3 data | NULL | Null Subcarrier reserved for Ant #1, 2, 3 Pilot |

Figure 251k—Data mapping with CC in the optional AMC Zone with 4 Tx antenna and Matrix A

### 8.4.8.3.1.2.2 STC Mapping for optional FUSC permutation

For the optional FUSC permutation in STC zone, the data subchannels shall be allocated for two consecutive OFDMA symbols. For a 2-antenna matrix A in 8.4.8.3.3, STC encoded data symbols shall be time mapped over two OFDMA symbols. The mapping starts at the lowest numbered subcarriers of lowest slot and continues in an ascending manner in subchannels first and then, if needed, proceeds to the next two symbols in time.

For a 2-antenna vertically encoded matrix B in 8.4.8.3.3 for the optional FUSC permutation, the data subchannels shall be allocated for two consecutive OFDMA symbols and the modulated data symbols shall be sequentially mapped for two transmit antennas along the subcarriers in the symbol. The mapping continues in an ascending manner in subchannels first and then proceeds to the next symbol in time. For a 2-antenna horizontally encoded matrix B in 8.4.8.3.3 each encoded stream is separately mapped to the corresponding antenna.

For a 3- and 4-antenna matrix A and matrix B in 8.4.8.3.4 and 8.4.8.3.4 for the optional FUSC permutation, STC encoded data symbols shall be mapped at two logical subcarriers over two OFDMA symbols. When the subcarrier pair (over two symbols) at logical frequency $k+1$ is allocated to pilots for antenna #0 or #1 and the pair at logical frequency $k+2$ is allocated to pilots for antenna #2 or #3, then the pair at logical frequency $k+3$ shall be jointly encoded with the pair at logical frequency $k$. The mapping starts at the lowest numbered subcarriers of the lowest slot and continues in an ascending manner in subchannels first and then proceeds to the next two symbols in time if needed. Data puncturing for CC or truncation for CTC shall be performed in a similar manner as in the optional AMC zone.

For 3- and 4-antenna vertically/horizontally encoded matrix C in the optional FUSC permutation, the same mapping rule for 2-antenna vertically/horizontally encoded matrix B shall be applied on the same frequency-time block with the 3- or 4-antenna pilot pattern.

A mapping example of a downlink burst for the optional FUSC using 4-antenna transmission is provided in the following:

Parameters are:

ID_CELL = 1, Symbol index *m*=0 (first symbol in STC zone), subchannel index = 0, The number of sub-channels = 1, 1024 FFT,

The indices of 48 data subcarriers in subchannel #0 for the optional FUSC are as follows:

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 23 | 46 | 58 | 79 | 104 | 121 | 132 | 156 | 170 | 196 | 215 | 231 | 245 |
| 254 | 273 | 293 | 316 | 328 | 349 | 374 | 391 | 402 | 426 | 440 | 466 | 485 | 501 |
| 515 | 524 | 543 | 563 | 586 | 598 | 619 | 644 | 661 | 672 | 696 | 710 | 736 | 755 |
| 771 | 785 | 794 | 813 | 833 | 856 | | | | | | | | |

If Convolutional Coding is used for 4 Tx antennas, data tones at subcarrier indices = {245,254,515,524,785,794} shall be punctured for additional pilots. If Convolutional Turbo Coding is used for 4 Tx antennas, the last 6 of 48 data tones shall be first truncated and the remaining 42 data tones shall be mapped at the following indices:,

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 23 | 46 | 58 | 79 | 104 | 121 | 132 | 156 | 170 | 196 | 215 | 231 | 273 |
| 293 | 316 | 328 | 349 | 374 | 391 | 402 | 426 | 440 | 466 | 485 | 501 | 543 | 563 |
| 586 | 598 | 619 | 644 | 661 | 672 | 696 | 710 | 736 | 755 | 771 | 813 | 833 | 856 |

#### 8.4.8.3.1.2.3 Burst packing of spatial multiplexed streams with CTC HARQ

For multiple spatial rate transmission and HARQ CTC, the packet shall be formed by concatenating multiple $N_{EP}/N_{SCH}$ FEC codewords together. For the case of vertical encoding (number of layers=1), there shall be only 1 CRC check at the end of the last codeword. The first block is of size $N_{EP}$ and the second block of size $N_{EP}$-16 bits. For the case of horizontal encoding (number of layers >1), each burst shall be a separate $N_{EP}/N_{SCH}$ pair with separate CRC. The randomization seed shall be reset for all of the $N_{EP}/N_{SCH}$ pairs in the combined codeword. Figure 251j shows an example of vertically encoded rate 2 with CTC HARQ transmission.

***Insert new subclause 8.4.8.3.2:***

#### 8.4.8.3.2 Symbol structure for the optional PUSC-ASCA

Symbol structure is defined in 8.4.6.3.1, pilots division between antennas per cluster for the STC/MIMO operation shall follow the division in the PUSC mode as defined in 8.4.8.1 and 8.4.8.2. Pilots may optionally be beamformed or precoded.

***Insert new subclause 8.4.8.3.3:***

### 8.4.8.3.3 Transmission schemes for 2-antenna BS in DL

The following matrices define the transmission format with the row index indicating antenna number and column index indicating OFDMA symbol time. For both DL permutation zones with 2-antenna BS, one of the following three transmission matrices shall be used:

$$A = \begin{bmatrix} S_i & -S^*_{i+1} \\ S_{i+1} & S^*_i \end{bmatrix}$$

$$B = \begin{bmatrix} S_i \\ S_i + 1 \end{bmatrix}$$

$$C = \frac{1}{\sqrt{1+r^2}} \begin{pmatrix} S_i + jr \cdot S_{i+3} & r \cdot S_{i+1} + S_{i+2} \\ S_{i+1} - r \cdot S_{i+2} & jr \cdot S_i + S_{i+3} \end{pmatrix}, r = \frac{-1+\sqrt{5}}{2}$$

where $S_i$ and $S_{i+1}$ in *B* may be encoded in different rates.

***Insert new subclause 8.4.8.3.4:***

### 8.4.8.3.4 Transmission schemes for 3-antenna BS in DL

The following definitions are applicable to modes that support STC for 3-antenna Tx.

For 3-antenna BS, one of the three transmission matrices A, B, or C, shall be used:

Let the complex symbols to be transmitted be $x_1, x_2, x_3 x_4$, which take values from a square QAM constellation; let $s_i = x_i e^{j\theta}$ for i=1, 2, . . ., 8, where $\theta = \tan^{-1}\left(\frac{1}{3}\right)$ ; and let

$\tilde{s}_1 = s_{1I} + js_{3Q}; \tilde{s}_2 = s_{2I} + js_{4Q}; \tilde{s}_3 = s_{3I} + js_{1Q}; \tilde{s}_4 = s_{4I} + js_{2Q}$ where $s_i = s_{iI} + js_{iQ}$.

The proposed Space-Time-Frequency code (over two OFDMA symbols and two subcarriers) for 3Tx-Rate 1 configuration with diversity order 3 is given in three permuted versions:

$$A_1 = \begin{bmatrix} \tilde{S}_1 & -\tilde{S}_2^* & 0 & 0 \\ \tilde{S}_2 & \tilde{S}_1^* & \tilde{S}_3 & -\tilde{S}_4^* \\ 0 & 0 & \tilde{S}_4 & \tilde{S}_3^* \end{bmatrix} \tag{124a}$$

$$A_2 = \begin{bmatrix} \tilde{S}_1 & -\tilde{S}_2^* & \tilde{S}_3 & -\tilde{S}_4^* \\ \tilde{S}_2 & \tilde{S}_1^* & 0 & 0 \\ 0 & 0 & \tilde{S}_4 & \tilde{S}_3^* \end{bmatrix}$$

$$A_3 = \begin{bmatrix} \tilde{S}_1 & -\tilde{S}_2^* & 0 & 0 \\ 0 & 0 & \tilde{S}_3 & -\tilde{S}_4^* \\ \tilde{S}_2 & \tilde{S}_1^* & \tilde{S}_4 & \tilde{S}_3^* \end{bmatrix}$$

where the ML decoding can be achieved by symbol-by-symbol decoding.

The matrix B is

$$B_1 = \begin{bmatrix} \sqrt{\frac{3}{4}} & 0 & 0 \\ 0 & \sqrt{\frac{3}{4}} & 0 \\ 0 & 0 & \sqrt{\frac{3}{2}} \end{bmatrix} \begin{bmatrix} \tilde{S}_1 & -\tilde{S}_2^* & \tilde{S}_5 & -\tilde{S}_6^* \\ \tilde{S}_2 & \tilde{S}_1^* & \tilde{S}_6 & \tilde{S}_5^* \\ \tilde{S}_7 & -\tilde{S}_8^* & \tilde{S}_3 & -\tilde{S}_4^* \end{bmatrix} \tag{124b}$$

$$B_2 = \begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{bmatrix} B_1$$

$$B_3 = \begin{bmatrix} 0 & 0 & 1 \\ 1 & 0 & 0 \\ 0 & 1 & 0 \end{bmatrix} B_1$$

where the definition for the remaining variables are as follows:

$$\tilde{s}_5 = s_{5I} + js_{7Q};\quad \tilde{s}_6 = s_{6I} + js_{8Q};\quad \tilde{s}_7 = s_{7I} + js_{5Q};\quad \tilde{s}_8 = s_{8I} + js_{6Q} \tag{124c}$$

The matrix C is used for spatial multiplexing.

$$C = \begin{bmatrix} S_1 \\ S_2 \\ S_3 \end{bmatrix} \tag{124d}$$

The index, *k*, of the permuted version of Matrix A and Matrix B to use for a particular deployment is given by: *k* = mod( floor( (*logical_data_subcarrier_number_for_first_tone_of_code*-1)/2) , 3) + 1, where *logical_data_subcarrier_number_for_first_tone_of_code* = 1, 2, 3, …, Total # of data subcarriers.

***Insert new subclause 8.4.8.3.4.1:***

### 8.4.8.3.4.1 Enhanced 3 Tx Matrix A with Antenna Grouping

For 3-Tx-antenna BS, transmission matrix A in 8.4.8.3.4 may be employed with adaptive antenna grouping, which is fed back from MS.

When MS reports 0b000, 0b0111 or 0b101110 on its CQICH (See 8.4.5.4.10.3 and 8.4.5.4.10.7), then BS shall group antenna 0 and 1 for the first subcarrier and antenna 1 and 2 for the second subcarrier. In matrix form, it shall be read as

$$A_1 = \begin{bmatrix} \tilde{s}_1 & -\tilde{s}_2^* & 0 & 0 \\ \tilde{s}_2 & \tilde{s}_1^* & \tilde{s}_3 & -\tilde{s}_4^* \\ 0 & 0 & \tilde{s}_4 & \tilde{s}_3^* \end{bmatrix} \tag{124e}$$

When MS reports 0b001, 0b1000 or 0b101111 on its CQICH, then BS shall group antenna 0 and 1 for the first subcarrier and antenna 0 and 2 for the second subcarrier. In matrix form, it shall be read as

$$A_2 = \begin{bmatrix} \tilde{s}_1 & -\tilde{s}_2^* & \tilde{s}_3 & -\tilde{s}_4^* \\ \tilde{s}_2 & \tilde{s}_1^* & 0 & 0 \\ 0 & 0 & \tilde{s}_4 & \tilde{s}_3^* \end{bmatrix} \tag{124f}$$

When MS reports 0b010, 0b1001 or 0b110000 on its CQICH, then BS shall group antenna 0 and 2 for the first subcarrier and antenna 1 and 2 for the second subcarrier. In matrix form, it shall be read as

$$A_3 = \begin{bmatrix} \tilde{s}_1 & -\tilde{s}_2^* & 0 & 0 \\ 0 & 0 & \tilde{s}_3 & -\tilde{s}_4^* \\ \tilde{s}_2 & \tilde{s}_1^* & \tilde{s}_4 & \tilde{s}_s^* \end{bmatrix} \tag{124g}$$

***Insert new subclause 8.4.8.3.4.1:***

### 8.4.8.3.4.2 Enhanced 3 Tx Matrix B with Antenna Grouping

For 3 Tx antenna BS, transmission matrix B for rate 2 may be employed with antenna grouping information that is fed back on a CQICH from MS.

When MS reports 0b000, 0b1010, or 0b110001 on its allocated CQICH, then BS shall transmit in the following transmission matrix:

$$B_1 = \begin{bmatrix} \tilde{s}_7 & -\tilde{s}_8^* & \tilde{s}_3 & -\tilde{s}_4^* \\ \tilde{s}_1 & -\tilde{s}_2^* & \tilde{s}_5 & -\tilde{s}_6^* \\ \tilde{s}_2 & \tilde{s}_1^* & \tilde{s}_6 & \tilde{s}_5^* \end{bmatrix} \tag{124h}$$

When MS reports 0b001, 0b1011, or b110010 on its allocated CQICH, then BS shall transmit in the following transmission matrix:

$$B_2 = \begin{bmatrix} \tilde{s}_1 & -\tilde{s}_2^* & \tilde{s}_5 & -\tilde{s}_6^* \\ \tilde{s}_7 & -\tilde{s}_8^* & \tilde{s}_3 & -\tilde{s}_4^* \\ \tilde{s}_2 & \tilde{s}_1^* & \tilde{s}_6 & \tilde{s}_5^* \end{bmatrix} \tag{124i}$$

When MS reports 0b010, 0b1100, or 0b110011 on its allocated CQICH, then BS shall transmit in the following transmission matrix:

$$B_3 = \begin{bmatrix} \tilde{s}_1 & -\tilde{s}_2^* & \tilde{s}_5 & -\tilde{s}_6^* \\ \tilde{s}_2 & \tilde{s}_1^* & \tilde{s}_6 & \tilde{s}_5^* \\ \tilde{s}_7 & -\tilde{s}_8^* & \tilde{s}_3 & -\tilde{s}_4^* \end{bmatrix} \tag{124j}$$

***Insert new subclause 8.4.8.3.4.3:***

### 8.4.8.3.4.3 3 Tx Matrix C with Antenna Selection

For the transmission matrix C, when k sub-streams are configured, $x_i=[s_1,s_2,..s_k]$, $k=1, \ldots, M$, $M=1,2$ Transmission matrix is adaptively changed according to the CQICH. For 3-transmit antennas BS, the transmission matrix is listed in Table 316f, where the mapping of the matrix $C_n$ to the CQICH is shown. The active antenna is power boosted.

### Table 316f—Enhanced 3 Tx Matrix C with Antenna Grouping

| Streams, k | CQICH (binary) | | | Power Boosting |
|---|---|---|---|---|
| | 0b110000 (option 1) | 0b110001 (option 2) | 0b110010 (option 3) | |
| 1 | $C_1 = c\begin{bmatrix} s_1 \\ 0 \\ 0 \end{bmatrix}$ | $C_2 = c\begin{bmatrix} 0 \\ s_1 \\ 0 \end{bmatrix}$ | $C_3 = c\begin{bmatrix} 0 \\ 0 \\ s_1 \end{bmatrix}$ | $c = 1$ |
| 2 | $C_1 = c\begin{bmatrix} s_1 \\ s_2 \\ 0 \end{bmatrix}$ | $C_2 = c\begin{bmatrix} s_1 \\ 0 \\ s_2 \end{bmatrix}$ | $C_3 = c\begin{bmatrix} 0 \\ s_1 \\ s_2 \end{bmatrix}$ | $c = 1/(\sqrt{2})$ |

Stream *k*=2 indicates TLV=176, with Bit #1 and Bit#16 set.

***Insert new subclause 8.4.8.3.5:***

### 8.4.8.3.5 Transmission schemes for 4-antenna BS

For all permutation zones using 4-antenna BS, one of the following three transmission matrices shall be used:

$$A = \begin{bmatrix} s_1 & -s_2^* & 0 & 0 \\ s_2 & s_1^* & 0 & 0 \\ 0 & 0 & s_3 & -s_4^* \\ 0 & 0 & s_4 & s_3^* \end{bmatrix} \tag{124k}$$

$$B = \begin{bmatrix} s_1 & -s_2^* & s_5 & -s_7^* \\ s_2 & s_1^* & s_6 & -s_8^* \\ s_3 & -s_4^* & s_7 & s_5^* \\ s_4 & s_3^* & s_8 & s_6^* \end{bmatrix} \tag{124l}$$

$$C = \begin{bmatrix} s_1 \\ s_2 \\ s_3 \\ s_4 \end{bmatrix} \tag{124m}$$

where $s_i$ may have different rates.

The permuted matrix-*A* (over two OFDMA symbols and two subcarriers) for 4Tx-Rate 1 is given in three permuted matrices:

$$A_1 = \begin{bmatrix} S_1 & -S^*_2 & 0 & 0 \\ S_2 & S^*_1 & 0 & 0 \\ 0 & 0 & S_3 & -S^*_4 \\ 0 & 0 & S_4 & S^*_3 \end{bmatrix}, \quad A_2 = \begin{bmatrix} S_1 & -S^*_2 & 0 & 0 \\ 0 & 0 & S_3 & -S^*_4 \\ S_2 & S^*_1 & 0 & 0 \\ 0 & 0 & S_4 & S^*_3 \end{bmatrix}, \quad A_3 = \begin{bmatrix} S_1 & -S^*_2 & 0 & 0 \\ 0 & 0 & S_3 & -S^*_4 \\ 0 & 0 & S_4 & S^*_3 \\ S_2 & S^*_1 & 0 & 0 \end{bmatrix}. \tag{124n}$$

The mapping of subscript *k* to determine the matrix $A_k$ is given by the following formula:

*k* = mod( floor( (*logical_data_subcarrier_number_for_first_tone_of_code*-1)/2) , 3) + 1

where

logical_data_subcarrier_number_for_first_tone_of_code = 1,2,3,…,Total # of data subcarriers.

The permuted matrix-*B* (over two OFDMA symbols and two subcarriers) for 4-Tx-Rate 2 is given in six permuted matrices:

$$B_1 = \begin{bmatrix} S_1 & -S^*_2 & S_5 & -S^*_7 \\ S_2 & S^*_1 & S_6 & -S^*_8 \\ S_3 & -S^*_4 & S_7 & S^*_5 \\ S_4 & S^*_3 & S_8 & S^*_6 \end{bmatrix}, \quad B_2 = \begin{bmatrix} S_1 & -S^*_2 & S_5 & -S^*_7 \\ S_2 & S^*_1 & S_6 & -S^*_8 \\ S_4 & S^*_3 & S_8 & S^*_6 \\ S_3 & -S^*_4 & S_7 & S^*_5 \end{bmatrix}, \quad B_3 = \begin{bmatrix} S_1 & -S^*_2 & S_5 & -S^*_7 \\ S_3 & -S^*_4 & S_7 & S^*_5 \\ S_2 & S^*_1 & S_6 & -S^*_8 \\ S_4 & S^*_3 & S_8 & S^*_6 \end{bmatrix}.$$

$$B_4 = \begin{bmatrix} S_1 & -S^*_2 & S_5 & -S^*_7 \\ S_4 & S^*_3 & S_8 & S^*_6 \\ S_2 & S^*_1 & S_6 & -S^*_8 \\ S_3 & -S^*_4 & S_7 & S^*_5 \end{bmatrix}, \quad B_5 = \begin{bmatrix} S_1 & -S^*_2 & S_5 & -S^*_7 \\ S_3 & -S^*_4 & S_7 & S^*_5 \\ S_4 & S^*_3 & S_8 & S^*_6 \\ S_2 & S^*_1 & S_6 & -S^*_8 \end{bmatrix}, \quad B_6 = \begin{bmatrix} S_1 & -S^*_2 & S_5 & -S^*_7 \\ S_4 & S^*_3 & S_8 & S^*_6 \\ S_3 & -S^*_4 & S_7 & S^*_5 \\ S_2 & S^*_1 & S_6 & -S^*_8 \end{bmatrix}. \tag{124o}$$

The mapping of subscript *k* to determine the matrix $B_k$ is given by the following formula:

*k* = mod( floor( (*logical_data_subcarrier_number_for_first_tone_of_code*-1)/2) , 6) + 1

where

logical_data_subcarrier_number_for_first_tone_of_code = 1,2,3,…,Total # of data subcarriers.

***Insert new subclause 8.4.8.3.5.1:***

### 8.4.8.3.5.1 Enhanced 4 Tx Matrix A with Antenna Grouping

For 4 Tx antenna BS, transmission matrix A in 8.4.8.3.5 may be employed with adaptive antenna grouping, which is fed back from MS.

When MS reports 0b101110 on its CQICH, then BS shall group antenna 0 and 1 for the first subcarrier and antenna 2 and 3 for the second subcarrier. In matrix form, it shall be read as

$$A_1 = \begin{bmatrix} s_1 & -s_2^* & 0 & 0 \\ s_2 & s_1^* & 0 & 0 \\ 0 & 0 & s_3 & -s_4^* \\ 0 & 0 & s_4 & s_3^* \end{bmatrix} \tag{124p}$$

When MS reports 0b101111 on its CQICH, then BS shall group antenna 0 and 2 for the first subcarrier and antenna 1 and 3 for the second subcarrier. In matrix form, it shall be read as

$$A_2 = \begin{bmatrix} s_1 & -s_2^* & 0 & 0 \\ 0 & 0 & s_3 & -s_4^* \\ s_2 & s_1^* & 0 & 0 \\ 0 & 0 & s_4 & s_3^* \end{bmatrix} \tag{124q}$$

When MS reports 0b110000 on its CQICH, then BS shall group antenna 0 and 3 for the first subcarrier and antenna 1 and 2 for the second subcarrier. In matrix form, it shall be read as

$$A_3 = \begin{bmatrix} s_1 & -s_2^* & 0 & 0 \\ 0 & 0 & s_3 & -s_4^* \\ 0 & 0 & s_4 & s_3^* \\ s_2 & s_1^* & 0 & 0 \end{bmatrix} \tag{124r}$$

***Insert new subclause 8.4.8.3.5.2:***

### 8.4.8.3.5.2 Enhanced 4 Tx Matrix B with Antenna Grouping

For 4 Tx antenna BS, transmission matrix B for rate 2 may be employed with antenna grouping information that is fed back on a CQICH from MS.

When MS reports 0b110001 on its allocated CQICH, then BS shall group antenna 0 and 1 for the first diversity pair and antenna 2 and 3 for the second diversity pair. In matrix form, it shall be read as

$$B_1 = \begin{bmatrix} s_1 & -s_2^* & s_5 & -s_7^* \\ s_2 & s_1^* & s_7 & s_5^* \\ s_3 & -s_4^* & s_6 & -s_8^* \\ s_4 & s_3^* & s_8 & s_6^* \end{bmatrix} \tag{124s}$$

When MS reports 0b110010 on its allocated CQICH, then BS shall transmit in the following transmission matrix:

$$B_2 = \begin{bmatrix} s_1 & -s_2^* & s_5 & -s_7^* \\ s_2 & s_1^* & s_7 & s_5^* \\ s_4 & s_3^* & s_8 & s_6^* \\ s_3 & -s_4^* & s_6 & -s_8^* \end{bmatrix} \tag{124t}$$

When MS reports 0b110011 on its allocated CQICH, then BS shall group antenna 0 and 2 for the first diversity pair and antenna 1 and 3 for the second diversity pair. In matrix form, it shall be read as

$$B_3 = \begin{bmatrix} s_1 & -s_2^* & s_5 & -s_7^* \\ s_3 & -s_4^* & s_6 & -s_8^* \\ s_2 & s_1^* & s_7 & s_5^* \\ s_4 & s_3^* & s_8 & s_6^* \end{bmatrix} \tag{124u}$$

When MS reports 0b110100 on its allocated CQICH, then BS shall transmit in the following transmission matrix:

$$B_4 = \begin{bmatrix} s_1 & -s_2^* & s_5 & -s_7^* \\ s_4 & s_3^* & s_8 & s_6^* \\ s_2 & s_1^* & s_7 & s_5^* \\ s_3 & -s_4^* & s_6 & -s_8^* \end{bmatrix} \tag{124v}$$

When MS reports 0b110101 on its allocated CQICH, then BS shall group antenna 0 and 3 for the first diversity pair and antenna 1 and 2 for the second diversity pair. In matrix form, it shall be read as

$$B_5 = \begin{bmatrix} s_1 & -s_2^* & s_5 & -s_7^* \\ s_3 & -s_4^* & s_6 & -s_8^* \\ s_4 & s_3^* & s_8 & s_6^* \\ s_2 & s_1^* & s_7 & s_5^* \end{bmatrix} \tag{124w}$$

When MS reports 0b110110 on its allocated CQICH, then BS shall transmit in the following transmission matrix:

$$B_6 = \begin{bmatrix} s_1 & -s_2^* & s_5 & -s_7^* \\ s_4 & s_3^* & s_8 & s_6^* \\ s_3 & -s_4^* & s_6 & -s_8^* \\ s_2 & s_1^* & s_7 & s_5^* \end{bmatrix} \tag{124x}$$

***Insert new subclause 8.4.8.3.5.3:***

### 8.4.8.3.5.3 4 Tx Matrix C with Antenna Selection

For 4-transmit antennas BS, the transmission matrix is listed in Table 316g, where the mapping of the matrix $C_n$ to the CQICH is shown. The active antenna is power boosted.

**Table 316g—Mapping of Pre-coding matrix and CQICH for 4 Tx Matrix C with Antenna Selection**

| **Streams, k** | **CQICH (binary)** | | | | | | **Power boosting** |
|---|---|---|---|---|---|---|---|
| | **0b110000 (option 1)** | **0b110001 (option 2)** | **0b110010 (option 3)** | **0b110011 (option 4)** | **0b110100 (option 5)** | **0b110101 (option 6)** | |
| 1 | $C_1 = c\begin{bmatrix} s_1 \\ 0 \\ 0 \\ 0 \end{bmatrix}$ | $C_2 = c\begin{bmatrix} 0 \\ s_1 \\ 0 \\ 0 \end{bmatrix}$ | $C_3 = c\begin{bmatrix} 0 \\ 0 \\ s_1 \\ 0 \end{bmatrix}$ | $C_4 = c\begin{bmatrix} 0 \\ 0 \\ 0 \\ s_1 \end{bmatrix}$ | | | $c = 1$ |
| 2 | $C_1 = c\begin{bmatrix} s_1 \\ s_2 \\ 0 \\ 0 \end{bmatrix}$ | $C_2 = c\begin{bmatrix} s_1 \\ 0 \\ s_2 \\ 0 \end{bmatrix}$ | $C_3 = c\begin{bmatrix} s_1 \\ 0 \\ 0 \\ s_2 \end{bmatrix}$ | $C_4 = c\begin{bmatrix} 0 \\ s_1 \\ s_2 \\ 0 \end{bmatrix}$ | $C_5 = c\begin{bmatrix} 0 \\ s_1 \\ 0 \\ s_2 \end{bmatrix}$ | $C_6 = c\begin{bmatrix} 0 \\ 0 \\ s_1 \\ s_2 \end{bmatrix}$ | $c = \frac{1}{\sqrt{2}}$ |
| 3 | $C_1 = c\begin{bmatrix} s_1 \\ s_2 \\ s_3 \\ 0 \end{bmatrix}$ | $C_2 = c\begin{bmatrix} s_1 \\ s_2 \\ 0 \\ s_3 \end{bmatrix}$ | $C_3 = c\begin{bmatrix} s_1 \\ 0 \\ s_2 \\ s_3 \end{bmatrix}$ | $C_4 = c\begin{bmatrix} 0 \\ s_1 \\ s_2 \\ s_3 \end{bmatrix}$ | | | $c = \frac{1}{\sqrt{3}}$ |

Stream $k$=2 indicates TLV=176, with Bit #1 and Bit#16 set

Stream $k$=3 indicates TLV=176, with Bit #11 and Bit#16 set

***Insert new subclause 8.4.8.3.6:***

#### 8.4.8.3.6 MIMO precoding

The space time coding output can be weighted by a matrix before mapping onto transmit antennas:

$$z = Wx$$

where $x$ is a $M_t \times 1$ vector with the output from the space-time coding (per-subcarrier), $M_t$ is the number of streams at the output of the space-time coding scheme. The matrix $W$ is an $N_t \times M_t$ weighting matrix where the quantity $N_t$ is the number of actual transmit antennas. The vector $z$ contains the signals after weighting for the different actual antennas. The labeling of the elements in the weighting matrix $W$ is performed in accordance with the example of $W$ given in Equation (124y) for the case of 4 actual antennas and 2 space-time coding output streams:

$$W = \begin{bmatrix} W_{11} & W_{12} \\ W_{21} & W_{22} \\ W_{31} & W_{32} \\ W_{41} & W_{42} \end{bmatrix} \tag{124y}$$

**Short-term closed loop precoding:**

When $M_t = 1$, then single stream precoding or beamforming shall be applied with the vector $W$ of dimension $N_t \times 1$. The transmission scheme before the precoder is the regular single antenna transmission. When $M_t = 2$, 3 or 4, then the two, three, or four STC output streams shall be transmitted with a precoding matrix of dimension $N_t \times 2$, $N_t \times 3$, $N_t \times 4$.

When using CQICH feedback type 0b100 (Index to precoding matrix in codebook) in Table 298a, the number of bits in the precoding matrix index in the codebook is determined by the number of bits in the CQICH Type (also in Table 298a).

**Long-term closed loop precoding:**

The rank of the precoding matrix is indicated in the long-term precoding feedback from the SS. The number of columns in the precoding matrix equals its rank. The STC scheme used, Matrix A, B or C, is selected from the set of STC schemes associated with the number of transmit antennas equaling the rank of the long-term precoding matrix used. For example, if the rank of the long-term precoding matrix is 2 and the spatial rate used is 1 then the Matrix A scheme for 2 Tx antennas is used.

When the long-term closed loop precoding is turned on, the life span of short-term precoding information, the rank of the long-term precoding codebook used and the index to the precoding matrix in the specified long-term precoding codebook is fed back with MAC-header feedback messages 0b0000 and 0b0001. If a short-term precoding matrix is available, the BS shall use this short-term matrix. If not, the BS shall use the fed back long-term precoding matrix, if available.

The long-term closed loop precoding uses the 6-bit codebook as specified in 8.4.5.4.10.12.

**Feeding back multiple precoder for band AMC operation**

For band AMC the BS has the choice to request a common precoding matrix for all bands or can request a programmable number, N (see Table 298a), of precoding matrices to be fed back for the N best bands selected in an ordered fashion. In the latter case, the precoding matrices are associated with the bands with the highest S/N values. As a secondary selection criteria, in case the ordering according to highest S/N is not unique, the bands with the lowest band index are chosen first. The index for each precoder is mapped to a CQICH channel of the corresponding size. The precoders for the different bands, in the order described previously, is signaled in the corresponding CQICH channels.

**Table 316h—Feedback for long-term precoding in MAC feedback header message**

| MAC-header feedback type bit indication (binary) | Feedback element | Number of bits | Description |
|---|---|---|---|
| 01000 | Feedback of index to long-term precoding matrix in codebook | 6 | Index to long-term precoding matrix element in codebook |
| 01000 | Rank of precoding codebook | 2 | $k$, Rank of precoding codebook = $k$+1 |
| 01000 | FEC and QAM feedback | 6 | FEC and QAM specification |

**Table 316i—Feedback for life span of short-term precoding in MAC feedback header message 0b01001**

| Bit field (N) (binary) | Life span in number of frames |
|---|---|
| 0000-1111 | $0.125*2^{(N+1)}$ |

**Precoding state feed forward and precoding application delay**

If the precoding state is not fed forward in the DL burst allocation IE, then the BS shall apply precoding according to the precoding feedback from the SS (antenna grouping, antenna selection or codebook based) with a predetermined number of frames delay.

***Insert new subclause 8.4.8.4:***

### 8.4.8.4 STC for the optional zones in the uplink

Two optional zones in the uplink, the optional PUSC and the optional AMC zones, are described in 8.4.6.2.5 and 8.4.6.3, respectively. STC may be used to improve system performance for these zones. Furthermore, two single transmit antenna MSs can perform collaborative spatial multiplexing onto the same subcarrier.

***Insert new subclause 8.4.8.4.1:***

### 8.4.8.4.1 Allocation of pilot subcarriers

For 2-antenna MS and the optional PUSC, pilots for each antenna shall be allocated as shown in Figure 251l.

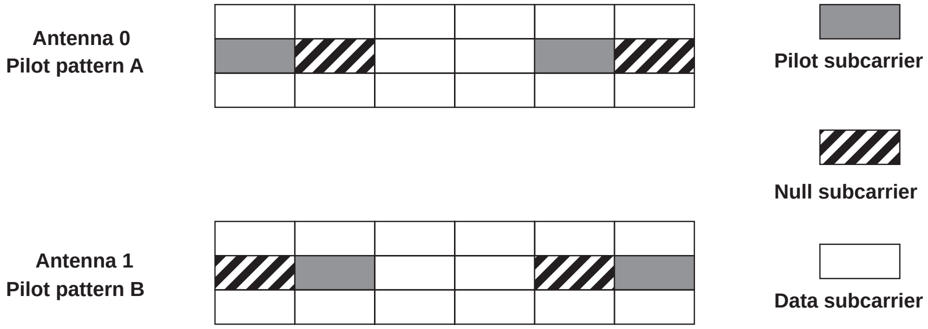


Figure 251l—Uplink pilot allocation for 2-antenna MS for the optional PUSC zones

For 2-antenna MS and the optional AMC, pilot allocation pattern shall be identical to that for the downlink optional AMC with 2 antennas described in 8.4.8.3.1.1—all pilots in the even symbols shall be allocated for antenna 0 or pattern-A, while pilots in the odd symbols shall be allocated for antenna 1 or pattern-B. This is shown in Figure 251f.

Two single transmit antenna MSs can perform collaborative spatial multiplexing onto the same subcarrier. In this case, one MS should use uplink pilot allocation with pattern-A, and the other MS should use the uplink pilot allocation with pattern-B.

***Insert new subclause 8.4.8.4.2:***

### 8.4.8.4.2 Allocation of data subchannels

For the optional PUSC permutation with matrix A in 8.4.8.4.3, the data subchannels shall be allocated for two consecutive slots in time. As can be seen in Figure 251m, STC encoded data symbols shall be time mapped over two OFDMA symbols. The mapping starts at the lowest numbered subcarriers of lowest slot and continues in an ascending manner in subchannels first and then proceeds to the next two symbols in time.

For 2-antenna matrix B in the optional PUSC permutation, modulated data symbols shall be sequentially mapped for two transmit antennas along the subcarriers in the symbol. The mapping continues in an ascending manner in subchannels first and then proceeds to the next symbol in time.

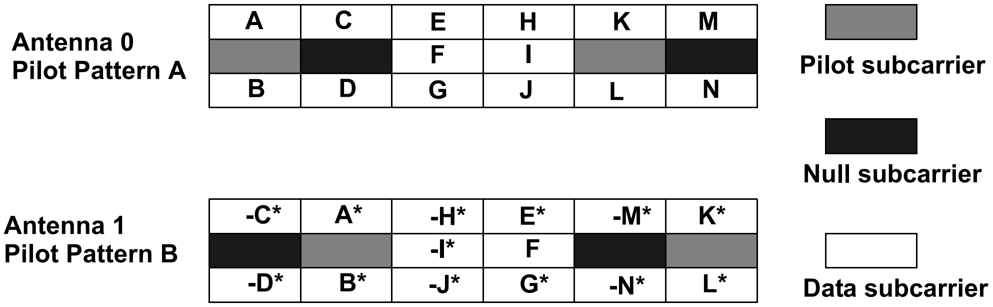


**Figure 251m—Uplink data mapping for 2-antenna SS with matrix A for the optional PUSC permutation**

For the uplink optional AMC permutation with matrix A and B, the data subchannels shall take 1x6 (1 bin for 6 symbols) format. The subcarrier permutation represented by Equation (112) in 8.4.6.3 shall not be applied for the uplink optional AMC permutation with matrix A and B. The data mapping rule is identical to that for the downlink AMC permutation with 2 antennas.

*Insert new subclause 8.4.8.4.3:*

### 8.4.8.4.3 Transmission schemes for 2-antenna MS in UL

The following matrices define the transmission format with the row index indicating antenna number and column index indicating OFDMA symbol time. For both UL permutation zones with 2-antenna MS, one of the following two transmission matrices shall be used:

$$A = \begin{bmatrix} S_i & -S^*_{i+1} \\ S_{i+1} & S^*_i \end{bmatrix}$$

$$B = \begin{bmatrix} S_i \\ S_{i+1} \end{bmatrix}$$

where $S_i$ and $S_{i+1}$ may be encoded in different rates.

The matrix B may also be used for two single antenna MSs to share the same subchannel (collaborative spatial multiplexing).

*Insert new subclause 8.4.8.5:*

### 8.4.8.5 MIMO midamble

The MIMO midamble consists of one OFDM symbol that is mapped onto multiple antennas. Non-overlapping subcarriers are allotted to the transmit antennas.

For FUSC and optional FUSC, the antenna to subcarrier mapping is shown in Figure 251n. Subcarriers index starts from the first one after the left guard band. DC subcarrier is also included in the numbering but nulled prior to transmission. The midamble carrier-set is defined using the following formula:

$$Midamble\_Carrier\_Set = -(N_{used}/2) + n + 2k\left\lceil \frac{N_t}{2} \right\rceil$$

where

$N_t$ is the number of transmit antennas (2, 3, or 4),
$n$ is the antenna index (0, 1,…, $N_t$ *-1;* $N_t \leqq 4$),
$k$ is the subcarrier running index.

The subcarrier to antenna mapping is depicted in Figure 251n for the case when $N_t$ = 4. The midamble sequence has the identical IDcell and segment mapping as the preamble.

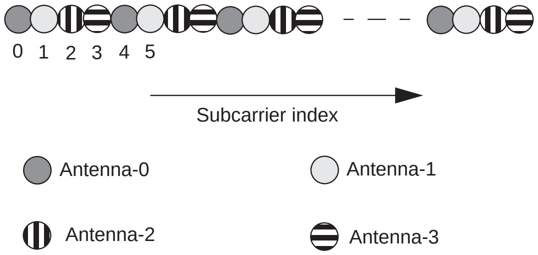

0 1 2 3 4 5
– — –
Subcarrier index
Antenna-0
Antenna-1
Antenna-2
Antenna-3

**Figure 251n—Midamble FUSC structure (frequency domain)**

For PUSC, the subchannel permutations and grouping remains same as for the data. Instead all the subcarriers are used as pilots. Only one symbol is used as the midamble. The midamble is allocated to the subcarriers and antennas as follows.

$$Midamble\_Carrier\_Set = -(N_{used}/2) + n + N_t k$$

where

$N_t$ is the number of transmit antennas,
$n$ is the antenna index 1,…, $N_t-1$,
$k$ is the subcarrier running index.

Figure 251o shows the antenna to subcarrier mapping for the case when $N_t$ = 4.

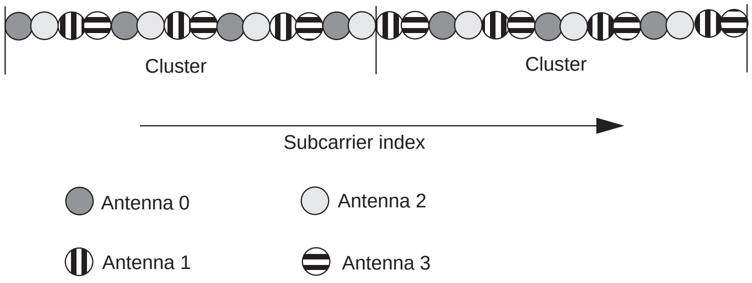

Cluster
Cluster
Subcarrier index
Antenna 0
Antenna 2
Antenna 1
Antenna 3

**Figure 251o—Midamble PUSC structure (frequency domain)**

***Insert new subclause 8.4.8.5.1:***

### 8.4.8.5.1 Midamble Sequence for PUSC

The midamble sequence for PUSC shall be obtained from the corresponding sequence used in the FUSC or optional FUSC for the relevant FFT size and number of antennas. For PUSC, however, all the used subcarriers shall further be clustered and divided into different segments as in the data traffic region.

***Insert new subclause 8.4.8.5.2:***

### 8.4.8.5.2 Midamble Sequence for FUSC and optional FUSC

The subcarrier locations and corresponding PN code BPSK modulation of subcarriers in a midamble are defined as in Equation (124z) and Equation (124aa). The DC carrier is nulled.

$$P_{ID_{cell},s}[k_{foi}] = \begin{cases} 1\text{-}(2)q_{ID_{cell}}[m],\ k_{foi} = 2m\left\lceil \frac{N_t}{2} \right\rceil - \frac{N_{used}}{2} + n,\ m = 0, 1, \ldots, \frac{N_{used}}{2\left\lceil \frac{N_t}{2} \right\rceil} - 1 \\ 0, \qquad otherwise \end{cases} \tag{124z}$$

$$q_{ID_{cell}}[m] = \begin{cases} R\left(8\left\lfloor \frac{m}{9} \right\rfloor + m mod9\right),\ m\ mod9 = 0, 1, 2, \ldots, 7 \\ \qquad\qquad \left(m = 0, 1, \ldots, \frac{N_{used}}{2\left\lceil \frac{N_t}{2} \right\rceil} - 1\right) \\ T\left(\left\lfloor \frac{m}{9} \right\rfloor\right), \qquad m\ mod9 = 8 \end{cases} \tag{124aa}$$

The sequence *R(r)* in (2) is either one of the following two formulas, depending on $N_{\mathrm{FFT}}$ and $N_{\mathrm{T}}$. The choice of the sequence *R(r)*, and the length of sequence $N_r$ supporting the choice are shown in Table 316j.

$$R_1(r) = H_{128}\left(ID_{cell} + 1, \Pi_{\left\lfloor \frac{r}{128} \right\rfloor}(rmod128)\right); r = 8\left\lfloor \frac{m}{9} \right\rfloor + mmod9 = 0, 1, \ldots, N_r\text{-}1 \tag{124ab}$$

$$R_2(r) = B_{ID_{cell}+1}g_{\Pi(r)}; r = 8\left\lfloor \frac{m}{9} \right\rfloor + mmod9 = 0, 1, \ldots, N_r\text{-}1 \tag{124ac}$$

**Table 316j—$N_r$ [The length of sequence *R(r)*]**

| $N_T$ | 2 | | | | 3 or 4 | | | |
|---|---|---|---|---|---|---|---|---|
| $N_{FFT}$ | 2048 | 1024 | 512 | 128 | 2048 | 1024 | 512 | 128 |
| $R_1(r)$ | 768 | 384 | 192 | — | 384 | 192 | — | — |
| $R_2(r)$ | — | — | — | 48 | — | — | 96 | 24 |

In $R_1(r)$, $H_{128}(i, j)$ denotes the number at $(i, j)$ of order 128 Walsh Hadamard matrix, where $i, j = 0, 1, \ldots, 127$. The first low vector of $H_{128}$ is the all-one sequence and shall not be used. $\Pi_{\left\lfloor \frac{m}{128} \right\rfloor}(l); l = 0, 1, \ldots, 127$ is the $l$-th value of the $\left\lfloor \frac{m}{128} \right\rfloor^{th}$ permutation out of six predefined permutations shown in Table 316k.

**Table 316k—Permutation ($l$ = 0, 1, 2, …, 127)**

| | |
|---|---|
| $\Pi_0(l)$ | 1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 0 |
| $\Pi_1(l)$ | 25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 0 |
| $\Pi_2(l)$ | 71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 0 |
| $\Pi_3(l)$ | 69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 0 |
| $\Pi_4(l)$ | 102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 0 |
| $\Pi_5(l)$ | 70, 35, 80, 40, 20, 10, 5, 67, 96, 48, 24, 12, 6, 3, 64, 32, 16, 8, 4, 2, 1, 65, 97, 113, 121, 125, 127, 126, 63, 94, 47, 86, 43, 84, 42, 21, 75, 100, 50, 25, 77, 103, 114, 57, 93, 111, 118, 59, 92, 46, 23, 74, 37, 83, 104, 52, 26, 13, 71, 98, 49, 89, 109, 119, 122, 61, 95, 110, 55, 90, 45, 87, 106, 53, 91, 108, 54, 27, 76, 38, 19, 72, 36, 18, 9, 69, 99, 112, 56, 28, 14, 7, 66, 33, 81, 105, 117, 123, 124, 62, 31, 78, 39, 82, 41, 85, 107, 116, 58, 29, 79, 102, 51, 88, 44, 22, 11, 68, 34, 17, 73, 101, 115, 120, 60, 30, 15, 0 |

In $R2(r)$, if the $k$, $1 \le k \le 127$ can be converted into binary as $b_6b_5b_4b_3b_2b_1b_0$, define $b_6$ as the MSB, $b_0$ as the LSB, $b_k$ is a row vector to represent $B_k = [b_0b_1b_2b_3b_4b_5b_6]$. The $g_u; 0 \le u \le N_r - 1$ is $u^{th}$ column vector of the generator matrix $G$. $B_kg_u$ is an inner product of $(1 \times 7)$ row vector and $(7 \times 1)$ column vector. The generator matrix $G$ and the permutation $\Pi(l); l = 0, 1, 2, \ldots, N_r - 1$ for each $N_{FFT}$ and $N_T$ are shown below.

The sequence $T(k)$ is determined by IDcell and should be chosen to achieve low PAPR.

***Insert new subclause 8.4.8.5.2.1:***

### 8.4.8.5.2.1 PAPR reduction sequence for BS with 2 antennas

The PAPR reduction sequences for BS with 2 antennas are listed in Table 316l, Table 316m, Table 316n for the cases of FFT size 2048 point, 1024 point, 512 point respectively. The case of FFT size 128 point is dealt with by Table 316c and Table 316p, together with Equation (124ad).

### Table 316l—PAPR reduction sequence for BS with 2 antennas (2048 point FFT)

| ID cell | Sequence | PAPR | ID cell | Sequence | PAPR |
|---|---|---|---|---|---|
| 0 | E5F121DCFF4A0E63825399D3 | 5.92384 | 57 | 53F2BFC63878B6C2C10C8A2C | 5.70754 |
| 1 | D10BA3F1A15DDF9C4D819B45 | 6.28771 | 58 | C20824E0B5348061E2A4C1CE | 6.05831 |
| 2 | 13310AB0491064CE7516898C | 5.88237 | 59 | 8F1B88288316B59939D490A9 | 6.002 |
| 3 | E53C10EB0B1E830D7C2302A2 | 5.72241 | 60 | 3203E66C6406767186F8955A | 6.79504 |
| 4 | 37DBDBACCEDC976D1DE87D53 | 6.54265 | 61 | B335E583FD89A0A410876B81 | 6.17206 |
| 5 | E43B8C8299E5B2B49798FA28 | 6.23106 | 62 | C11D537E5E2992361F2CC44B | 6.06154 |
| 6 | 52A78E348A46E8E84CF29D7B | 6.96087 | 63 | F1E074FEB2CF55427C573C6F | 5.80776 |
| 7 | CA6B366D37E54A7EDF32A688 | 6.23321 | 64 | BC8C283A7CA014EC79837DD7 | 5.82436 |
| 8 | 3852A3F8B0E1E7FC41301F17 | 6.35304 | 65 | DF29647F465044A0BC7D2720 | 6.28397 |
| 9 | 271E4591888CBCD44B32B809 | 5.88167 | 66 | F29CCF3995F08458FA0F8908 | 5.89065 |
| 10 | 1CB9181F0A47346785BC9464 | 6.5208 | 67 | 28F5D1FD67E98528DB28BB5D | 6.08206 |
| 11 | 786E7023033922819D70233B | 6.16551 | 68 | DC5908BB6B8E1B84ADF881A8 | 6.01325 |
| 12 | D7E0A495CFE8CEC3D2AF4B5D | 5.99014 | 69 | 0AF44605329EE32ACF75481B | 5.84218 |
| 13 | 360ECD45D330B876A8F13462 | 6.43524 | 70 | C7CEF13FD6FE89346FB543B2 | 6.33524 |
| 14 | C63BDDD2D536FF2416B7A424 | 6.01736 | 71 | 5D2B9D0E4306F96A65BAF4EB | 6.34218 |
| 15 | 10A8B5DAB83CE78B3FCFC31D | 6.19619 | 72 | 0E2D2473C890413D9A9D8DB1 | 6.05022 |
| 16 | 6152A33C894DC0B62EEA0DDA | 6.13798 | 73 | 7C082A7E84B366733C6E19D1 | 5.9351 |
| 17 | 757A237D70ABD7AB1FFB04F0 | 5.95019 | 74 | 85C50A024C78CC1B3AEF4C94 | 5.84302 |
| 18 | BC0D0BEA01E586B664401CFC | 6.2348 | 75 | 298A3E89079EF4C27CC921A9 | 6.13354 |
| 19 | 8A5CD82D82B19593F8266E7E | 5.67582 | 76 | 825D06F901CE94D8168D8A46 | 6.00828 |
| 20 | F44201B0903E55006BDFD5B0 | 6.78315 | 77 | 73DCC20AFF8C5837F539EE22 | 6.27564 |
| 21 | 5F252E0EC94C7965A2B347F3 | 6.37986 | 78 | 553DD23CB093EFD7C544F013 | 5.88433 |
| 22 | 6E376986A947B180015A0A9A | 6.24373 | 79 | 5EE648A514E40CF0E7ECE2A1 | 5.95859 |
| 23 | 3669CAF711FC2129743CFFBA | 6.1472 | 80 | F7B98C7D1DD5CE51B6B678A3 | 6.54896 |
| 24 | C1D8E53D16322CB3B1386B0E | 5.87095 | 81 | 9B840FF5F78473E2F75B8E2D | 5.87521 |
| 25 | 9E1F780C45570E3A475F5A77 | 6.11801 | 82 | 8C99E9A614E8AC8C74566752 | 6.03187 |
| 26 | 32F36D066051FAE51512A8F3 | 6.27711 | 83 | B7EC60A09ACD2CABB53DEDE9 | 5.95608 |
| 27 | 464AD0462512248F26313BC4 | 6.50894 | 84 | 2900FBF0CC91DA813CDBEAD0 | 5.87135 |
| 28 | 03F93CDFCA5B9D3262FD2D25 | 6.12574 | 85 | 949EF4015122026200DF05F1 | 6.11214 |

**Table 316l—PAPR reduction sequence for BS with 2 antennas (2048 point FFT)** ***(continued)***

| ID cell | Sequence | PAPR | ID cell | Sequence | PAPR |
|---|---|---|---|---|---|
| 29 | 694CAFC989888FC1F358CA8F | 5.86597 | 86 | F3AE5B267C36BF3877E4AC49 | 5.87287 |
| 30 | 8C9F1D8E186EAFEDF0D6F4DD | 6.17035 | 87 | A4E43FBE54A0280D65419C99 | 6.0007 |
| 31 | C4E95F3E65B40D938946B132 | 5.84552 | 88 | F116946F21EF61D108AC2F42 | 6.94574 |
| 32 | 5891E3188FA53AE34576A803 | 5.85053 | 89 | 5B82DE3F0ADB20D788A045A6 | 6.13544 |
| 33 | 409FF8A9E7FCDA58D4A5241B | 6.10709 | 90 | AC639F8BDB63A8C4E4746E65 | 6.25857 |
| 34 | 3C70E4E442FA01B79EE09FA5 | 6.20979 | 91 | 70C588D838AB0FC61F8EABDA | 5.85846 |
| 35 | 36817EE5B08B5B4B9CE88CBE | 5.77008 | 92 | D6A8AD537E8258E745C1C476 | 5.82355 |
| 36 | BA78FAA5BDCC40837F5205DA | 6.31919 | 93 | 8A4F652DF088D93FC0073FD8 | 6.00051 |
| 37 | A490E570CE08172BD82A3633 | 5.73775 | 94 | 450F92DF140D63380103F31B | 6.48422 |
| 38 | 8433E275E271D4EC11019463 | 5.78564 | 95 | EAAF05F63641E7AFED3A5A79 | 5.90759 |
| 39 | F83B07F42EFAE5F1EA281A78 | 5.68333 | 96 | 5F501203D217CF94BC44A6C1 | 6.5396 |
| 40 | B9B93373373FFCB301EFCD77 | 5.79877 | 97 | 71F6C952D988BC8847E0BA88 | 6.09041 |
| 41 | 22B5A5AAC8B3756C6C4ADFE6 | 6.27794 | 98 | BF472D6610532AE50CDF829A | 6.28286 |
| 42 | C6DFADA3233FF4EE17DE5E17 | 5.87103 | 99 | D15D9E8AECFE8C296D5802D6 | 6.22803 |
| 43 | 70D09DC4F9121828C70B6064 | 5.76809 | 100 | D5AD5575149C76589FF8784A | 6.07452 |
| 44 | F01F5956C24E2156253809D8 | 6.64621 | 101 | 7868B4788F33D2EA66C86BE2 | 5.83685 |
| 45 | 8E157642C21545D6AFC4C9EE | 5.77721 | 102 | B722E30271A97725EA79020A | 5.97044 |
| 46 | 391D93EF8012E5D2F8E2C299 | 6.87607 | 103 | 30209E7F80F14A76FCB45DBF | 6.06914 |
| 47 | EC1D207A7BA6C4852C105E34 | 6.09394 | 104 | 6FA8FDC42599BDFDCEEFD828 | 5.99957 |
| 48 | 55858594CBAC6A7760D72623 | 6.0547 | 105 | 9CAF25C12BA260391958223B | 5.91873 |
| 49 | FBB76DDCC08E8B0A89E8D35B | 6.30027 | 106 | CD82CBA6EA27C514AA8F40A0 | 5.72081 |
| 50 | 6394D6CFC5269D0B8DFCE4D6 | 5.71258 | 107 | 96852F4F3B879A23F97D3DFA | 6.24847 |
| 51 | F92EDE555781CC62F5C3FA42 | 6.26962 | 108 | 236F33011BD7E277C5BC9561 | 5.84184 |
| 52 | E66B7E6E901C802D1725C31B | 6.98039 | 109 | 9B74FD2CA98D58E7B8EDD5DB | 6.1246 |
| 53 | 0BA101B2F3F78E672EFC0CC7 | 6.25099 | 110 | 2DC51FEED52392D7174435E8 | 5.80747 |
| 54 | 26E1EC3E787F6092D1634683 | 6.54994 | 111 | 8708EE1A78F79E3E14D30DD7 | 6.23013 |
| 55 | 4767A25488E79F75E2F45FA1 | 6.25162 | 112 | FCCD639AD5BA5B1451CBD600 | 5.96117 |
| 56 | 1A2FC69DC4DCAD0399DAF857 | 6.06972 | 113 | 652492280DC624A59D2A3F82 | 6.32939 |

### Table 316m—PAPR reduction sequence for BS with 2 antennas (1024 point FFT)

| ID cell | Sequence | PAPR | ID cell | Sequence | PAPR | ID cell | Sequence | PAPR |
|---|---|---|---|---|---|---|---|---|
| 0 | C9A1F9FB33E2 | 5.73908 | 43 | 13CBBBDD1888 | 5.25927 | 86 | 6414C0DB128C | 6.26365 |
| 1 | C615462A8D6E | 5.69178 | 44 | 34B0D91482A7 | 5.43386 | 87 | 08FEAB4846B9 | 5.5487 |
| 2 | D8400C1E2B47 | 5.67259 | 45 | 0DB3ECE942B0 | 5.40054 | 88 | 7E160C4BA0F0 | 5.7677 |
| 3 | DBCF1478431C | 5.91286 | 46 | A4D876BF7C4E | 5.45618 | 89 | 5CCA9AF7C373 | 5.61368 |
| 4 | CC93B30C0EB9 | 5.55863 | 47 | 7D492A0F5B39 | 6.40321 | 90 | 21B3DF421DE7 | 5.43398 |
| 5 | C6F3D332B053 | 5.3082 | 48 | C82DA6102B09 | 5.31582 | 91 | 9323DD2F2771 | 5.2348 |
| 6 | 9BA4E419EBB5 | 5.5186 | 49 | F68C09C7D629 | 5.1445 | 92 | A26015CF1514 | 5.78478 |
| 7 | 48FD85CD7E76 | 6.11686 | 50 | 4D6C3B62D026 | 6.44183 | 93 | 8220CF898D60 | 5.43634 |
| 8 | E992B4493831 | 5.69693 | 51 | EBD13D02E539 | 5.35096 | 94 | 8CCEC410F8A6 | 5.33904 |
| 9 | 4E1401A862B5 | 5.92235 | 52 | 760432EDBC5B | 5.42816 | 95 | 4FFDECD6D0E0 | 5.50659 |
| 10 | 9D3239BF5543 | 5.50286 | 53 | 022040211B53 | 5.58372 | 96 | 42D052099826 | 5.68271 |
| 11 | 2B8584BFB3D8 | 5.19875 | 54 | 2663067DE01D | 5.50621 | 97 | 8785DFDA586A | 5.2863 |
| 12 | AB42706F96A0 | 5.44334 | 55 | C0776A8DD057 | 5.29609 | 98 | 68DDF31B930F | 5.65759 |
| 13 | 9DB123495FB7 | 5.63328 | 56 | 96117C9722E1 | 5.61786 | 99 | F0539BCDAACB | 5.6598 |
| 14 | A6EFBCB2865D | 6.0094 | 57 | 204C31E521C4 | 5.27659 | 100 | 372C0613FE2C | 5.21517 |
| 15 | 709300E57360 | 5.73209 | 58 | C8C12F23551B | 5.70925 | 101 | 37402B2A80A9 | 6.29655 |
| 16 | 6E2122FC796F | 5.82368 | 59 | 1217E2F687C1 | 5.51497 | 102 | 523AE3212125 | 5.41681 |
| 17 | 7F01F8B4454F | 5.47779 | 60 | DBF86CB15B3B | 5.57367 | 103 | 02EDF46F9694 | 5.47569 |
| 18 | CDF8525E2FF7 | 5.33406 | 61 | BCC4EC437886 | 5.94074 | 104 | E64CC083190E | 5.71759 |
| 19 | 0AC1FA2585A5 | 6.24242 | 62 | AA2734F33EF9 | 5.71983 | 105 | 65DE3871D0D1 | 5.80455 |
| 20 | 46843DFB1135 | 5.65053 | 63 | CBA739A84A4D | 5.96463 | 106 | 7808E3E5FE8E | 5.88159 |
| 21 | 8B411A6D7235 | 5.524 | 64 | E12166CA6DF5 | 5.64715 | 107 | 070004E13E81 | 5.79589 |
| 22 | 096A3287FE74 | 5.65888 | 65 | DE42128CD418 | 5.16399 | 108 | 1CE29934CF8D | 5.33859 |
| 23 | E26CD654FF1A | 5.89291 | 66 | F90F21A0B95F | 5.52101 | 109 | 52B8A394BDBC | 5.9872 |
| 24 | D955EFF989FE | 5.90035 | 67 | DCC08885C1D0 | 5.34739 | 110 | 1A13C7DB3016 | 5.31546 |
| 25 | 882566402741 | 5.62867 | 68 | 152AFEFAA90D | 5.34108 | 111 | CE75430244B7 | 5.40294 |
| 26 | 9FCD0AB3FCF8 | 5.79711 | 69 | CB30CE0D8CD2 | 5.89277 | 112 | DD89BD52F023 | 5.81172 |
| 27 | 8E477A39DA36 | 5.45249 | 70 | 849C1C0DA6A3 | 5.64765 | 113 | 6B98276F9841 | 5.59191 |

### Table 316m—PAPR reduction sequence for BS with 2 antennas (1024 point FFT) *(continued)*

| ID cell | Sequence | PAPR | ID cell | Sequence | PAPR | ID cell | Sequence | PAPR |
|---|---|---|---|---|---|---|---|---|
| 28 | 83740061371F | 5.42528 | 71 | B8177804D737 | 5.78193 | | | |
| 29 | 179FBF270668 | 5.59438 | 72 | 693BE40CEE81 | 5.6998 | | | |
| 30 | 0B4738E24AE1 | 6.26907 | 73 | 632921AF950C | 6.29239 | | | |
| 31 | 9BD23A217294 | 5.83321 | 74 | C4D296ABB9B0 | 5.55821 | | | |
| 32 | E783A99153C7 | 5.57411 | 75 | 08DCE8EE0E46 | 5.61434 | | | |
| 33 | 60690386D94B | 5.56542 | 76 | 616A6B8637F3 | 5.29314 | | | |
| 34 | EEB11CF6A279 | 5.61602 | 77 | DB69C2C67E5F | 5.67251 | | | |
| 35 | 17737FC0364B | 5.46925 | 78 | B7922C4D47E0 | 5.54227 | | | |
| 36 | DBA832CB29FF | 5.46318 | 79 | 5A4273474A62 | 5.41366 | | | |
| 37 | 841030AA2B58 | 5.66141 | 80 | 50082E465126 | 5.57391 | | | |
| 38 | 573AE8A1189A | 6.49919 | 81 | 2E3844099ABD | 5.27701 | | | |
| 39 | 26EF1E523190 | 5.45727 | 82 | F8EFB7F0CE2F | 5.76264 | | | |
| 40 | 45F27228B846 | 6.37869 | 83 | 64B7E857C964 | 5.89799 | | | |
| 41 | D26C39A8D803 | 5.63232 | 84 | 5B4DDAF2A8D1 | 6.02566 | | | |
| 42 | 4514BB4432A6 | 5.74245 | 85 | B639EE82C328 | 5.71509 | | | |

### Table 316n—PAPR reduction sequence for BS with 2 antennas (512 point FFT)

| ID cell | Sequence | PAPR | ID cell | Sequence | PAPR | ID cell | Sequence | PAPR |
|---|---|---|---|---|---|---|---|---|
| 0 | C88B5B | 4.67601 | 43 | F3D2C6 | 4.93286 | 85 | B286FB | 5.2203 |
| 1 | 4B943B | 5.01945 | 44 | 0BFE87 | 5.03341 | 86 | 36016D | 5.00459 |
| 2 | 26A2CA | 4.9099 | 45 | 92AA64 | 4.93443 | 87 | 98D31F | 4.85287 |
| 3 | ABF43A | 4.9298 | 46 | A5D580 | 5.18021 | 88 | 6A87B3 | 4.80097 |
| 4 | F653DD | 5.58288 | 47 | 6D6DFD | 4.94058 | 89 | 958B99 | 5.40979 |
| 5 | 686FDB | 5.08845 | 48 | 6A578D | 5.58274 | 90 | 8AB689 | 4.89558 |
| 6 | 0D2D4F | 5.49959 | 49 | 967EE4 | 5.18235 | 91 | 570A5C | 4.75712 |
| 7 | E4BEB2 | 5.03402 | 50 | CE4755 | 6.35302 | 92 | 47A9A6 | 5.42678 |
| 8 | C68129 | 5.41883 | 51 | 2D6ECE | 5.92368 | 93 | 4B2F30 | 5.47629 |
| 9 | 4E1401A862B5 | 5.41345 | 52 | 6BA1CF | 6.12984 | 94 | 0D6033 | 5.36666 |
| 10 | 9D3239BF5543 | 5.25745 | 53 | 019E02 | 6.09087 | 95 | 3F7DAA | 4.73588 |
| 11 | 2B8584BFB3D8 | 4.60192 | 54 | A06B8B | 4.90168 | 96 | E64518 | 5.68267 |
| 12 | AB42706F96A0 | 5.20474 | 55 | 9CBA18 | 5.48837 | 97 | F94B7D | 4.92173 |
| 13 | 9DB123495FB7 | 5.1286 | 56 | 05FD60 | 5.16162 | 98 | 78D213 | 5.38737 |
| 14 | A6EFBCB2865D | 4.94086 | 57 | FC2322 | 4.95813 | 99 | 9EDE1D | 5.05499 |
| 15 | 709300E57360 | 4.73214 | 58 | F0898A | 5.74311 | 100 | 8E3B36 | 5.76876 |
| 16 | 36BF3C | 5.22147 | 59 | F22469 | 5.32756 | 101 | 74AF80 | 5.10266 |
| 17 | 56684C | 5.74529 | 60 | 57673A | 6.33084 | 102 | CC8769 | 4.89204 |
| 18 | 654D89 | 5.24514 | 61 | 1A38DB | 5.56632 | 103 | 265829 | 5.3906 |
| 19 | 2781F3 | 4.89117 | 62 | A69433 | 4.90576 | 104 | 7CF001 | 5.44668 |
| 20 | 46876A | 4.62728 | 63 | 9B80BB | 4.82736 | 105 | B5D0CE | 5.14106 |
| 21 | CE53D0 | 4.94685 | 64 | 6B75F8 | 4.66086 | 106 | 43277F | 5.24521 |
| 22 | 523974 | 4.87706 | 65 | DF32CD | 5.28631 | 107 | 015C21 | 4.93279 |
| 23 | 4A0453 | 5.02621 | 66 | D1F692 | 4.86675 | 108 | A4AB8B | 5.01596 |
| 24 | 47F9ED | 5.91721 | 67 | E6FCC8 | 5.65351 | 109 | B3A938 | 5.15091 |
| 25 | BB2C96 | 4.83723 | 68 | 08DF3D | 4.79648 | 110 | 3333D3 | 4.78207 |
| 26 | 48B142 | 5.21914 | 69 | 39CFC0 | 4.95539 | 111 | AFA03D | 5.52105 |
| 27 | FFDA6B | 5.52578 | 70 | EC8BAD | 5.95318 | 112 | 88F995 | 5.11364 |
| 28 | 8F8DC4 | 4.95493 | 71 | 16B9AC | 5.12127 | 113 | E1668B | 5.77986 |

### Table 316n—PAPR reduction sequence for BS with 2 antennas (512 point FFT) *(continued)*

| ID cell | Sequence | PAPR | ID cell | Sequence | PAPR | ID cell | Sequence | PAPR |
|---|---|---|---|---|---|---|---|---|
| 29 | 1A1037 | 5.06145 | 72 | 6E6D24 | 5.88171 | | | |
| 30 | 50F345 | 5.39428 | 73 | B2027C | 5.22276 | | | |
| 31 | 9C2ABE | 5.15445 | 74 | E05272 | 5.72503 | | | |
| 32 | 97191F | 4.88407 | 75 | 859C89 | 5.65769 | | | |
| 33 | 61FCD0 | 5.82153 | 76 | 6624DD | 4.98579 | | | |
| 34 | 6F8969 | 6.25241 | 77 | F2D404 | 5.27575 | | | |
| 35 | 156F56 | 5.42931 | 78 | 8B81D9 | 5.26581 | | | |
| 36 | BC8D17 | 5.08773 | 79 | 5C69D7 | 4.97194 | | | |
| 37 | F3092A | 5.05832 | 80 | 645838 | 5.86814 | | | |
| 38 | A41DBD | 4.75378 | 81 | 8DEFA5 | 4.94176 | | | |
| 39 | 6EA1E4 | 4.83662 | 82 | 22059A | 5.76969 | | | |
| 40 | 6A29F7 | 5.19888 | 83 | 70A052 | 5.26498 | | | |
| 41 | 462826 | 4.79626 | 84 | 50E6D6 | 5.65313 | | | |
| 42 | 5FB555 | 4.97374 | | | | | | |

$$G = [g_0 g_1 g_2 \dots g_{47}] \tag{124ad}$$

$$= \begin{bmatrix} 010101010101010100000101011000110000000011111111 \\ 001100110011001100010001000100010000001101010110 \\ 000011110000111101010101010101010000010101100011 \\ 000000001111111100110011001100110001000100010001 \\ 000000110101011000001111000011110101010101010101 \\ 000001010110001100000000111111110011001100110011 \\ 000100010001000100000011010101100000111100001111 \end{bmatrix}$$

### Table 316o—Permutation (*l* = 0, 1, 2, …, 47)

| | |
|---|---|
| $\Pi(l)$ | 5,6,4,10,7,2,14,0,8,11,13,12,3,15,1,9,26,29,19,27,31,17,20,16,23,28,24,21,18,30,25,22,43,46,34,47, 44,41,37,36,39,38,35,33,32,45,40,42 |

### Table 316p—PAPR Reduction Sequence for BS with 2 Antennas (128 point FFT)

| ID cell | Sequence | PAPR | ID cell | Sequence | PAPR | ID cell | Sequence | PAPR |
|---|---|---|---|---|---|---|---|---|
| 0 | 1 1 1 0 1 1 | 6.67057 | 43 | 1 0 0 1 1 0 | 6.50695 | 86 | 1 0 1 0 1 1 | 5.47231 |
| 1 | 0 0 1 1 0 0 | 5.883 | 44 | 0 0 0 0 0 1 | 5.58222 | 87 | 0 1 0 1 1 1 | 4.27052 |
| 2 | 1 1 1 1 1 1 | 4.95588 | 45 | 1 1 1 0 1 1 | 5.19814 | 88 | 0 0 0 1 0 1 | 4.98455 |
| 3 | 0 1 1 0 0 1 | 4.92942 | 46 | 1 0 0 1 1 0 | 5.50865 | 89 | 0 0 0 1 0 1 | 4.85573 |
| 4 | 1 0 0 1 0 0 | 4.84232 | 47 | 1 0 0 0 0 0 | 5.40503 | 90 | 1 0 1 1 0 0 | 4.66224 |
| 5 | 0 1 0 1 0 0 | 5.97707 | 48 | 1 0 0 1 0 0 | 4.48416 | 91 | 0 1 1 0 0 1 | 5.59862 |
| 6 | 0 0 0 0 1 1 | 5.2818 | 49 | 0 1 0 0 1 1 | 5.59862 | 92 | 0 1 0 1 0 1 | 5.13782 |
| 7 | 0 1 1 1 0 1 | 4.62935 | 50 | 0 1 0 1 0 0 | 4.76609 | 93 | 1 1 0 0 0 0 | 5.73533 |
| 8 | 1 1 1 1 0 1 | 4.80191 | 51 | 0 1 1 1 0 1 | 4.87033 | 94 | 0 1 1 1 1 1 | 6.31115 |
| 9 | 0 1 1 1 1 0 | 4.62839 | 52 | 1 1 1 0 0 1 | 5.60052 | 95 | 0 1 1 1 0 1 | 4.76096 |
| 10 | 1 0 0 0 0 0 | 4.93818 | 53 | 1 0 1 0 0 1 | 4.18939 | 96 | 0 1 0 1 1 1 | 4.43229 |
| 11 | 0 0 0 0 1 0 | 4.62239 | 54 | 1 1 1 1 0 1 | 5.00411 | 97 | 1 0 0 1 1 1 | 4.52351 |
| 12 | 1 1 0 0 1 1 | 6.23206 | 55 | 1 1 1 1 0 0 | 4.91284 | 98 | 1 0 0 1 0 0 | 4.16266 |
| 13 | 0 0 0 0 0 1 | 4.76556 | 56 | 0 0 0 0 1 0 | 6.92296 | 99 | 1 1 1 0 1 0 | 5.72573 |
| 14 | 1 1 0 1 1 1 | 5.21957 | 57 | 0 0 0 0 1 0 | 5.39012 | 100 | 0 1 0 1 0 0 | 4.34746 |
| 15 | 0 1 1 0 0 0 | 6.73261 | 58 | 0 1 1 0 0 1 | 6.0232 | 101 | 1 0 0 1 0 0 | 6.81937 |
| 16 | 0 0 1 1 1 0 | 4.9981 | 59 | 1 1 0 1 0 0 | 6.27241 | 102 | 0 1 0 1 1 1 | 5.86829 |
| 17 | 0 1 1 0 0 0 | 5.23977 | 60 | 0 0 1 0 1 0 | 5.26582 | 103 | 0 1 0 1 1 0 | 5.22038 |
| 18 | 1 1 1 1 1 0 | 5.59862 | 61 | 1 0 0 0 0 1 | 5.47146 | 104 | 1 0 0 0 0 0 | 4.8724 |
| 19 | 0 1 1 1 0 1 | 6.75846 | 62 | 0 0 0 0 1 0 | 6.43249 | 105 | 0 1 1 0 1 1 | 6.7858 |
| 20 | 0 0 1 1 1 1 | 4.86729 | 63 | 1 0 0 1 1 1 | 4.69906 | 106 | 1 0 0 0 1 0 | 5.75267 |
| 21 | 1 1 0 0 0 0 | 5.57405 | 64 | 1 1 1 0 0 0 | 5.28969 | 107 | 1 1 0 0 1 1 | 5.1796 |
| 22 | 1 0 1 0 0 1 | 4.82303 | 65 | 1 0 1 0 1 1 | 6.66865 | 108 | 1 1 1 0 0 0 | 6.00083 |
| 23 | 0 1 0 1 0 1 | 4.54948 | 66 | 1 0 1 0 1 1 | 5.90593 | 109 | 1 0 1 0 0 1 | 4.6724 |
| 24 | 0 1 1 1 0 1 | 5.45765 | 67 | 0 1 1 1 0 0 | 6.13642 | 110 | 1 0 0 1 0 0 | 4.8345 |
| 25 | 1 1 0 0 0 1 | 4.91648 | 68 | 0 0 1 0 0 0 | 4.9337 | 111 | 0 0 1 1 1 0 | 4.05646 |
| 26 | 1 0 0 1 0 1 | 3.95813 | 69 | 0 1 1 0 1 0 | 5.13715 | 112 | 0 0 1 1 1 1 | 5.6271 |
| 27 | 1 0 0 0 0 1 | 6.03433 | 70 | 1 1 1 1 0 0 | 5.05877 | 113 | 0 1 1 1 1 1 | 5.59862 |

### Table 316p—PAPR Reduction Sequence for BS with 2 Antennas (128 point FFT) *(continued)*

| ID cell | Sequence | PAPR | ID cell | Sequence | PAPR | ID cell | Sequence | PAPR |
|---|---|---|---|---|---|---|---|---|
| 28 | 1 1 0 0 0 1 | 4.50629 | 71 | 1 0 0 1 0 0 | 5.42538 | | | |
| 29 | 0 1 0 0 0 1 | 4.80454 | 72 | 1 1 1 0 1 0 | 5.21428 | | | |
| 30 | 1 0 1 1 1 1 | 4.94614 | 73 | 1 0 1 1 0 1 | 4.27288 | | | |
| 31 | 1 0 1 1 0 0 | 4.54236 | 74 | 0 1 0 0 0 1 | 4.63478 | | | |
| 32 | 0 1 1 0 0 0 | 3.86311 | 75 | 1 0 1 0 0 1 | 5.47216 | | | |
| 33 | 0 1 1 0 0 0 | 5.18297 | 76 | 1 0 1 0 0 0 | 6.49514 | | | |
| 34 | 1 1 0 1 0 1 | 5.59137 | 77 | 1 1 0 0 0 0 | 5.35897 | | | |
| 35 | 1 0 0 1 0 0 | 5.51632 | 78 | 0 0 0 0 0 1 | 5.59862 | | | |
| 36 | 1 1 0 0 1 0 | 4.64969 | 79 | 0 1 0 0 0 0 | 5.36634 | | | |
| 37 | 1 1 1 0 0 0 | 5.59862 | 80 | 0 0 0 0 1 0 | 4.79522 | | | |
| 38 | 0 0 0 0 1 1 | 6.56393 | 81 | 0 0 1 1 1 0 | 5.03585 | | | |
| 39 | 1 0 1 0 0 0 | 6.63257 | 82 | 1 1 0 0 1 1 | 6.41538 | | | |
| 40 | 0 0 1 0 1 1 | 6.30837 | 83 | 0 1 1 0 0 1 | 5.92329 | | | |
| 41 | 0 0 0 1 0 1 | 5.76388 | 84 | 1 0 1 1 1 0 | 5.24541 | | | |
| 42 | 0 0 0 1 1 1 | 5.17733 | 85 | 0 0 0 0 0 1 | 6.41868 | | | |

***Insert new subclause 8.4.8.5.2.2:***

### 8.4.8.5.2.2 PAPR Reduction Sequence for BS with 3 or 4 antennas

For FFT size = 2048, the sequence *T(k)* is the same as $N_t = 2$, $N_{FFT} = 1024$ case.

For FFT size = 1024, the sequence *T(k)* is the same as $N_t = 2$, $N_{FFT} = 512$ case.

For FFT size = 512,

$$G = [g_0 g_1 g_2 \ldots g_{95}] =$$

[001100110011001101010101010101010001000100010001000001010110001100000011010101100000000011111111
000011110000111100110011001100110101010101010101000100010001000100000101011000110000001101010110
000000001111111100001111000011110011001100110011010101010101010100010001000100010000010101100011
000000110101011000000000111111110000111100001111001100110011001101010101010101010001000100010001
000001010110001100000011010101100000000011111111000011110000111100110011001100110101010101010101
000100010001000100000101011000110000001101010110000000001111111100001111000011110011001100110011]

### Table 316q—Permutation ($l$ = 0, 1, 2, …, 95)

| | |
|---|---|
| $\Pi(l)$ | 2,6,0,10,14,11,7,3,8,15,1,12,9,4,13,5,18,26,24,17,29,19,21,16,23,22,25,28,27,31,20,30,41,34, 38,44,36,43,35,32,45,47,46,39,40,33,37,42,60,56,59,61,51,62,52,49,58,48,53,50,54,57,55,63, 71,77,76,74,67,66,68,75,78,64,69,79,72,70,65,73,81,92,83,87,82,94,86,88,95,91,93,90,84,85, 80,89 |

### Table 316r—PAPR reduction sequence for BS with 3 or 4 antennas (512 point FFT)

| ID cell | Sequence | PAPR | ID cell | Sequence | PAPR | ID cell | Sequence | PAPR | ID cell | Sequence | PAPR |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | CB3 | 6.26336 | 32 | 1F3 | 5.26429 | 64 | 73E | 5.29366 | 96 | 478 | 4.77121 |
| 1 | D47 | 5.27748 | 33 | 573 | 4.94488 | 65 | 0FE | 6.62956 | 97 | 17E | 5.66118 |
| 2 | 59D | 4.9581 | 34 | 07F | 6.36319 | 66 | 5CB | 4.88939 | 98 | 696 | 4.93494 |
| 3 | F21 | 5.05997 | 35 | 9A3 | 5.91188 | 67 | C59 | 4.30678 | 99 | 31A | 5.36534 |
| 4 | 87E | 6.51422 | 36 | C86 | 5.36258 | 68 | 5B5 | 5.54517 | 100 | 9D7 | 4.78933 |
| 5 | BFA | 5.33856 | 37 | 349 | 4.98064 | 69 | E2D | 5.27261 | 101 | 2A4 | 5.45932 |
| 6 | 4D4 | 7.0618 | 38 | C83 | 6.14253 | 70 | 5F6 | 5.03828 | 102 | 35C | 6.40963 |
| 7 | 3E0 | 6.41769 | 39 | EE0 | 5.95156 | 71 | 9A9 | 5.25379 | 103 | CBD | 5.39788 |
| 8 | 3E4 | 4.87727 | 40 | 4CA | 5.40169 | 72 | BDB | 5.14859 | 104 | 44C | 4.38835 |
| 9 | 6F7 | 4.15136 | 41 | 634 | 4.82317 | 73 | AE7 | 5.39255 | 105 | 416 | 4.38145 |
| 10 | 8D0 | 5.86359 | 42 | 360 | 5.05168 | 74 | 2C2 | 4.97124 | 106 | 6B6 | 5.5007 |
| 11 | 33E | 5.68455 | 43 | 7B6 | 5.20885 | 75 | 6A3 | 6.20876 | 107 | E79 | 5.6706 |
| 12 | CA3 | 5.79482 | 44 | 4A7 | 5.52378 | 76 | D3A | 4.83271 | 108 | 34F | 5.62588 |
| 13 | 119 | 5.29216 | 45 | 0D4 | 6.47369 | 77 | 741 | 5.5686 | 109 | DC4 | 5.29578 |
| 14 | AA3 | 5.3423 | 46 | 523 | 5.20757 | 78 | 737 | 5.64126 | 110 | 586 | 5.00808 |
| 15 | EC5 | 5.40257 | 47 | F29 | 5.0776 | 79 | 7AC | 5.17063 | 111 | DF3 | 4.48385 |
| 16 | A08 | 5.63148 | 48 | A67 | 5.52381 | 80 | 79F | 5.0828 | 112 | F2B | 5.53794 |
| 17 | 96C | 5.44285 | 49 | 251 | 5.10732 | 81 | 3FA | 5.22885 | 113 | ED1 | 5.58523 |
| 18 | 9D3 | 5.19112 | 50 | B8E | 4.77121 | 82 | 99C | 6.01707 | | | |
| 19 | 5BC | 5.41859 | 51 | 5B0 | 5.38618 | 83 | 755 | 6.51422 | | | |
| 20 | 4BC | 5.96539 | 52 | B6B | 5.20069 | 84 | A44 | 4.93486 | | | |
| 21 | D15 | 6.07706 | 53 | DCC | 6.18175 | 85 | F67 | 4.86142 | | | |
| 22 | A31 | 4.76142 | 54 | 356 | 5.46713 | 86 | 4D4 | 6.21941 | | | |
| 23 | 4B3 | 4.67373 | 55 | 7FB | 6.23427 | 87 | 810 | 4.25677 | | | |

### Table 316r—PAPR reduction sequence for BS with 3 or 4 antennas (512 point FFT) *(continued)*

| ID cell | Sequence | PAPR | ID cell | Sequence | PAPR | ID cell | Sequence | PAPR | ID cell | Sequence | PAPR |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 24 | B0A | 5.24324 | 56 | C6B | 4.64117 | 88 | 201 | 4.47647 | | | |
| 25 | BB7 | 4.81109 | 57 | 956 | 5.81606 | 89 | 054 | 6.8165 | | | |
| 26 | 245 | 4.99566 | 58 | 100 | 5.04293 | 90 | 654 | 5.87238 | | | |
| 27 | 834 | 4.81878 | 59 | DF0 | 6.56931 | 91 | F34 | 5.31419 | | | |
| 28 | A59 | 5.78273 | 60 | 663 | 5.4996 | 92 | 4FF | 6.88515 | | | |
| 29 | 807 | 5.59368 | 61 | 602 | 5.72958 | 93 | 4AA | 6.75475 | | | |
| 30 | 694 | 5.53837 | 62 | 894 | 4.96955 | 94 | E8D | 6.10937 | | | |
| 31 | 6C6 | 6.42782 | 63 | 247 | 5.37554 | 95 | 944 | 4.79898 | | | |

For FFT size = 128

$$G = [g_0 g_1 g_2 \dots g_{23}] \tag{124ae}$$

$$= \begin{bmatrix} 010101010101010101010101 \\ 001100110011001100110011 \\ 000011110000111100001111 \\ 111111110000000011111111 \\ 000000001111111111111111 \\ 111111001010000010010000 \\ 111110100000011000001100 \end{bmatrix}$$

### Table 316s—Permutation (*l* = 0, 1, 2, …, 23)

| | |
|---|---|
| $\Pi(l)$ | 11,6,4,9,7,8,0,10,5,1,2,3,17,20,21,14,18,16,23,15,19,22,12,13 |

### Table 316t—PAPR reduction sequence for BS with 3 or 4 antennas (128 point FFT)

| ID cell | Sequence | PAPR | ID cell | Sequence | PAPR | ID cell | Sequence | PAPR | ID cell | Sequence | PAPR |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0 1 0 | 5.35724 | 32 | 1 0 1 | 4.61762 | 64 | 0 1 1 | 3.52173 | 96 | 1 0 0 | 4.18255 |
| 1 | 0 0 0 | 5.17414 | 33 | 1 0 1 | 3.5604 | 65 | 0 0 0 | 5.01602 | 97 | 1 1 0 | 3.49527 |
| 2 | 1 1 1 | 6.51422 | 34 | 0 1 0 | 5.96329 | 66 | 0 0 1 | 6.01058 | 98 | 0 1 0 | 4.47417 |
| 3 | 0 0 0 | 3.82903 | 35 | 0 0 0 | 6.00008 | 67 | 0 1 0 | 4.70152 | 99 | 0 1 1 | 6.09081 |
| 4 | 1 1 0 | 5.5707 | 36 | 0 1 1 | 5.2032 | 68 | 0 0 0 | 3.37021 | 100 | 1 0 1 | 4.2738 |
| 5 | 1 1 1 | 4.51562 | 37 | 0 1 1 | 5.5032 | 69 | 0 0 1 | 5.18544 | 101 | 0 0 1 | 3.77032 |
| 6 | 1 0 1 | 4.99659 | 38 | 1 1 1 | 4.63273 | 70 | 1 0 1 | 5.59372 | 102 | 0 0 0 | 4.79531 |
| 7 | 1 0 0 | 4.507 | 39 | 0 0 0 | 4.79863 | 71 | 1 1 0 | 4.64525 | 103 | 1 1 0 | 3.80557 |
| 8 | 0 0 0 | 2.77148 | 40 | 1 1 1 | 6.68743 | 72 | 0 0 0 | 4.54804 | 104 | 0 0 1 | 3.67728 |
| 9 | 0 1 1 | 4.52863 | 41 | 1 0 1 | 4.93428 | 73 | 1 0 1 | 6.18314 | 105 | 1 0 0 | 5.55408 |
| 10 | 0 0 1 | 4.77121 | 42 | 1 1 0 | 5.43501 | 74 | 0 1 0 | 4.32808 | 106 | 1 1 1 | 4.96913 |
| 11 | 1 0 0 | 4.59416 | 43 | 1 1 1 | 5.22032 | 75 | 0 0 1 | 4.56337 | 107 | 0 1 1 | 4.52983 |
| 12 | 0 1 0 | 3.78955 | 44 | 0 0 0 | 6.51422 | 76 | 0 0 0 | 5.36844 | 108 | 0 1 1 | 5.0537 |
| 13 | 1 0 0 | 4.60896 | 45 | 1 1 1 | 4.98055 | 77 | 0 1 1 | 4.98055 | 109 | 0 1 1 | 4.67829 |
| 14 | 1 0 0 | 4.5935 | 46 | 0 0 1 | 3.50075 | 78 | 0 0 0 | 4.43788 | 110 | 1 0 1 | 6.11194 |
| 15 | 1 0 0 | 4.22853 | 47 | 0 0 0 | 5.08034 | 79 | 1 0 0 | 6.51422 | 111 | 1 1 0 | 3.53966 |
| 16 | 1 0 1 | 4.53933 | 48 | 0 1 0 | 5.41647 | 80 | 1 1 1 | 4.21693 | 112 | 1 0 0 | 4.49668 |
| 17 | 1 0 0 | 4.22832 | 49 | 1 1 0 | 4.02914 | 81 | 0 0 1 | 4.73888 | 113 | 0 0 0 | 4.44827 |
| 18 | 0 1 1 | 4.53739 | 50 | 0 1 0 | 3.77237 | 82 | 1 1 1 | 5.31912 | | | |
| 19 | 0 0 1 | 4.84545 | 51 | 1 1 1 | 3.99062 | 83 | 0 0 1 | 6.51422 | | | |
| 20 | 1 0 0 | 5.1608 | 52 | 0 1 1 | 4.62794 | 84 | 0 0 1 | 6.01936 | | | |
| 21 | 1 1 0 | 6.19203 | 53 | 1 0 0 | 4.81314 | 85 | 1 0 1 | 5.38087 | | | |
| 22 | 0 0 1 | 4.58568 | 54 | 0 0 0 | 4.20522 | 86 | 1 1 0 | 4.70313 | | | |
| 23 | 0 1 1 | 5.684 | 55 | 1 0 0 | 5.39106 | 87 | 0 0 0 | 3.79899 | | | |
| 24 | 0 1 0 | 4.76503 | 56 | 0 1 1 | 5.58402 | 88 | 1 0 0 | 5.31434 | | | |
| 25 | 0 0 0 | 4.77579 | 57 | 1 1 1 | 4.58125 | 89 | 1 1 0 | 6.41534 | | | |
| 26 | 0 1 0 | 4.73628 | 58 | 0 0 0 | 4.72378 | 90 | 0 0 1 | 4.11983 | | | |

### Table 316t—PAPR reduction sequence for BS with 3 or 4 antennas (128 point FFT) *(continued)*

| ID cell | Sequence | PAPR | ID cell | Sequence | PAPR | ID cell | Sequence | PAPR | ID cell | Sequence | PAPR |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 27 | 1 0 0 | 4.98055 | 59 | 0 0 0 | 4.16781 | 91 | 1 1 0 | 4.18856 | | | |
| 28 | 0 1 1 | 4.77121 | 60 | 0 0 1 | 6.57249 | 92 | 0 1 0 | 4.81524 | | | |
| 29 | 1 0 0 | 4.44124 | 61 | 1 0 0 | 3.98784 | 93 | 0 1 0 | 5.0717 | | | |
| 30 | 0 0 0 | 5.17708 | 62 | 0 0 1 | 5.95339 | 94 | 0 1 0 | 5.05024 | | | |
| 31 | 0 0 0 | 4.2966 | 63 | 1 1 0 | 5.27337 | 95 | 0 0 0 | 4.77121 | | | |

***Insert new subclause 8.4.8.9:***

### 8.4.8.9 STC subpacket combining

In the STC transmission, for both downlink and uplink, the STC sub-packet re-transmission can be generated by using the Space time code incremental redundancy version. The transmission rule for space-time coded incremental redundancy codes set is listed in Table 316u, Table 316v, and Table 316w.

### Table 316u—STC subpacket combining (2-transmit antenna case)

| | Initial transmission | Odd re-transmission | Even re-transmission |
|---|---|---|---|
| Space time code incremental redundancy for matrix A | $S_2^{(0)} = \begin{bmatrix} S_1 \\ S_2 \end{bmatrix}$ | $S_2^{(odd)} = \begin{bmatrix} -S_2{}^* \\ S_1{}^* \end{bmatrix}$ | $S_2^{(even)} = \begin{bmatrix} S_1 \\ S_2 \end{bmatrix}$ |

### Table 316v—STC subpacket combining (3-transmit antenna case)

| | Initial transmission | Odd re-transmission | Even re-transmission |
|---|---|---|---|
| Space time code incremental redundancy for matrix C | $S_2^{(0)} = \begin{bmatrix} S_1 \\ S_2 \\ S_3 \end{bmatrix}$ | $S_2^{(odd)} = \begin{bmatrix} -S^*{}_2 \\ S^*{}_1 \\ S^*{}_3 \end{bmatrix}$ | $S_2^{(even)} = \begin{bmatrix} S_1 \\ S_2 \\ S_3 \end{bmatrix}$ |

**Table 316w—STC subpacket combining (4-transmit antenna case)**

| | initial transmission | odd re-transmission | even re-transmission |
|---|---|---|---|
| Space time code incremental redundancy for matrix C | $S_2^{(0)} = \begin{bmatrix} S_1 \\ S_2 \\ S_3 \\ S_4 \end{bmatrix}$ | $S_2^{(odd)} = \begin{bmatrix} -S^*_2 \\ S^*_1 \\ -S^*_4 \\ S^*_3 \end{bmatrix}$ | $S_2^{(even)} = \begin{bmatrix} S_1 \\ S_2 \\ S_3 \\ S_4 \end{bmatrix}$ |

The MS shall process the initial transmission, first re-transmission, and second re-transmission etc. in the form of space time decoding. The re-transmission of FEC codeword shall use the Chase combing re-transmission.

### 8.4.9 Channel coding

***Change the first paragraph as indicated:***

Channel coding procedures include randomization (see 8.4.9.1), FEC encoding (see 8.4.9.2), bit interleaving (see 8.4.9.3), repetition (see 8.4.9.5) and modulation (see 8.4.9.4). ~~When repetition code is used, allocation for the transmission shall always include an even number of adjacent subchannels. The basic block shall pass the regular coding chain where the first subchannel shall set the randomization seed used in 8.4.9.1, and the data shall follow the coding chain up to the mapping. The data outputted from the modulation (8.4.9.4) shall be mapped onto the block of subchannels allocated for the basic block and then it will be also mapped on the following consecutive allocated subchannels (for repetition coding of 2, another block of subchannels of the same size is used; for repetition coding of 4, another 3 blocks of subchannels of the same size are used; and for repetition of 6, another 5 blocks of subchannels of the same size are used), the process of regular encoding and repetition encoding is shown in Figure 252.~~

***Replace Figure 252 with the following figure:***

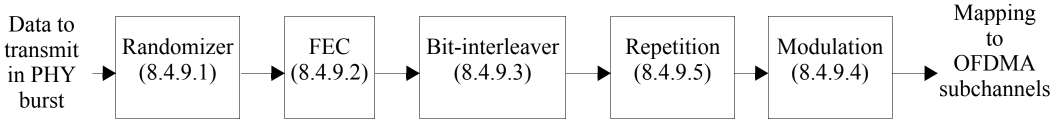

Data to transmit in PHY burst
Randomizer (8.4.9.1)
FEC (8.4.9.2)
Bit-interleaver (8.4.9.3)
Repetition (8.4.9.5)
Modulation (8.4.9.4)
Mapping to OFDMA subchannels

**Figure 252—Channel coding process for regular and repetition coding transmission**

***Insert the following sentence as the end of the subclause:***

Repetition shall only be applied to QPSK modulation.

### 8.4.9.1 Randomization

*Change the first paragraph as indicated:*

Data randomization is performed on all data transmitted on the downlink and uplink, except the FCH. The randomization is initialized on each FEC block ~~(using the first Subchannel offset and OFDMA symbol offset on which the FEC block is mapped. Symbol offset, for both UL and DL, shall be counted from the start of the frame, where the DL preamble shall be count 0)~~. If the amount of data to transmit does not fit exactly the amount of data allocated, padding of 0xFF ("1" only) shall be added to the end of the transmission block, up to the amount of data allocated. Here, the amount of data allocated means the amount of data that corresponds to the amount of $\lfloor N_s / R \rfloor$ slots, where $N_s$ is the number of the slots allocated for the data burst and $R$ is the repetition factor used.

*Change the paragraph above Figure 254 as follows:*

The randomizer is initialized with the vector ~~created as shown in Figure 254.~~ [LSB] 0 1 1 0 1 1 1 0 0 0 1 0 1 0 1 [MSB].

*Change Figure 253 as indicated:*

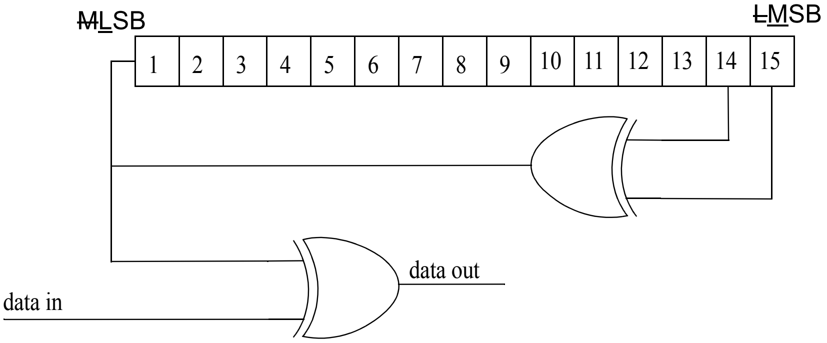

~~M~~LSB
~~L~~MSB
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
data out
data in

Figure 253—PRBS generator for data randomization

*Delete Figure 254; insert Figure 254a:*

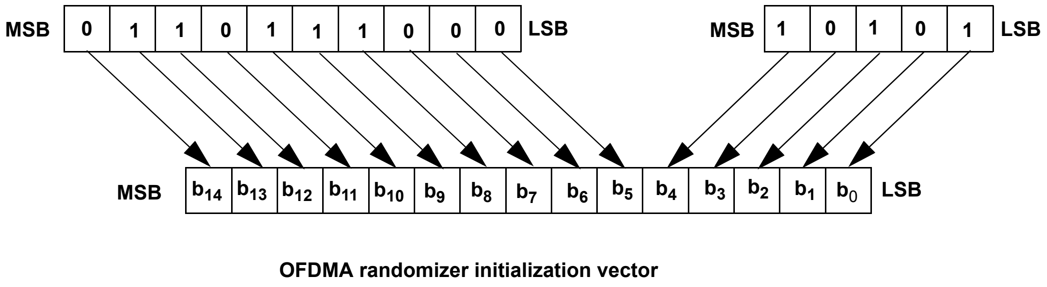

MSB
0
1
1
0
1
1
1
0
0
0
LSB
MSB
1
0
1
0
1
LSB
MSB
$b_{14}$
$b_{13}$
$b_{12}$
$b_{11}$
$b_{10}$
$b_9$
$b_8$
$b_7$
$b_6$
$b_5$
$b_4$
$b_3$
$b_2$
$b_1$
$b_0$
LSB
OFDMA randomizer initialization vector

Figure 254a—Creation of the OFDMA randomizer initialization vector for HARQ

***Insert the following text below Figure 254a:***

HARQ requires that the randomizer pattern be identical for each HARQ attempt. For HARQ operation, the randomizer shall be initialized with the vector created as shown in Figure 254a.

### 8.4.9.2 Encoding

***Replace any instance of the word 'subchannel' with word 'slot'.***

***Change the text in 8.4.9.2 as indicated:***

Concatenation of a number of ~~subchannels~~slots shall be performed in order to make larger blocks of coding where it is possible, with the limitation of not ~~passing~~exceeding the largest supported block ~~under the same~~ size for the applied modulation and coding ~~rate (the block defined by 64-QAM modulation)~~. Table 318 specifies the concatenation of subchannels for different allocations and modulations. The parameters in Table 317 and Table 318 shall apply to the CC encoding scheme (see 8.4.9.2.1) and the BTC encoding scheme (see 8.4.9.2.2); for the CTC encoding scheme (see 8.4.9.2.3), the concatenation rule is defined in 8.4.9.2.3.1, and for the LDPC encoding scheme (see 8.4.9.2.5) the concatenation rule is defined in 8.4.2.9.5.4.

***Change the second bullet of the fourth paragraph as indicated:***

— *n*: ⌊ number of allocated ~~subchannels~~slots/repetition factor ⌋

***Change Table 317 as indicated:***

**Table 317—~~Subchannel~~Slots concatenation rule**

| Number of ~~subchannels~~slots | ~~Subchannels~~Slots concatenated |
|---|---|
| $n \leq j$ | 1 block of *n* ~~subchannels~~slots |
| $n > j$ | If ($n \bmod j = 0$)<br>*k* blocks of *j* slots<br><br>else<br>*(k–1)* blocks of *j* ~~subchannels~~slots<br>1 block of ceil(($m$+$j$)/2) ~~subchannels~~slots<br>1 block of floor(($m$+$j$)/2) ~~subchannels~~slots |

#### 8.4.9.2.1 Convolutional coding (CC)

***Change the title of Table 319 to read: "The ~~inner~~ convolutional code with puncturing configuration"***

***Remove the column with value '5/6' for the rate field in Table 319.***

***Change the title of Table 320 to read: "Useful data payload for a ~~subchannel~~slot"***

***Insert new subclause 8.4.9.2.1.1:***

#### 8.4.9.2.1.1 Incremental Redundancy HARQ support (optional)

HARQ implementation is optional. An Incremental Redundancy (IR) based HARQ is taking the puncture pattern into account, and for each retransmission the coded block is not the same. Different puncture patterns are used to create HARQ packets identified by SPID. The puncture patterns are predefined or can be easily deducted from the original pattern, and can be selected based on SPID. At the receiver, the received signals are de-punctured according to its specific puncture pattern, which is decided by the current SPID, then the combination is performed at bit metrics level.

The puncture pattern for the HARQ packet with SPID=0 is the same as the mandatory one in Table 320a. The puncture pattern for the HARQ packet with SPID=1 is the left cyclic shift of the one from SPID=0, as shown in Table 320a. Following the same rule, the puncture patterns for packets with SPID=2 and SPID=3 are shown in Table 320a.

**Table 320a—Puncture pattern definition for HARQ**

| | | Code Rate | | | |
|---|---|---|---|---|---|
| | | **1/2** | **2/3** | **3/4** | **5/6** |
| **SPID = 0** | **X** | 1 | 10 | 101 | 10101 |
| | **Y** | 1 | 11 | 110 | 11010 |
| **SPID = 1** | **X** | 1 | 01 | 011 | 01011 |
| | **Y** | 1 | 11 | 101 | 10101 |
| **SPID = 2** | **X** | 1 | 10 | 110 | 10110 |
| | **Y** | 1 | 11 | 011 | 01011 |
| **SPID = 3** | **X** | 1 | 01 | 101 | 01101 |
| | **Y** | 1 | 11 | 110 | 10110 |

*Change the title of 8.4.9.2.2 as indicated:*

### 8.4.9.2.2 Block Turbo ~~C~~coding (optional)

*Change relevant rows in Table 322 and Table 323 as indicated:*

**Table 322—Useful data payload for a subchannel**

| | **QPSK** | | **16-QAM** | | **64-QAM** | | **Coded ~~B~~bytes** |
|---|---|---|---|---|---|---|---|
| **Encoding ~~R~~rate** | R=1/2 | R=3/4 | R=1/2 | R=3/4 | R=1/2 | R=3/4 | |
| Allowed ~~D~~data (~~B~~bytes) | ~~16~~12 | 20 | 16 | 20 | | | 24 |
| | ~~16~~18 | 25 | | | 16 | 25 | 36 |

**Table 323—Optional channel coding per modulation**

| **Data ~~B~~bytes** | **Coded ~~B~~bytes** | **Constituent** | **Code parameters** |
|---|---|---|---|
| ~~16~~12 | 24 | ~~(8,7)(32,26)~~(32,31)(16,11) | $I_x$=~~2~~14, $I_y$=~~0~~5, B=~~0~~6, Q=~~2~~0 |
| ~~16~~18 | 36 | (32,~~26~~31)(16,11) | $I_x$=~~11~~5, $I_y$=~~2~~5, B=~~6~~9, Q=~~7~~3 |

### 8.4.9.2.3 Convolutional turbo codes (optional)

#### 8.4.9.2.3.1 CTC encoder

***Replace any instance of the word 'subchannel' with word 'slot'.***

***Change the first three sentences of the first paragraph as indicated:***

~~The Convolutional Turbo Code (CTC) defined in this subclause is designed to enable support of hybrid ARQ (HARQ). HARQ implementation is optional.~~ The CTC encoder, including its constituent encoder, is depicted in Figure 257. The CTC defined in this subclause can be used for the support of the optional hybrid ARQ (HARQ).

***Change the second paragraph below Figure 257 as indicated:***

The order in which the encoded bit shall be fed into the subpacket generation block (8.4.9.2.3.4) is:

$$A, B, Y_1, Y_2, W_1, W_2 =$$

~~$A_0, B_0, \ldots, A_{N-1}, B_{N-1}, Y_{1,0}, Y_{1,1}, \ldots, Y_{1,N-1}, Y_{2,0}, Y_{2,1}, \ldots, Y_{2,N-1}, W_{1,0}, W_{1,1}, \ldots, W_{1,N-1}, W_{2,0}, W_{2,1}, \ldots, W_{2,N-1}$~~

$$A_0, A_1, \ldots, A_{N-1}, B_0, B_1, \ldots, B_{N-1}, Y_{1,0}, Y_{1,1}, \ldots, Y_{1,N-1}, Y_{2,0}, Y_{2,1}, \ldots, Y_{2,N-1}$$
$$W_{1,0}, W_{1,1}, \ldots, W_{1,N-1}, W_{2,0}, W_{2,1}, \ldots, W_{2,N-1}$$

***Change the first sentence of the fourth paragraph below Figure 257 as indicated:***

Concatenation of a number of ~~subchannels~~slots shall be performed in order to make larger blocks of coding where it is possible, with the limitation of not ~~passing~~exceeding the largest supported block ~~under the same~~size for the applied modulation and coding ~~rate (the block defined by 64-QAM modulation)~~.

***Change the second bullet of the paragraph above Table 324 as indicated:***

— *n*: ⌊ number of allocated ~~subchannels~~slots/repetition factor ⌋

***Change Table 324 as indicated:***

**Table 324~~—Subchannel~~Slots concatenation rule for CTC**

| Number of ~~subchannels~~slots | ~~Subchannels~~Slots concatenated |
|---|---|
| $n \leq j$<br>$n \neq 7$ | 1 block of n ~~subchannels~~slots |
| $n = 7$ | 1 block of 4 ~~subchannels~~slots<br>1 block of 3 ~~subchannels~~slots |
| $n > j$ | If ($n$ mod $j$ = 0)<br>$k$ blocks of $j$ slots<br><br>else<br>(~~k~~$k$-1) blocks of ~~j~~$j$ ~~subchannels~~slots<br>1 block of $L_{b1}$ ~~subchannels~~slots<br>1 block of $L_{b2}$ ~~subchannels~~slots<br><br>where<br>$L_{b1}$ = ceil(($m$+$j$)/2)<br>$L_{b2}$ = floor(($m$+$j$)/2)<br><br>If ($L_{b1}$ = 7) or ($L_{b2}$ = 7)<br>$Lb1 = Lb1 + 1$; $Lb2 = Lb2 - 1$; |

***Change the title of Table 326 and the entries as indicated:***

**Table 326~~—Optimal~~ CTC channel coding per modulation**

| Modulation | Data block size (bytes) | Encoded data block size (bytes) | Code rate | N | $P_0$ | $P_1$ | $P_2$ | $P_3$ |
|---|---|---|---|---|---|---|---|---|
| 16-QAM | 54 | ~~108~~72 | 3/4 | 216 | 13 | 108 | 0 | 108 |
| 64-QAM | 18 | ~~24~~36 | 1/2 | 72 | 11 | 6 | 0 | 6 |

***Change the title of Table 327 and the entries as indicated:***

**Table 327~~—Optimal~~ CTC channel coding per modulation when supporting ~~H-ARQ~~ HARQ**

| Data block size (bytes) | N | P0 | P1 | P2 | P3 |
|---|---|---|---|---|---|
| 120 | 480 | ~~13~~ 53 | ~~240~~ 62 | ~~120~~ 12 | ~~360~~ 2 |
| 240 | 960 | ~~13~~ 43 | ~~480~~ 64 | ~~240~~ 300 | ~~720~~ 824 |
| 360 | 1440 | ~~17~~ 43 | 720 | 360 | 540 |
| 480 | 1920 | ~~17~~ 31 | ~~960~~ 8 | ~~480~~ 24 | ~~1440~~ 16 |
| 600 | 2400 | ~~17~~ 53 | ~~1200~~ 66 | ~~600~~ 24 | ~~1800~~ 2 |

### 8.4.9.2.3.2 CTC interleaver

***Change the subclause as indicated:***

The interleaver requires the parameters $P_0$, $P_1$, $P_2$ and $P$~~$_1$~~$_3$, shown in Table 326.

The two-step interleaver shall be performed by:

**Step 1: Switch alternate couples**

Let the sequence $u_0=[(A_0, B_0), (A_1, B_1), (A_2, B_2), (A_3, B_3), \ldots, (A_{N-1}, B_{N-1})]$ be the input to first encoding $C_1$.

```
for ~~j~~ i = 0 ... N-1
    ~~if ($j_{mod_2}$ ==0) let (B,A) = (A,B) (i.e., switch the couple)~~
    if (i mod 2 == 1) let $(A_i, B_i) \rightarrow (B_i, A_i)$ (i.e., switch the couple)
    This step gives a sequence $u_1= [(A_0, B_0), (B_1, A_1), (A_2, B_2), (B_2, A_3), \ldots,$
    $(B_{N-1}, A_{N-1})] = [u_1(0), u_1(1), u_1(2), u_1(3), \ldots, u_1(N-1)]$.
```

**Step 2: $P$~~$_i$~~$(j)$**

The function $P$~~$_i$~~$(j)$ provides ~~the interleaved address $i$ of the consider couple $j$~~ the address of the couple of the sequence $u_1$ that shall be mapped onto the address $j$ of the interleaved sequence (i.e., $u_2(j) = u_1(P(j))$).

```
for $j = 0 \ldots N-1$
    ~~switch $j_{mod_4}$ :~~
    ~~case 0: $= (P_0 \cdot j + 1)_{mod_N}$~~
    ~~case 1: $= (P_0 \cdot j + 1 + N/2 + P_1)_{mod}$~~
    ~~case 2: $= (P_0 \cdot j + 1 + P_2)_{mod_N}$~~
    ~~case 3: $= (P_0 \cdot j + 1 + N/2 + P_3)_{mod}$~~
    switch j mod 4:
    case 0:$P(j) = (P_0 \cdot j + 1)_{mod_N}$
    case 1: $(j) = (P_0 \cdot j + 1 + N/2 + P_1)_{mod}$
    case 2:$P(j) = (P_0 \cdot j + 1 + P_2)_{mod}$
    case 3: $(j) = (P_0 \cdot j + 1 + N/2 + P_3)_{mod}$
```

This step gives a sequence $u_2= [u_1(P(0)), u_1(P(1)), u_1(P(2)), u_1(P(3)), \ldots, u_1(P(N-1))] = [(B_{P(0)}, A_{P(0)}), (A_{P(1)}, B_{P(1)}), (B_{P(2)}, A_{P(2)}), (A_{P(3)}, B_{P(3)}), \ldots, (A_{P(N-1)}, B_{P(N-1)})]$. Sequence $u_2$ is the input to the second encoding $C_2$.

### 8.4.9.2.3.3 Determination of CTC circulation states

***Change the first sentence of the first paragraph as indicated:***

The state of the encoder is denoted $S$ ($0 \le S \le 7$) with ~~$S$ the value read binary (left to right) out of the constituent encoder memory~~ $S = 4s_1 + 2s_2 + s_3$ (see Figure 257).

### 8.4.9.2.3.4 Subpacket generation

***Replace 'S*$N_{ep}$' with '3*$N_{ep}$' in Figure 258.***

### 8.4.9.2.3.4.1 Symbol separation

***Change the subclause as indicated:***

All of the encoded symbols shall be demultiplexed into six subblocks denoted $A$, $B$, $Y_1$, $Y_2$, $W_1$, and $W_2$. The encoder output symbols shall be sequentially distributed into six subblocks with the first $N$ encoder output symbols going to the $A$ subblock, the second $N$ encoder output going to the $B$ subblock, the third $N$ to the $Y_1$ subblock, the fourth $N$ to the $Y_2$ subblock, the fifth $N$ to the $W_1$ subblock, the sixth $N$ to the $W_2$ subblock~~, etc~~.

### 8.4.9.2.3.4.2 Subblock interleaving

***Renumber the numbered list in the second paragraph to start with '1.' instead of '3.'***

***Change the third bullet of the second paragraph as indicated:***

5. Form a tentative output address $T_k$ according to the formula:

$$T_k = 2^m(k \bmod J) + BRO_m(\lfloor k/J \rfloor)$$

where $BRO_m(y)$ indicates the bit-reversed $m$-bit value of $y$ (i.e., BRO~~3~~$_3$(6) = 3).

***Change relevant entries in Table 329 as indicated:***

**Table 329—Parameters for the subblock interleavers**

| Block size (bits) $N_{EP}$ | $N$ | Subblock interleaver parameters | |
|---|---|---|---|
| | | $m$ | $J$ |
| 216 | 108 | ~~6~~5 | ~~3~~4 |
| 360 | 180 | 6 | 3 |

### 8.4.9.2.3.4.4 Symbol selection

***Change the first sentence of the second paragraph as indicated:***

Mother code is transmitted with one of the subpackets.

***Change the first and third bullets of the third paragraph as indicated:***

$k$ be the subpacket index when HARQ is enabled. $k = 0$ for the first transmission and increases by one for the next subpacket. $k = 0$ when ~~H-ARQ~~ HARQ is not used. When there are more than one FEC block in a burst, the subpacket index for each FEC block shall be the same.

$N_{SCHk}$ ~~be the number of subchannel(s) allocated for the $k$-th subpacket.~~
be the number of the concatenated slots for the subpacket defined in Table 324 for non HARQ CTC scheme defined in 8.4.9.2.3.1 and be the same as $N_{sch}$ that is indicated in the allocation IE for HARQ CTC scheme defined in 8.4.9.2.3.5

***Change the title of 8.4.9.2.3.5 as indicated:***

### 8.4.9.2.3.5 ~~Optional H-ARQ~~ Optional IR HARQ (Incremental redundancy HARQ) support

***Change the subclause as indicated:***

The procedure of HARQ CTC subpacket generation is as follows: Padding, CRC addition, Fragmentation, Randomization and CTC encoding. ~~H-ARQ~~ HARQ implementation is optional. The randomization block in 8.4.9.1, the concatenation scheme in 8.4.9.2.3.1, and the interleaving in 8.4.9.3 shall not be applied for the encoding described in this subclause.

#### 8.4.9.2.3.5.1 Padding

***Change the last sentence of the first paragraph as indicated:***

The padded packet is input into the ~~randomization~~CRC encoding block.

***Renumber subclause 8.4.9.2.3.5.3 as 8.4.9.2.3.5.2***

#### 8.4.9.2.3.5.2 CRC encoding

***Change the second paragraph as indicated:***

The size of the CRC is 16 bits. CRC16-CCITT, as defined in ITU-T Recommendation X.25, shall be included at the end of the padded ~~and randomized~~ packet. The CRC covers both the padded bits and the information part of the padded ~~and randomized~~ packet. After the CRC operation, ~~T~~the packet size shall belong to set {48, 96, 144, 192, 288, 384, 480, 960, 1920, 2880, 3840, 4800, 9600, 14400, 19200, 24000}.

***Renumber subclause 8.4.9.2.3.5.4 as 8.4.9.2.3.5.3***

***Renumber subclause 8.4.9.2.3.5.2 as 8.4.9.2.3.5.4***

#### 8.4.9.2.3.5.4 Randomization

***Change the first two paragraphs as indicated:***

The randomization is performed on each ~~allocation (burst)~~encoder packet, which means that for each ~~allocation of a data block~~encoder packet the randomizer shall be ~~used~~initialized independently.

The PRBS generator shall be $1 + X^{14} + X^{15}$ as shown in Figure 260. Each data byte to be transmitted shall enter sequentially into the randomizer, MSB first. Preambles are not randomized. The seed value shall be used to calculate the randomization bits, which are combined in an XOR operation with the serialized bit stream of each FEC block. ~~The randomizer sequence is applied to the output from the padding block. The bit issued from the randomizer shall be applied to the CRC encoder.~~

***Change Figure 260 as indicated:***

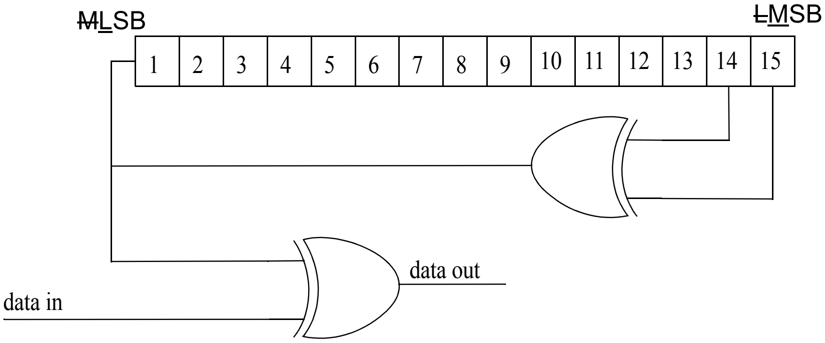


**Figure 260—PRBS generator of the randomization**

***Change the two paragraphs below Figure 260 as indicated:***

~~The bit issued from the randomizer shall be applied to the encoder.~~

The scrambler is initialized with the vector ~~created as shown in Figure 261. The lowest 5 bits are IDcell or UL_IDcell and the other bits are set "0."~~[LSB] 0 1 1 0 1 1 1 0 0 0 1 0 1 0 1 [MSB].

The bit issued from the randomizer shall be applied to the encoder.

***Delete Figure 261.***

### 8.4.9.2.3.5.6 Modulation order of DL traffic burst

***Change the first paragraph as indicated:***

For DL, the modulation order (2 for QPSK, 4 for 16-QAM, and 6 for 64-QAM) shall be set for all the allowed transmission formats as shown in Table 331. The transmission format is given by the $N_{EP}$ (Encoding Packet Size) and the $N_{SCH}$ (number of allotted ~~subchannels~~slots). $N_{EP}$ per an encoding packet is {144, 192, 288, 384, 480, 960, 1920, 2880, 3840, 4800}. The $N_{SCH}$ per an encoding packet is {1, ..., 480}. In Table 331, the numbers in the first row are $N_{EP}$'s and the numbers in the remaining rows are $N_{SCH}$'s and related parameters. In Table 331, the modulation order is denoted by *MOD*, and it has the values of two for QPSK, four for 16-QAM, and six for 64-QAM. *SCH* denotes for the number of allocated slots.

***Change the third paragraph below Equation (128) as indicated:***

The information of $N_{EP}$ and $N_{SCH}$ shall be signaled in ~~UL~~HARQ MAP. Instead of the actual values of $N_{EP}$ and $N_{SCH}$, the encoded value of $N_{EP}$ ($N_{EP}$ code) and $N_{SCH}$ ($N_{SCH}$ code) shall be used for the signaling. They are encoded by 4 bits, respectively. The encoding of $N_{EP}$ ($N_{EP}$ code) is shown in Table 332. The encoding of $N_{SCH}$ (Nsch code) is performed per $N_{EP}$ value. For each $N_{EP}$, there are less than 16 kinds of $N_{SCH}$ values and they are encoded from "0"(the smallest number of ~~subchannels~~slots) to "15" in increasing order. When the number of $N_{SCH}$ values for a $N_{EP}$ is smaller than 16, the smallest number of the smallest codes are used. When the fragmentation is applied and the number of the subpackets for an allocation is *n*, *n**$N_{EP}$ and $N_{SCH}$ (the number of ~~subchannels~~slots allocated for a subpacket) should be signaled.

***Change relevant entries in Table 331 as indicated:***

**Table 331—Transmission format and modulation level for DL**

| $N_{EP}$ | 144 | 192 | 288 | 384 | 480 | 960 | 1920 | 2880 | 3840 | 4800 |
|---|---|---|---|---|---|---|---|---|---|---|
| *SCH*<br>*MPR*<br>*MOD*<br>Rate<br>Rate | | | | | 20.00<br>0.50<br>2.00<br>1/4<br>0.25 | 20.00<br>~~0.50~~1.0<br>2.00<br>~~1/4~~1/2<br>0.~~25~~5 | 20.00<br>~~1~~2.00<br>~~2~~4.00<br>1/2<br>0.50 | 20.00<br>~~2~~3.00<br>~~4~~6.00<br>1/2<br>0.50 | 20.00<br>~~3~~4.00<br>6.00<br>~~1/2~~2/3<br>~~0.50~~0.67 | 20.00<br>5.00<br>6.00<br>5/6<br>0.83 |
| *SCH*<br>*MPR*<br>*MOD*<br>Rate<br>Rate | | | 36<br>0.17<br>2.00<br>1/12<br>0.08 | | | | | | | |

***Insert the following note below Table 331:***

NOTE—In Table 331, the first Rate entry is the theoretical rate and the second Rate entry is an approximated rate.

### 8.4.9.2.3.5.7 Modulation order of UL traffic burst

***Change the first paragraph as indicated:***

For UL, the modulation order (2 for QPSK and 4 for 16-QAM) shall be set for all the allowed transmission formats as shown in Table 333. The transmission format is given by the $N_{EP}$ (Encoding Packet Size) and the $N_{SCH}$ (number of ~~allotted~~allocated ~~subchannels~~slots). $N_{EP}$ per an encoding packet is {48, 96, 144, 192, 288, 384, 480, 960, 1920, 2880, 3840, 4800}. The $N_{SCH}$ per an encoding packet is {1...~~288~~240}. In Table 333, the numbers in the first row are $N_{EP}$'s and the numbers in the remaining rows are $N_{SCH}$'s and related parameters. In Table 333, the modulation order is denoted by MOD, and it has the values of two for QPSK, four for 16-QAM, and six for 64-QAM. *SCH* denotes for the number of allocated slots.

***Change the third paragraph below Equation (129) as indicated:***

The information of $N_{EP}$ and $N_{SCH}$ shall be signaled in ~~UL~~HARQ MAP. Instead of the actual values of $N_{EP}$ and $N_{SCH}$, the encoded value of $N_{EP}$ ($N_{EP}$ code) and $N_{SCH}$ ($N_{SCH}$ code) shall be used for the signaling. They are encoded by 4 bits, respectively. The encoding of $N_{EP}$ ($N_{EP}$ code) is shown in Table 332. The encoding of $N_{SCH}$ (Nsch code) is performed per $N_{EP}$ value. For each $N_{EP}$, there are less than 16 kinds of $N_{SCH}$ values and they are encoded from "0"(the smallest number of ~~subchannels~~slots) to "15" in increasing order. When the number of $N_{SCH}$ values for a $N_{EP}$ is smaller than 16, then the corresponding number of codes is used. When the fragmentation is applied and the number of the subpackets for an allocation is *n*, $n*N_{EP}$ and $N_{SCH}$ (the number of ~~subchannels~~slots allocated for a subpacket) should be signaled.

***Change relevant entries in Table 333 as indicated:***

**Table 333—Transmission format and modulation level for UL**

| $N_{EP}$ | 48 | 96 | 144 | 192 | 288 | 384 | 480 | 960 | 1920 | 2880 | 3840 | 4800 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *SCH*<br>*MPR*<br>*MOD*<br>Rate<br>Rate | 3.00<br>0.33<br>2.00<br>1/6<br>0.17 | 3.00<br>0.67<br>2.00<br>1/3<br>0.33 | 3.00<br>1.00<br>2.00<br>~~1/5~~1/2<br>0.50 | 3.00<br>1.33<br>2.00<br>2/3<br>0.67 | 3.00<br>2.00<br>4.00<br>1/2<br>0.5 | 3.00<br>2.67<br>4.00<br>2/3<br>0.67 | 3.00<br>3.33<br>4.00<br>5/6<br>0.83 | | | | | |
| *SCH*<br>*MPR*<br>*MOD*<br>Rate<br>Rate | | | | | | | | | 13.00<br>3.08<br>~~3~~4.00<br>10/13<br>0.77 | | | |
| *SCH*<br>*MPR*<br>*MOD*<br>Rate<br>Rate | | | 18.00<br>0.17<br>2.00<br>1/12<br>0.08 | | 18.0<br>0.33<br>2.00<br>1/6<br>0.17 | | | | | 18.00<br>3.33<br>4.00<br>5/6<br>0.83 | ~~18.00~~<br>~~3.33~~<br>~~4.00~~<br>~~5/6~~<br>~~0.83~~ | |
| *SCH*<br>*MPR*<br>*MOD*<br>Rate<br>Rate | | | | | | | 20.00<br>0.50<br>2.00<br>1/4<br>0.25 | 20.00<br>~~0~~1.~~5~~00<br>2.00<br>1/~~4~~2<br>0.~~2~~50 | 20.00<br>~~1~~2.00<br>~~2~~4.00<br>1/2<br>0.50 | 20.00<br>~~2~~3.00<br>4.00<br>~~1~~3/~~2~~4<br>0.75~~0~~ | ~~20.0~~<br>~~3.00~~<br>~~4.00~~<br>~~3/4~~<br>~~0.75~~ | |
| *SCH*<br>*MPR*<br>*MOD*<br>Rate<br>Rate | | | | | | | 30.00<br>0.33<br>2.00<br>1/6<br>0.17 | 30.00<br>0.67<br>2.00<br>1/3<br>0.33 | 30.00<br>1.33<br>2.00<br>2/3<br>0.67 | 30.00<br>2.00<br>4.00<br>1/2<br>0.50 | 30.00<br>2.67<br>4.00<br>2/3<br>0.67 | 30.0<br>3.33<br>~~3~~4.00<br>5/6<br>0.83 |

***Insert the following note below Table 333:***

NOTE—In Table 333, the first rate entry is the theoretical rate and the second rate entry is an approximated rate.

***Insert new subclause 8.4.9.2.5:***

### 8.4.9.2.5 Low Density Parity Check code (optional)

***Insert new subclause 8.4.9.2.5.1:***

#### 8.4.9.2.5.1 Code description

The LDPC code is based on a set of one or more fundamental LDPC codes. Each of the fundamental codes is a systematic linear block code. Using the described methods in 8.4.9.2.5.2 Code Rate and Block Size Adjustment, the fundamental codes can accommodate various code rates and packet sizes.

Each LDPC code in the set of LDPC codes is defined by a matrix **H** of size $m$-by-$n$, where $n$ is the length of the code and $m$ is the number of parity check bits in the code. The number of systematic bits is $k = n - m$.

The matrix **H** is defined as:

$$\mathbf{H} = \begin{bmatrix} \mathbf{P}_{0,0} & \mathbf{P}_{0,1} & \mathbf{P}_{0,2} & \cdots & \mathbf{P}_{0,n_b-2} & \mathbf{P}_{0,n_b-1} \\ \mathbf{P}_{1,0} & \mathbf{P}_{1,1} & \mathbf{P}_{1,2} & \cdots & \mathbf{P}_{1,n_b-2} & \mathbf{P}_{1,n_b-1} \\ \mathbf{P}_{2,0} & \mathbf{P}_{2,1} & \mathbf{P}_{2,2} & \cdots & \mathbf{P}_{2,n_b-2} & \mathbf{P}_{0,n_b-1} \\ \cdots & \cdots & \cdots & \cdots & \cdots & \cdots \\ \mathbf{P}_{m_b-1,0} & \mathbf{P}_{m_b-1,1} & \mathbf{P}_{m_b-1,2} & \cdots & \mathbf{P}_{m_b-1,n_b-2} & \mathbf{P}_{m_b-1,n_b-1} \end{bmatrix} = \mathbf{P}^{H_b}$$

where $\mathbf{P}_{i,j}$ is one of a set of $z$-by-$z$ permutation matrices or a $z$-by-$z$ zero matrix. The matrix **H** is expanded from a binary base matrix $\mathbf{H}_\mathrm{b}$ of size $m_b$-by-$n_b$, where $n = z \cdot n_b$ and $m = z \cdot m_b$ ,with $z$ an integer Š 1. The base matrix is expanded by replacing each 1 in the base matrix with a $z$-by-$z$ permutation matrix, and each 0 with a $z$-by-$z$ zero matrix. The base matrix size $n_b$ is an integer equal to 24.

The permutations used are circular right shifts, and the set of permutation matrices contains the $z \times z$ identity matrix and circular right shifted versions of the identity matrix. Because each permutation matrix is specified by a single circular right shift, the binary base matrix information and permutation replacement information can be combined into a single compact model matrix $\mathbf{H}_\mathrm{bm}$. The model matrix $\mathbf{H}_\mathrm{bm}$ is the same size as the binary base matrix $\mathbf{H}_\mathrm{b}$, with each binary entry$(i,j)$ of the base matrix $\mathbf{H}_\mathrm{b}$ replaced to create the model matrix $\mathbf{H}_\mathrm{bm}$. Each 0 in $\mathbf{H}_\mathrm{b}$ is replaced by a blank or negative value (e.g., by –1) to denote a $z \times z$ all-zero matrix, and each 1 in $\mathbf{H}_\mathrm{b}$ is replaced by a circular shift size $p(i,j) \geq 0$. The model matrix $\mathbf{H}_\mathrm{bm}$ can then be directly expanded to **H**.

$\mathbf{H}_\mathrm{b}$ is partitioned into two sections, where $\mathbf{H}_\mathrm{b1}$ corresponds to the systematic bits and $\mathbf{H}_\mathrm{b2}$ corresponds to the parity-check bits, such that $H_b = \left\lfloor (H_{b1})_{m_b \times k_b} \middle| (H_{b2})_{m_b \times m_b} \right\rfloor$.

Section $\mathbf{H}_\mathrm{b2}$ is further partitioned into two sections, where vector $\mathbf{h}_\mathrm{b}$ has odd weight, and $\mathbf{H}'_\mathrm{b2}$ has a dual-diagonal structure with matrix elements at row $i$, column $j$ equal to 1 for $i=j$, 1 for $i=j+1$, and 0 elsewhere:

The base matrix has $h_b(0)=1$, $h_b(m_b\text{-}1)=1$, and a third value $h_b(j)$, $0<j<(m_b\text{-}1)$ equal to 1. The base matrix structure avoids having multiple weight –1 columns in the expanded matrix.

$$H_{b2} = \left[ h_b \,\middle|\, H'_{b2} \right]$$

$$= \left[ \begin{array}{c|cccccc} h_b(0) & 1 & & & & & \\ h_b(1) & 1 & 1 & & 0 & & \\ . & & 1 & \ddots & & & \\ . & & & \ddots & 1 & & \\ . & & 0 & & 1 & 1 & \\ h_b(m_b-1) & & & & & 1 & \end{array} \right]$$

In particular, the non-zero sub-matrices are circularly right shifted by a particular circular shift value. Each 1 in $\mathbf{H'}_{b2}$ is assigned a shift size of 0, and is replaced by a *z*x*z* identity matrix when expanding to **H**. The two located at the top and the bottom of $\mathbf{h}_b$ are assigned equal shift sizes, and the third 1 in the middle of $\mathbf{h}_b$ is given an unpaired shift size.

A base model matrix is defined for the largest code length ($n$ = 2304) of each code rate. The set of shifts $\{p(i,j)\}$ in the base model matrix are used to determine the shift sizes for all other code lengths of the same code rate. Each base model matrix has $n_b = 24$ columns, and the expansion factor $z_f$ is equal to $n/24$ for code length $n$. Here f is the index of the code lengths for a given code rate, $f = 0, 1, 2, \ldots 18$. For code length $n = 2304$ the expansion factor is designated $z_0 = 96$.

For code rates 1/2, 3/4 A and B code, 2/3 B code, and 5/6 code, the shift sizes $\{p(f, i, j)\}$ for a code size corresponding to expansion factor $z_f$ are derived from $\{p(i,j)\}$ by scaling $p(i,j)$ proportionally,

$$p(f, i, j) = \begin{cases} p(i,j), p(i,j) \le 0 \\ \left\lfloor \dfrac{p(i,j)z_f}{z_0} \right\rfloor, p(i,j) > 0 \end{cases} \qquad (129a)$$

where $\lfloor x \rfloor$ denotes the flooring function that gives the nearest integer towards $-\infty$.

For code rate 2/3 A code, the shift sizes $\{p(f, i, j)\}$ for a code size corresponding to expansion factor $z_f$ are derived from $\{p(i,j)\}$ by using a modulo function.

$$p(f, i, j) = \begin{cases} p(i,j), p(i,j) \le 0 \\ mod(p(i,j), z_f), p(i,j) > 0 \end{cases}$$

Rate 1/2:

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -1 | 94 | 73 | -1 | -1 | -1 | -1 | -1 | 55 | 83 | -1 | -1 | 7 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| -1 | 27 | -1 | -1 | -1 | 22 | 79 | 9 | -1 | -1 | -1 | 12 | -1 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| -1 | -1 | -1 | 24 | 22 | 81 | -1 | 33 | -1 | -1 | -1 | 0 | -1 | -1 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| 61 | -1 | 47 | -1 | -1 | -1 | -1 | -1 | 65 | 25 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 | -1 |
| -1 | -1 | 39 | -1 | -1 | -1 | 84 | -1 | -1 | 41 | 72 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | -1 | -1 | -1 | -1 | -1 | -1 |
| -1 | -1 | -1 | -1 | 46 | 40 | -1 | 82 | -1 | -1 | -1 | 79 | 0 | -1 | -1 | -1 | -1 | 0 | 0 | -1 | -1 | -1 | -1 | -1 |
| -1 | -1 | 95 | 53 | -1 | -1 | -1 | -1 | -1 | 14 | 18 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | -1 | -1 | -1 | -1 |
| -1 | 11 | 73 | -1 | -1 | -1 | 2 | -1 | -1 | 47 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | -1 | -1 | -1 |
| 12 | -1 | -1 | -1 | 83 | 24 | -1 | 43 | -1 | -1 | -1 | 51 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | -1 | -1 |
| -1 | -1 | -1 | -1 | -1 | 94 | -1 | 59 | -1 | -1 | 70 | 72 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | -1 |
| -1 | -1 | 7 | 65 | -1 | -1 | -1 | -1 | 39 | 49 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 |
| 43 | -1 | -1 | -1 | -1 | 66 | -1 | 41 | -1 | -1 | -1 | 26 | 7 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 |

Note that the R=1/2 code is designed such that after a model matrix row permutation of [0, 2, 4, 11, 6, 8, 10, 1, 3, 5, 7, 9] consecutive rows do not intersect, which may be used to increase decoding throughput in some layered decoding architectures.

Rate 2/3 A code:

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | 0 | -1 | -1 | 2 | 0 | -1 | 3 | 7 | -1 | 1 | 1 | -1 | -1 | -1 | -1 | 1 | 0 | -1 | -1 | -1 | -1 | -1 | -1 |
| -1 | -1 | 1 | -1 | 36 | -1 | -1 | 34 | 10 | -1 | -1 | 18 | 2 | -1 | 3 | 0 | -1 | 0 | 0 | -1 | -1 | -1 | -1 | -1 |
| -1 | -1 | 12 | 2 | -1 | 15 | -1 | 40 | -1 | 3 | -1 | 15 | -1 | 2 | 13 | -1 | -1 | -1 | 0 | 0 | -1 | -1 | -1 | -1 |
| -1 | -1 | 19 | 24 | -1 | 3 | 0 | -1 | 6 | -1 | 17 | -1 | -1 | -1 | 8 | 39 | -1 | -1 | -1 | 0 | 0 | -1 | -1 | -1 |
| 20 | -1 | 6 | -1 | -1 | 10 | 29 | -1 | -1 | 28 | -1 | 14 | -1 | 38 | -1 | -1 | 0 | -1 | -1 | -1 | 0 | 0 | -1 | -1 |
| -1 | -1 | 10 | -1 | 28 | 20 | -1 | -1 | 8 | -1 | 36 | -1 | 9 | -1 | 21 | 45 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | -1 |
| 35 | 25 | -1 | 37 | -1 | 21 | -1 | -1 | 5 | -1 | -1 | 0 | -1 | 4 | 20 | -1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 |
| -1 | 6 | 6 | -1 | -1 | -1 | 4 | -1 | 14 | 30 | -1 | 3 | 36 | -1 | 14 | -1 | 1 | -1 | -1 | -1 | -1 | -1 | -1 | 0 |

Rate 2/3 B code:

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | -1 | 19 | -1 | 47 | -1 | 48 | -1 | 36 | -1 | 82 | -1 | 47 | -1 | 15 | -1 | 95 | 0 | -1 | -1 | -1 | -1 | -1 | -1 |
| -1 | 69 | -1 | 88 | -1 | 33 | -1 | 3 | -1 | 16 | -1 | 37 | -1 | 40 | -1 | 48 | -1 | 0 | 0 | -1 | -1 | -1 | -1 | -1 |
| 10 | -1 | 86 | -1 | 62 | -1 | 28 | -1 | 85 | -1 | 16 | -1 | 34 | -1 | 73 | -1 | -1 | -1 | 0 | 0 | -1 | -1 | -1 | -1 |
| -1 | 28 | -1 | 32 | -1 | 81 | -1 | 27 | -1 | 88 | -1 | 5 | -1 | 56 | -1 | 37 | -1 | -1 | -1 | 0 | 0 | -1 | -1 | -1 |
| 23 | -1 | 29 | -1 | 15 | -1 | 30 | -1 | 66 | -1 | 24 | -1 | 50 | -1 | 62 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | -1 | -1 |
| -1 | 30 | -1 | 65 | -1 | 54 | -1 | 14 | -1 | 0 | -1 | 30 | -1 | 74 | -1 | 0 | -1 | -1 | -1 | -1 | -1 | 0 | 0 | -1 |
| 32 | -1 | 0 | -1 | 15 | -1 | 56 | -1 | 85 | -1 | 5 | -1 | 6 | -1 | 52 | -1 | 0 | -1 | -1 | -1 | -1 | -1 | 0 | 0 |
| -1 | 0 | -1 | 47 | -1 | 13 | -1 | 61 | -1 | 84 | -1 | 55 | -1 | 78 | -1 | 41 | 95 | -1 | -1 | -1 | -1 | -1 | -1 | 0 |

Note that the R=2/3 B code is designed such that after a model matrix row permutation of [0, 3, 6, 1, 4, 7, 2, 5] consecutive rows do not intersect, which may be used to increase decoding throughput in some layered decoding architectures.

Rate 3/4 A code:

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 6 | 38 | 3 | 93 | -1 | -1 | -1 | 30 | 70 | -1 | 86 | -1 | 37 | 38 | 4 | 11 | -1 | 46 | 48 | 0 | -1 | -1 | -1 | -1 |
| 62 | 94 | 19 | 84 | -1 | 92 | 78 | -1 | 15 | -1 | -1 | 92 | -1 | 45 | 24 | 32 | 30 | -1 | -1 | 0 | 0 | -1 | -1 | -1 |
| 71 | -1 | 55 | -1 | 12 | 66 | 45 | 79 | -1 | 78 | -1 | -1 | 10 | -1 | 22 | 55 | 70 | 82 | -1 | -1 | 0 | 0 | -1 | -1 |
| 38 | 61 | -1 | 66 | 9 | 73 | 47 | 64 | -1 | 39 | 61 | 43 | -1 | -1 | -1 | -1 | 95 | 32 | 0 | -1 | -1 | 0 | 0 | -1 |
| -1 | -1 | -1 | -1 | 32 | 52 | 55 | 80 | 95 | 22 | 6 | 51 | 24 | 90 | 44 | 20 | -1 | -1 | -1 | -1 | -1 | -1 | 0 | 0 |
| -1 | 63 | 31 | 88 | 20 | -1 | -1 | -1 | 6 | 40 | 56 | 16 | 71 | 53 | -1 | -1 | 27 | 26 | 48 | -1 | -1 | -1 | -1 | 0 |

Rate 3/4 B code:

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| -1 | 81 | -1 | 28 | -1 | -1 | 14 | 25 | 17 | -1 | -1 | 85 | 29 | 52 | 78 | 95 | 22 | 92 | 0 | 0 | -1 | -1 | -1 | -1 |
| 42 | -1 | 14 | 68 | 32 | -1 | -1 | -1 | -1 | 70 | 43 | 11 | 36 | 40 | 33 | 57 | 38 | 24 | -1 | 0 | 0 | -1 | -1 | -1 |
| -1 | -1 | 20 | -1 | -1 | 63 | 39 | -1 | 70 | 67 | -1 | 38 | 4 | 72 | 47 | 29 | 60 | 5 | 80 | -1 | 0 | 0 | -1 | -1 |
| 64 | 2 | -1 | -1 | 63 | -1 | -1 | 3 | 51 | -1 | 81 | 15 | 94 | 9 | 85 | 36 | 14 | 19 | -1 | -1 | -1 | 0 | 0 | -1 |
| -1 | 53 | 60 | 80 | -1 | 26 | 75 | -1 | -1 | -1 | -1 | 86 | 77 | 1 | 3 | 72 | 60 | 25 | -1 | -1 | -1 | -1 | 0 | 0 |
| 77 | -1 | -1 | -1 | 15 | 28 | -1 | 35 | -1 | 72 | 30 | 68 | 85 | 84 | 26 | 64 | 11 | 89 | 0 | -1 | -1 | -1 | -1 | 0 |

Rate 5/6 code:

| | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 25 | 55 | -1 | 47 | 4 | -1 | 91 | 84 | 8 | 86 | 52 | 82 | 33 | 5 | 0 | 36 | 20 | 4 | 77 | 80 | 0 | -1 | -1 |
| -1 | 6 | -1 | 36 | 40 | 47 | 12 | 79 | 47 | -1 | 41 | 21 | 12 | 71 | 14 | 72 | 0 | 44 | 49 | 0 | 0 | 0 | 0 | -1 |
| 51 | 81 | 83 | 4 | 67 | -1 | 21 | -1 | 31 | 24 | 91 | 61 | 81 | 9 | 86 | 78 | 60 | 88 | 67 | 15 | -1 | -1 | 0 | 0 |
| 50 | -1 | 50 | 15 | -1 | 36 | 13 | 10 | 11 | 20 | 53 | 90 | 29 | 92 | 57 | 30 | 84 | 92 | 11 | 66 | 80 | -1 | -1 | 0 |

***Insert new subclause 8.4.9.2.5.2:***

### 8.4.9.2.5.2 Code rate and block size adjustment

The LDPC code flexibly supports different block sizes for each code rate through the use of an expansion factor. Each base model matrix has $n_b$=24 columns, and the expansion factor (*z* factor) is equal to *n*/24 for code length *n*. In each case, the number of information bits is equal to the code rate times the coded length *n*.

**Table 333a—LDPC block sizes and code rates**

| ***n*** **(bits)** | ***n*** **(bytes)** | **z factor** | ***k*** **(bytes)** | | | | **Number of subchannels** | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | **R = 1/2** | **R = 2/3** | **R = 3/4** | **R = 5/6** | **QPSK** | **16QAM** | **64QAM** |
| 576 | 72 | 24 | 36 | 48 | 54 | 60 | 6 | 3 | 2 |
| 672 | 84 | 28 | 42 | 56 | 63 | 70 | 7 | — | — |
| 768 | 96 | 32 | 48 | 64 | 72 | 80 | 8 | 4 | — |
| 864 | 108 | 36 | 54 | 72 | 81 | 90 | 9 | — | 3 |
| 960 | 120 | 40 | 60 | 80 | 90 | 100 | 10 | 5 | — |
| 1056 | 132 | 44 | 66 | 88 | 99 | 110 | 11 | — | — |
| 1152 | 144 | 48 | 72 | 96 | 108 | 120 | 12 | 6 | 4 |
| 1248 | 156 | 52 | 78 | 104 | 117 | 130 | 13 | — | — |
| 1344 | 168 | 56 | 84 | 112 | 126 | 140 | 14 | 7 | — |
| 1440 | 180 | 60 | 90 | 120 | 135 | 150 | 15 | — | 5 |
| 1536 | 192 | 64 | 96 | 128 | 144 | 160 | 16 | 8 | — |
| 1632 | 204 | 68 | 102 | 136 | 153 | 170 | 17 | — | — |
| 1728 | 216 | 72 | 108 | 144 | 162 | 180 | 18 | 9 | 6 |
| 1824 | 228 | 76 | 114 | 152 | 171 | 190 | 19 | — | — |
| 1920 | 240 | 80 | 120 | 160 | 180 | 200 | 20 | 10 | — |
| 2016 | 252 | 84 | 126 | 168 | 189 | 210 | 21 | — | 7 |

**Table 333a—LDPC block sizes and code rates *(continued)***

| *n* (bits) | *n* (bytes) | z factor | *k* (bytes) | | | | Number of subchannels | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | R = 1/2 | R = 2/3 | R = 3/4 | R = 5/6 | QPSK | 16QAM | 64QAM |
| 2112 | 264 | 88 | 132 | 176 | 198 | 220 | 22 | 11 | — |
| 2208 | 276 | 92 | 138 | 184 | 207 | 230 | 23 | — | — |
| 2304 | 288 | 96 | 144 | 192 | 216 | 240 | 24 | 12 | 8 |

***Insert new subclause 8.4.9.2.5.3:***

### 8.4.9.2.5.3 Packet encoding

The encoding block size *k* shall depend on the number of subchannels allocated and the modulation specified for the current transmission. Concatenation of a number of subchannels shall be performed in order to make larger blocks of coding where it is possible, with the limitation of not passing the largest block under the same coding rate (the block defined by the 64-QAM modulation). Table 333b specifies the concatenation of subchannels for different allocations and modulations. The concatenation rule follows the subchannel concatenation rule for CC (see Table 317) except that for LDPC the concatenation does not depend on the code rate.

For any modulation and FEC rate, given an allocation of $N_{SCH}$ subchannels, we define the following parameters:

$j_i$: parameter dependent on the modulation and number of antennas in case of spatial multiplexing
$N_{SCH}$: number of allocated subchannels
$F$: floor($N_{SCH}/j_i$)
$M$: $N_{SCH} \bmod j_i$

The subchannel concatenation rule for CC in Table 317 is applied, noting that in Table 317 the parameter *n* is equal to $N_{SCH}$, the parameter *k* is equal to *F*, and the parameter *m* is equal to *M*. The parameter $j_i$ for LDPC is determined as shown in Table 333b:

**Table 333b—Parameter '*j*' for LDPC**

| $j_1$ | $j_2$ | $j_3$ | $j_4$ | Modulation |
|---|---|---|---|---|
| 24 | 12 | 8 | 6 | QPSK |
| 12 | 6 | 4 | 3 | 16-QAM |
| 8 | 4 | 2 | 2 | 64-QAM |

Control information and packets that result in a codeword size *n* of less than 576 bits are encoded using convolutional coding (CC) with appropriate code rates and modulation orders, as described in 8.4.9.2.1.

### 8.4.9.3 Interleaving

***Change the first sentence of the first paragraph as indicated:***

All encoded data bits shall be interleaved by a block interleaver with a block size corresponding to the number of coded bits per the encoded block size $N_{\mathrm{cbps}}$ ~~as set in 8.4.9.2~~.

***Insert new subclause 8.4.9.3.1:***

#### 8.4.9.3.1 Optional interleaver for CC

For the CC optional interleaver, the interleaver structure is as defined in 8.4.9.3. The value of $d$ in Equation (126) through Equation (129) shall be set to $16 \times n$ for the DL and $16 \times n$ for the UL, where $n$ is the number of allocated slots per FEC block.

### 8.4.9.4 Modulation

***Change the title of subclause 8.4.9.4.1 as indicated:***

#### 8.4.9.4.1 ~~Permutation definition~~ Subcarrier randomization

***Replace Figure 262 with the following figure:***

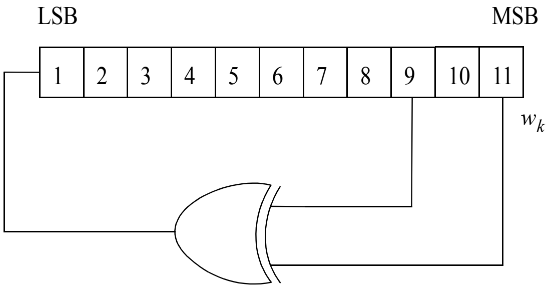


**Figure 262—PRBS generator for pilot modulation**

***Change the second paragraph below Figure 262 as indicated:***

The initialization vector of the PRBS generator for both uplink and downlink shall be designated b10..b0, such that:

b~~1~~0..b~~6~~4 = Five least significant bits of IDcell as indicated by the frame preamble in the first downlink zone and in the downlink AAS zone with Diversity_Map support, DL_PermBase following STC_DL_Zone_IE() and 5 LSB of DL_PermBase following AAS_DL_IE without Diversity_Map support~~, except for zones marked by “Use all SC indicator = 1,” where these bits shall be set to 1,~~ in the downlink. Five least significant bits of ~~UL~~ IDcell (as determined by the preamble) in the uplink. For downlink and uplink, b0 is MSB and b4 is LSB, respectively.

b5..b~~4~~6 = Set to the segment number + 1 as indicated by the frame preamble in the first downlink zone and in the downlink AAS zone with Diversity_Map support, PRBS_ID as indicated by the STC_DL_Zone_IE or AAS_DL_IE without Diversity_Map support in other downlink zones.~~,~~

~~except for zones marked by “Use all SC indicator = 1,” where these bits shall be set to 1~~0b11 in the uplink. For downlink and uplink, b5 is MSB and b6 is LSB, respectively.

b~~3~~7..b10 =0b1111 (all ones) in the downlink and four least significant bits of the Frame Number in the uplink. ~~Four least significant bits of symbol offset from the first data symbol in the frame (i.e., the symbol in the frame in which the DL-MAP starts)~~ For downlink and uplink, b7 is MSB and b10 is LSB, respectively.

***Change the last paragraph as indicated:***

For example, should the initialization vector of the PRBS generator be b10..b0 = 10101010101, the initializations result in the sequence $w_k$ = 10101010101000000000.... in the uplink. ~~The PRBS shall be initialized so that its first output bit coincides with the first usable subcarrier (as defined in Table 313)~~ The PRBS generator shall be clocked *n* times, *n* = Symbol_Offset mod 32, before the generated output is applied to the subcarriers, where symbol offset is counted from the first symbol in each zone as zero in the downlink except downlink AAS zone with Diversity_Map support where the symbol offset is counted from the first symbol of the first downlink zone as zero and from Allocation start time in the uplink (i.e., the first symbol in the uplink subframe is indexed 0). As a result, the PRBS shall be used such that its *n*-th output bit will coincide with the first usable subcarrier as defined for the zone in which the symbol resides. The output bit shall be counted from zero. Subcarriers belonging to UL allocations with UIUC=12 or UIUC=13 shall not be randomized. A new value shall be generated by the PRBS generator for every subcarrier up to the highest numbered usable subcarrier, in order of physical subcarriers, including the DC subcarrier and usable subcarriers that are not allocated.

***Insert the following paragraph at the end of the subclause:***

Consider DL PUSC. Let *w*0, *w*1, *w*2, … be the bits generated after loading the correct initialization vector. The subcarriers of the first symbol in the zone (with symbol offset of zero) shall use the bits *w*0, *w*1, *w*2, …., *w*1680. For subcarriers of the second symbol (with symbol offset of 1) shall use the bits *w*1, *w*2, *w*3, …, *w*1681.

### 8.4.9.4.2 Data modulation

***Change the first sentence of the first paragraph as indicated:***

After ~~bit interleaving~~ the repetition block, the data bits are entered serially to the constellation mapper. Gray-mapped QPSK and 16-QAM (as shown in Figure 263) shall be supported, whereas the support of 64-QAM is optional.

***Change the last paragraph as indicated:***

Each *M* interleaved bits (*M*=2,4,6) shall be mapped to the constellation bits *b*(*M*-1)-*b*0 in MSB first order (i.e., the first bit shall be mapped to the higher index bit in the constellation), in addition, the *M* bits shall be ordered MSB first.

The constellation-mapped data shall be subsequently modulated onto the allocated data subcarriers. Before mapping the data to the physical subcarriers (i.e,. after applying the subcarrier permutation), ~~and~~ each subcarrier shall be multiplied by the factor $2*(1/2 - w_k)$ according to the subcarrier physical index, *k*.

The operation shall be also applied for the subcarriers for the FAST_FEEDBACK and ACK channels except the ranging.

In the downlink, data subcarriers that belong to slots that are not allocated in the DL-MAP shall not be transmitted (zero energy). Data subcarriers which are part of a gap allocation (DIUC=13) shall be modulated at the BS discretion. In the downlink, such subcarriers that belong to the allocated slots for a burst but are not modulated shall not be transmitted (zero energy).

*Change the following text in 8.4.9.4.3 as indicated:*

### 8.4.9.4.3 Pilot modulation

*Change text in 8.4.9.4.3 as indicated:*

For the mandatory tile structure in the uplink, and for the TUSC1/TUSC2 structures in the downlink, pilot subcarriers shall be inserted into each data burst in order to constitute the symbol and they shall be modulated according to their subcarrier location within the OFDMA symbol.

In ~~the downlink and for the optional uplink tile structure~~ all permutations except uplink PUSC and downlink TUSC1, each pilot shall be transmitted with a boosting of 2.5 dB over the average non-boosted power of each data tone. The Pilot subcarriers shall be modulated according to Equation (135).

*Replace Equation (135) with the following:*

$$\begin{aligned} Re\{c_k\} &= \frac{8}{3}\left(\frac{1}{2} - w_k\right) \cdot p_k \\ Im\{c_k\} &= 0 \end{aligned} \tag{135}$$

where

$p_k$ is the pilot's polarity (as described in 8.4.6.3.3) for SDMA allocations in AMC AAS zone, and $p = 1$ otherwise.

*Change the text in the last paragraph as indicated:*

In the downlink, for PUSC, FUSC, AMC and optional FUSC permutations, all pilots (of the segment, in case of PUSC) shall be modulated, whether or not all the subchannels are allocated in the DL-MAP. For AMC and PUSC-ASCA permutations in AAS zone or in a zone using 'Dedicated pilots', the BS ~~is not required to~~ shall not modulate the pilots that belong ~~to~~in bins that are not allocated in the DL-MAP, or are allocated as gaps (DIUC=13).

*Insert the following text at the end of the subclause:*

In STC mode with DL PUSC or UL PUSC permutations, the power of pilot subcarriers shall be further scaled so that the total power transmitted by each antenna, is equal to the total power transmitted in non-STC mode, ignoring data boosting.

In the downlink, for PUSC, FUSC, AMC and optional FUSC permutations, all pilots (of the segment, in case of PUSC) shall be modulated, whether or not all the subchannels are allocated in the DL-MAP. For AMC permutation in AAS zone, the BS is not required to modulate the pilots that belong to bins that are not allocated in the DL-MAP, or are allocated as gaps (UIUC=13).

*Change the title of 8.4.9.4.3.1 as indicated:*

#### 8.4.9.4.3.1 Preambl~~es/midambles~~ pilot modulation

***Insert new subclause 8.4.9.5:***

### 8.4.9.5 Repetition

Repetition coding can be used to further increase signal margin over the modulation and FEC mechanisms. In the case of repetition coding, $R = 2$, 4, or 6, the number of allocated slots ($N_S$) shall be a whole multiple of the repetition factor $R$ for uplink. For the downlink, the number of the allocated slots ($N_S$) shall be in the range of $[R \times K, R \times K + (R - 1)]$, where $K$ is the number of the required slots before applying the repetition scheme. For example, when the required number of slots before the repetition is $10( = K)$ and the repetition of $R = 6$ shall be applied for the burst transmission, then the number of the allocated slots ($N_S$) for the burst can be from 60 slots to 65 slots.

The binary data that fits into a region that is repetition coded is reduced by a factor $R$ compared to a non-repeated region of the $(\lfloor N_S/R \rfloor \times R)$ slots with the same size and FEC code type. After FEC and bit-interleaving, the data is segmented into slots, and each group of bits designated to fit in a slot will be repeated $R$ times to form $R$ contiguous slots following the normal slot ordering that is used for data mapping. The actual constellation data can be different because of the subcarrier randomization as defined by 8.4.9.4.1. This repetition scheme applies only to QPSK modulation; it can be applied in all coding schemes except HARQ with CTC defined in 8.4.9.2.3.5.

***Insert new subclause 8.4.9.6:***

### 8.4.9.6 Zone boosting

When the usage of the subchannels in the first DL PUSC zone is limited by the “Used subchannel bitmap” in FCH, all subcarriers including pilot subcarriers in the corresponding zones shall be boosted. The amount of subcarrier boosting is the ratio of the number of the useful subcarriers excluding DC subcarrier and the number of the allowed subcarriers. The “allowed subcarriers” refers to the data and pilot subcarriers that are allowed to be used in the zone by the “Used subchannel bitmap” in FCH. When zone boosting is applied, the amount of additional subchannel boosting, as specified by the boosting field in the DL MAP_IE that can be applied, shall not exceed 9 dB minus the amount of zone boosting.

***Insert a new subclause 8.4.9.7:***

### 8.4.9.7 Multiple HARQ (optional)

Supported Multiple HARQ modes may be enabled for any of the existing FEC modes. A change in the HARQ mode is signaled using the “HARQ Compact_DL-MAP IE format for Switch HARQ Mode” (see 6.3.2.3.43.6.7). The definitions of the HARQ modes are defined in Table 333c.

**Table 333c—HARQ Modes definition**

| HARQ Mode | Definition |
|---|---|
| 0 | CTC Incremental Redundancy |
| 1 | Generic Chase |
| 2 | Convolutional Coding (CC) Incremental Redundancy |
| 3..15 | *Reserved* |

***Insert a new subclause 8.4.9.7.1:***

### 8.4.9.7.1 Generic Chase HARQ

When Chase Combining HARQ is enabled for a particular MS, the HARQ_MAP will be used to signal the allocation and the HARQ Control IE will use the "Generic Chase" allocation format. The encoding of the companded subchannel field is defined in Table 333d. Concatenation rules for each respective coding mode are applied as defined for non-HARQ transmissions.

**Table 333d—Companded subchannels**

| Companded subchannels | Assigned subchannels | Companded subchannels | Assigned subchannels |
|---|---|---|---|
| 0 | 1 | 16 | 40 |
| 1 | 2 | 17 | 48 |
| 2 | 3 | 18 | 56 |
| 3 | 4 | 19 | 64 |
| 4 | 5 | 20 | 80 |
| 5 | 6 | 21 | 96 |
| 6 | 7 | 22 | 112 |
| 7 | 8 | 23 | 128 |
| 8 | 10 | 24 | 160 |
| 9 | 12 | 25 | 192 |
| 10 | 14 | 26 | 224 |
| 11 | 16 | 27 | 256 |
| 12 | 20 | 28 | 320 |
| 13 | 24 | 29 | 384 |
| 14 | 28 | 30 | 448 |
| 15 | 32 | 31 | 512 |

When HARQ is applied to a packet, error detection is provided on the HARQ packet through a Cyclic Redundancy Check (CRC).

The size of the CRC is 16 bits. CRC 16-CCITT, as defined in ITU-T Recommendation X.25, shall be included at the end of the HARQ packet and after the padding bits.

***Insert a new subclause 8.4.9.7.2:***

### 8.4.9.7.2 CC Incremental Redundancy HARQ

When Convolutional Coding (CC) Incremental Redundancy (IR) is enabled for a particular SS, the HARQ_MAP will be used to signal the allocation and the HARQ Control IE will use the "CC IR" allocation format. The encoding of the companded subchannel field is identical to Generic Chase HARQ and is defined in Table 332. Concatenation rules for each respective coding mode are applied as defined for non-HARQ transmissions.

### 8.4.10 Control mechanisms

#### 8.4.10.3 Power ~~C~~control

***Change the third paragraph as indicated:***

To maintain at the BS a power density consistent with the modulation and FEC rate used by each SS, the BS may change the SS TX power through power correction messages, as well as the SS assigned modulation and FEC rate. There are, however, situations where the SS should automatically update its TX power, without being explicitly instructed by the BS. This happens when the SS transmits in region marked by UIUC = 0, UIUC = 12, or UIUC = 14. In all these situations, the SS shall use a temporary TX power value set according to Equation (138) (in dB),

$$P_{new} = P_{last} + (C/N_{new} - C/N_{last}) - (\log10(R_{new}) - \log10(R_{last})) + Offset \qquad (138)$$

where

| | |
|---|---|
| $P_{new}$ | is the temporary TX Power, |
| $P_{last}$ | is the last used TX Power, |
| $C/N_{new}$ | is the normalized C/N of new modulation/FEC rate instructed by the UIUC, |
| $C/N_{last}$ | is the normalized C/N of the last used modulation/FEC rate, |
| $R_{new}$ | is the number of repetitions for the new modulation/FEC rate instructed by the UIUC, |
| $R_{last}$ | is the number of repetitions on the last used modulation/FEC rate, |
| $Offset$ | is an accumulation of power correction terms sent by the BS since the last transmission. |

In all other situations, the SS shall use TX power value set according to Equation (138a) (in dB),

$$P_{new} = P_{last} + Offset \qquad (138a)$$

The default normalized C/N values per modulation are given by Table 334. These values may be overridden by the BS by using a dedicated UCD message TLV.

***Change Table 334 as indicated:***

**Table 334—Normalized C/N per modulation**

| Modulation/ FEC rate | Normalized C/N |
|---|---|
| ACK region | –3.0 |
| ~~Fast_feedback IE~~FAST_FEEDBACK | 0 |
| CDMA code | 3 |
| QPSK 1/3 | 0.5 |
| QPSK 1/2 | 6 |
| QPSK 2/3 | 7.5 |
| QPSK 3/4 | 9 |

**Table 334—Normalized C/N per modulation *(continued)***

| Modulation/ FEC rate | Normalized C/N |
|---|---|
| Sounding transmission | 9 |
| 16-QAM 1/2 | 12 |
| 16-QAM 2/3 | 14.5 |
| 16-QAM 3/4 | 15 |
| 16-QAM 5/6 | 17.5 |
| 64-QAM 1/2 | 18 |
| 64-QAM 2/3 | 20 |
| 64-QAM 3/4 | 21 |
| 64-QAM 5/6 | 23 |

***Delete the first paragraph below Table 334.***

~~To maintain at the BS a power density consistent with the modulation used by each SS, the BS may change the SS TX power as well as the SS assigned modulation and FEC rate. There are, however, situations where the SS should automatically update its TX power, without being explicitly instructed by the BS. This happens when the SS transmits in region marked by UIUC = 0, UIUC = 12, or UIUC = 14. In all these situations, the SS shall use a temporary TX power value set according to the formula Temporary_TX_Power = Last_TX_Power_Normalized_C/N_of_last_modualtion + Normalized_C/N_of_QPSK_1/2_modulation.~~

***Change the second paragraph below Table 334 as indicated:***

The SS shall report the maximum available power and the normalized transmitted power. These parameters may be used by the base station for optimal assignment of coding schemes and modulations and also for optimal allocation of subchannels. The algorithm is vendor-specific. ~~These parameters are reported in the REG-RSP message.~~ The maximum available power may be reported in SBC-REQ. The current transmitted power shall also reported in the R~~NG~~EP-RSP message if the relevant flag in the REP-REQ message has been set.

***Insert a new subclause 8.4.10.3.1***

### 8.4.10.3.1 Closed loop power control

***Insert the following text before Table 334:***

For the periodic ranging, once MS sends periodic ranging code and fails to receive RNG-RSP, MS may adjust its Tx power for the subsequent periodic ranging codes transmission up to $P_{TX\_IR\_MAX}$ (6.3.9.5.1). For the bandwidth request ranging, once MS sends bandwidth request ranging code and fails to receive CDMA allocation IE or RNG-RSP, MS may adjust its Tx power for the subsequent bandwidth request ranging codes transmission up to $P_{TX\_IR\_MAX}$ (6.3.9.5.1).

***Insert a new subclause 8.4.10.3.2:***

### 8.4.10.3.2 Optional open loop power control

When the open loop power control is supported and the uplink power control mode is changed to open loop power control by PMC_RSP, the power per a subcarrier shall be maintained for the UL transmission as follows. This open loop power control shall be applied for the all uplink bursts.

$$P(dBm) = L + C/N + NI - 10\log 10(R) + Offset\_SS_{perSS} + Offset\_BS_{perSS} \tag{138a}$$

where

$P$ is the TX Power level (dBm) per a subcarrier for the current transmission, including MS Tx antenna gain.
$L$ is the estimated average current UL propagation loss. It shall include SS Tx antenna gain and path loss, but exclude the BS Rx antenna gain.
$C/N$ is the normalized $C/N$ of the modulation/FEC rate for the current transmission, as appearing in Table 334. Table 334 can be modified by UCD (Normalized $C/N$ override).
$R$ is the number of repetitions for the modulation/FEC rate.
$NI$ is the estimated average power level (dBm) of the noise and interference per a subcarrier at BS, not including BS Rx antenna gain.
$Offset\_SS_{perSS}$ is the correction term for SS-specific power offset. It is controlled by SS. Its initial value is zero.
$Offset\_BS_{perSS}$ is the correction term for SS-specific power offset. It is controlled by BS with power control messages. When Offset_BSperSS is set through the PMC_RSP message, it shall include BS Rx antenna gain.

The estimated average current UL propagation loss, L, shall be calculated based on the total power received on the active subcarriers of the frame preamble, and with reference to the BS_EIRP parameter sent by the BS.

The default normalized C/N values per modulation are given by Table 334. The operating parameters BS_EIRP and NI are signaled by a DCD message (see Table 358).

Additionally, the BS controls the Offset_BSperSS using PMC_RSP message (6.3.2.3.58) to override the Offset_BSperSS value, or using RNG-RSP (6.3.2.3.6), Fast Power Control (FPC) message (6.3.2.3.34), Power Control IE (8.4.5.4.5) and UL-MAP_Fast_Tracking_IE (8.4.5.4.22) to adjust the Offset_BSperSS value. The accumulated power control value shall be used for Offset_BSperSS.

The Offset_BSperSS can be updated using relative or fixed form (as a function of the relevant adjustment commands used). Fixed form is used when the parameter is obtained from a PMC_RSP message. In this case, the SS should replace the old Offset_BSperSS value by the new Offset_BSperSS sent by the BS. With all other messages mentioned in the previous paragraph, relative form is used. In this case, MS should increase and decrease the Offset_BSperSS according to the offset value sent by BS.

The actual power setting shall be quantized to the nearest implementable value, subject to the specification (8.4.12.1). For each transmission, the SS shall limit the power, as required to satisfy the spectral masks and EVM requirements.

**Passive Uplink open loop power control:**

In passive Uplink open loop power control the SS will set Offset_SSperSS to zero and modify the TX power value using Equation (138a).

**Active Uplink open loop power control**

An alternative way is that the SS may adjust $Offset\_SS_{perSS}$ value within a range.

$$Offset\_Bound_{lower} \leq Offset\_SS_{perSS} \leq Offset\_Bound_{upper} \quad (138b)$$

where

$Offset_Bound_{upper}$is the upper bound of $Offset\_SS_{perSS}$
$Offset_Bound_{lower}$is the lower bound of $Offset\_SS_{perSS}$

Or in case ARQ is enabled at some UL connections, the $Offset\_SS_{perSS}$ may be updated automatically based on the Ack/Nack within the range as specified by Equation (138c). The specific algorithm is described as follows (in dB):

$$\begin{aligned}&\textit{if NAK is received}Offset\_SS_{perSS} = Offset\_SS_{perSS} + UP\_STEP\\&\text{else if ACK is receivedOffset\_SS}_{\text{perSS}} = \text{Offset\_SS}_{\text{perSS}} \text{ - DOWN\_STEP} \quad (138c)\\&\textit{else where}Offset\_SS_{perSS} = Offset\_SS_{perSS}\end{aligned}$$

where

$UP\_STEP$ is the up adjustment step as specified by “SS-specific up power offset adjustment step” TLV DOWN _STEP is the down adjustment step as specified by “SS-specific down power offset adjustment step” TLV.

The operating parameters $UP\_STEP$, DOWN _STEP, $Offset\_Bound_{upper}$, $Offset\_Bound_{lower}$ are signaled by a dedicated UCD message TLV.

***Insert a new subclause 8.4.10.3.2.1:***

### 8.4.10.3.2.1 UL Tx power and Headroom transmission condition

SS may report its transmission power status using Bandwidth request and UL Tx Power Report header (6.3.2.1.2.1.2), PHY channel report header (6.3.2.1.2.1.5) or UL Tx Power Report extended subheader (6.3.2.2.7.5). Further, when the following conditions are met, SS may send its transmission power status using Bandwidth request and UL Tx Power Report header (6.3.2.1.2.1.2), PHY channel report header (6.3.2.1.2.1.5) or UL Tx Power Report extended subheader (6.3.2.2.7.5).

$$|M_{avg}(n_{last}) - M_{avg}(n)| \geq Tx\_Power\_Report\_Threshold \quad (dB) \quad (138d)$$

or

$$n - n_{last} \geq Tx\_Power\_Report\_Interval$$

where

$$M(n) = L + NI + Offset\_SS_{perSS} + Offset\_BS_{perSS} \quad (dB),$$
$$M_{avg}(n) = 10\log(\alpha_{p\_avg} \cdot 10^{M(n)/10} + (1 - \alpha_{p\_avg}) \cdot 10^{(M_{avg}(n-1))/10}),$$

$n_{last}$ is the time index when the last SS Tx Power Report is sent. The unit is frame. Tx_Power_Report_Threshold, Tx_Power_Report_Interval, and $\alpha_{p\_avg}$ are indicated in UCD. In UCD, there are sets of those parameters sets: Depending on the allocation CQICH to SS, the corresponding parameter set shall be used.

### 8.4.11 Channel quality measurements

### 8.4.11.2 RSSI mean and standard deviation

***Change the second paragraph as indicated:***

Mean and standard deviation statistics shall be reported in units of dBm and dB, respectively. To prepare such reports, statistics shall be quantized in 1 dB increments, ranging from –40 dBm (encoded 0x53) to –123 dBm (encoded 0x00). Values outside this range shall be assigned the closest extreme value within the scale.

***Replace Equation (142) and Equation (143) with the following equations:***

$$\hat{x}^2_{RSSI}[k] = \begin{cases} |R[0]|^2 & k = 0 \\ (1-\alpha_{avg})\hat{x}^2_{RSSI}[k-1] + \alpha_{avg}|R[k]|^2 & k > 0 \end{cases} \qquad (mW)^2 \qquad (142)$$

$$\hat{\sigma}_{RSSI\ dB} = 5\log\left(\left|\hat{x}^2_{RSSI}[k] - (\hat{\mu}_{RSSI}[k])^2\right|\right) \qquad dBm \qquad (143)$$

***Insert the following paragraph at the end of the subclause:***

The message time index is incremented every frame. The reported RSSI value shall be an estimate of the total received power of the frame preamble of the segment of the connected BS.

### 8.4.11.3 CINR mean and standard deviation

***Change the subclause as indicated:***

When physical CINR measurements are mandated by the BS, an SS shall obtain a CINR measurement (implementation-specific). From a succession of these measurements, the SS shall derive and update estimates of the mean and/or the standard deviation of the CINR, and report them via REP-RSP messages and/or report the estimate of the mean of the physical CINR via the fast-feedback channel (CQICH).

For the REP-RSP, the following encoding shall be used unless different encoding scheme is defined. Mean and standard deviation statistics for CINR shall be reported in units of dB. To prepare such reports, statistics shall be quantized in 1 dB increments, ranging from a minimum of –10 dB (encoded 0x00) to a maximum of 53 dB (encoded 0x3F). Values outside this range shall be assigned the closest extreme value within the scale.

The method used to estimate the CINR of a single message is left to individual implementation, but the relative and absolute accuracy of a CINR measurement derived from a single message shall be ± 1 dB and ± 2 dB, respectively. The specified accuracy shall apply to the range of CINR values starting from 3 dB below SNR of the most robust rate, to 10 dB above the SNR of the least robust rate. See Table 338.

If physical CINR report from the preamble was instructed, then the reported CINR shall be an estimate of the CINR over the subcarriers of the preamble. For the frequency reuse configuration=3 type, the reported CINR shall be the estimate of the CINR over the modulated subcarriers of the preamble. For the frequency reuse configuration=1, the reported CINR shall be the estimate of the average CINR over all subcarriers of the preamble except the guard subcarriers and the DC subcarriers. In other words, the signal on the unmodulated subcarriers (except the guard subcarriers and the DC subcarriers) shall also be considered as noise and interference for the CINR estimate of the frequency reuse configuration=1. The reported value shall represent the average CINR on non-boosted data subcarriers of the first zone in the frame; hence preamble boosting shall be compensated for in both desired signal and interference/noise calculation.

In case physical CINR report on specific permutation zone was instructed, then the reported value shall represent the average CINR on non-boosted data subcarriers of the zone on which measurement was requested; hence pilot boosting shall be compensated for in both desired signal and interference/noise calculation.

In case physical CINR reporting on STC zone is instructed, the SS shall report the average post-combined CINR.

In addition, the range over which these single-packet measurements are measured should extend 3 dB on each side beyond the –10 dB to 53 dB limits for the final reported, averaged statistics.

One possible method to estimate the CINR of a single message is to compute the ratio of the sum of signal power and the sum of residual error for each data sample, using Equation (144).

$$CINR[k] = \frac{\sum_{n=0}^{N-1} |s[k,n]|^2}{\sum_{n=0}^{N-1} |r[k,n] - s[k,n]|^2} \tag{144}$$

where $r[k,n]$ received sample $n$ within message measured at time index $k$ in frame units; $s[k,n]$ the corresponding detected or pilot sample (with channel state weighting) ~~corresponding to received symbol $n$~~. The message time index is incremented every frame. The SS shall maintain separate message time index counters and mean CINR estimates for REP-RSP-based reports and for Fast-Feedback-based reports. When the CINR configuration is changed (i.e., CINR report configuration in a CQICH IE or REP-REQ message differ from the previous CQICH_IE or REP-REQ respectively), the SS shall reset the corresponding message time index to zero.

The mean CINR statistic (in dB) shall be derived from a multiplicity of single messages using Equation (145).

$$\hat{\mu}_{CINR\ dB}[k] = 10\log(\hat{\mu}_{CINR}[k]) \tag{145}$$

where

$$\hat{\mu}_{CINR}[k] = \begin{cases} CINR[0] & k = 0 \\ (1 - \alpha_{avg})\hat{\mu}_{CINR}[k-1] + \alpha_{avg}\, CINR[k] & k > 0 \end{cases} \tag{146}$$

~~$k$ is the time index for the message (with the initial message being indexed by $k = 0$, the next message by $k = 1$, etc.)~~; CINR[$k$] is a linear measurement of CINR (derived by any mechanism ~~which~~ that delivers the prescribed accuracy) for message $k$; and $\alpha_{avg}$ is an averaging parameter specified by the BS.

To solve for the standard deviation, the expectation-squared statistic shall be updated using Equation (147).

$$\hat{x}^2_{CINR}[k] = \begin{cases} |CINR[0]|^2 & k = 0 \\ (1-\alpha_{avg})\hat{x}^2_{CINR}[k-1] + \alpha_{avg}|CINR[k]|^2 & k > 0 \end{cases} \qquad (147)$$

and the result applied to

$$\hat{\sigma}_{CINR\ dB} = 5\log\left(\left|\hat{x}^2_{CINR}[k] - (\hat{\mu}_{CINR}[k])^2\right|\right) \quad dB \qquad (148)$$

The averaging parameter ($\alpha_{avg}$) may be sent as a DCD message TLV. Unless specified otherwise, the default averaging parameter ($\alpha_{avg}$) is 1/4. When the averaging parameter ($\alpha_{avg}$) is given to an SS through REP-REQ, this value shall only be used for deriving physical CINR estimates reported through REP-RSP, and can further only be changed through another REP-REQ message. When the averaging parameter is given to an SS through CQICH_Allocation IE, this value shall only be used for deriving physical CINR estimates reported through fast-feedback channel (CQICH), and can further only be changed through another CQICH Allocation IE. An averaging parameter value sent through DCD shall not override the averaging parameter value sent in a dedicated REP-REQ message or a CQICH Allocation IE.

***Insert new subclause 8.4.11.4:***

### 8.4.11.4 Optional Frequency Selectivity Characterization

In order to characterize the relationship between channel frequency selectivity and link performance in a compact form, the parameters of an effective CINR versus weighting parameter β curve can be sent from the SS to the BS using an unsolicited REP-RSP TLV. When requested by the BS, the SS shall compute a quadratic approximation of an effective CINR (dB) vs. βdB=10log(β) curve. The quadratic approximation is represented as: effective-CINR dB(βdB) = $a$+$b$×βdB + $c$×βdB. Where $a$, $b$ and $c$ are the Y-intercept, linear, and quadratic parameters, respectively, that are to be estimated by the SS. The quadratic approximation is derived by performing a curve fit to an experimentally derived effective CINR versus β curve.

### 8.4.12 Transmitter requirements

### 8.4.12.2 Transmitter spectral flatness

***Insert the following paragraph as the first paragraph:***

All requirements on the transmitter apply to the RF output connector of the equipment. For equipment with integral antenna only, a reference antenna with 0 dBi gain shall be assumed.

***Change the next paragraph as indicated:***

The average energy of the constellations in each of the $n$ spectral lines shall deviate no more than indicated in Table 335. The absolute difference between adjacent subcarriers shall not exceed 0.1 dB excluding intentional boosting or suppression of subcarriers, CSIT sounding symbols and PAPR reduction subchannels are not allocated.

***Insert the following sentence after Table 335:***

The power transmitted at spectral line 0 shall not exceed –15 dB relative to total transmitted power.

### 8.4.12.3 Transmitter constellation error and test method

***Insert the following sentence to the end of the first paragraph:***

When measuring the transmitter constellation error, it should be noted that if multiple permutation zones are present in a DL sub-frame, the pilot level may shift when transitioning from zone to zone, as the BS attempts to maintain constant power density throughout the frame.

***Change Table 336 as indicated:***

**Table 336—Allowed relative constellation error versus data rate**

| Burst type | Relative constellation error for SS (dB) | Relative constellation error for BS (dB) |
|---|---|---|
| QPSK-1/2 | ~~16.4~~ -15 | -15 |
| QPSK-3/4 | ~~18.2~~ -18 | -18 |
| 16-QAM-1/2 | ~~23.4~~ -20.5 | -20.5 |
| 16-QAM-3/4 | ~~25.2~~ -24 | -24 |
| 64-QAM-1/2 | -26 | -26 |
| 64-QAM-2/3 | ~~29.7~~ -28 | -28 |
| 64-QAM-3/4 | ~~31.4~~ -30 | -30 |

***Replace the text starting from the second paragraph below Table 336 until the end of the subclause with the following new subclause:***

#### 8.4.12.3.1 RMS constellation error measurement for BS (downlink)

The test may be performed in any permutation zone like PUSC. The sampled signal shall be processed in a manner similar to an actual receiver, according to the following steps:

a) The BS under test shall transmit all subchannels defined in the symbol structure (see 8.4.6).
b) Locate the Preamble.
c) Perform timing and frequency estimation.
d) Compensate the timing offset as estimated.
e) The received signal shall be de-rotated according to estimated frequency offset.
f) The complex channel response coefficients shall be estimated for each of the subcarriers.
g) Divide each subcarrier value by the complex estimated channel response coefficient.
h) For each data-carrying subcarrier, find the closest constellation point and compute the Euclidean distance from it.
i) Compute the RMS average of all errors in a packet, given by Equation (149).

***Insert new subclause 8.4.12.3.2:***

### 8.4.12.3.2 RMS constellation error measurement for SS

The sampled signal shall be processed in a manner similar to an actual receiver, according to the following steps:

a) The SS under test shall transmit on part of the UL subchannels. Recommended value is 1/4 of the UL subchannels.
b) The tester will locate a complete UL subframe.
c) Perform timing and frequency estimation.
d) Compensate the timing offset as estimated.
e) The received signal shall be de-rotated according to estimated frequency offset.
f) Estimate the average channel according to the pilots.
g) Divide each subcarrier value with a complex estimated channel response coefficient.
h) For each data-carrying subcarrier, find the closest constellation point and compute the Euclidean distance from it.
i) Compute the RMS average of all errors in a packet. It is given by Equation (149).
j) Normal RMS constellation error measurement shall be performed in scenarios where the number of modulated subcarriers is constant across symbols.
k) In case the number of subcarriers varies between symbols, it is recommended to measure RMS constellation error separately for symbols with different power levels.

***Insert new subclause 8.4.12.3.3:***

### 8.4.12.3.3 Calculation of RMS constellation error

$$Error_{RMS}{}^2 = \frac{1}{N_f}\sum_{i=1}^{N_f}\frac{\sum_{j=1}^{L_P}\sum_{k\in S}[(I(i,j,k)-I_0(i,j,k))^2+(Q(i,j,k)-Q_0(i,j,k))^2]}{\sum_{j=1}^{L_P}\sum_{k\in S}[I_0(i,j,k)^2+Q_0(i,j,k)^2]} \qquad (149)$$

where

| | |
|---|---|
| $L_P$ | is the length of the packet, |
| $N_f$ | is the number of frames for the measurement, |
| $(I_0 (i,j,k), Q_0 (i,j,k))$ | denotes the ideal symbol point of the *i*-th frame, *j*-th OFDMA symbol of the frame, *k*-th subcarrier of the OFDMA symbol in the complex plane, |
| $(I(i,j,k), Q(i,j,k))$ | denotes the observed point of the *i*-th frame, *j*-th OFDMA symbol of the frame, |
| *k*-th | is the subcarrier of the OFDMA symbol in the complex plane, |
| $S$ | is the group of modulated data subcarriers where the measurement is performed. |

***Insert new subclause 8.4.12.3.4:***

### 8.4.12.3.4 Unmodulated subcarrier errors for SS

Unmodulated subcarrier errors is a measure of the amount of noise emitted by the SS on the unmodulated subcarriers (within the used subcarriers range). The measure is relative to the power emitted by the SS on the modulated subcarriers.

a) The SS under test shall transmit on part of the UL subchannels.
b) The tester will locate a complete UL subframe.
c) Perform timing and frequency estimation.
d) Compensate the timing offset as estimated.
e) The received signal shall be de-rotated according to estimated frequency offset.
f) The unmodulated subcarrier errors (relative to the transmitted power) shall be measured according to Equation (149a).
g) The value of the unmodulated subcarrier error shall not exceed the maximum values defined in Table 336.

$$Error_{RMS}^2 = \frac{1}{N_f}\sum_{i=1}^{N_f}\frac{\sum_{j=1}^{L_P}\sum_{k\in S_u}[I(i,j,k)^2+Q(i,j,k)^2]}{\sum_{j=1}^{L_P}\sum_{k\in S}[I_0(i,j,k)^2+Q_0(i,j,k)^2]} \tag{149a}$$

where

| | |
|---|---|
| $L_P$ | is the length of the packet, |
| $N_f$ | is the number of frames for the measurement, |
| $(I_0(i,j,k), Q_0(i,j,k))$ | denotes the ideal symbol point of the *i*-th frame, *j*-th OFDMA symbol of the frame, *k*-th subcarrier of the OFDMA symbol in the complex plane, |
| $(I(i,j,k), Q(i,j,k))$ | denotes the observed point of the *i*-th frame, *j*-th OFDMA symbol of the frame, |
| *k*-th | is the subcarrier of the OFDMA symbol in the complex plane, |
| $S$ | is the group of modulated data subcarriers where the measurement is performed. |
| $S_u$ | is the group of the un-modulated data subcarriers. It includes all subcarriers in the range 0 ... $N_{used}$-1, except the DC subcarrier and the modulated subcarriers (in *S*). |

***Insert new subclause 8.4.12.4:***

### 8.4.12.4 Transmitter reference timing accuracy

At the BS, the transmitted downlink radio frame shall be time-aligned with the 1pps timing pulse (8.4.10.1.1). The start of the preamble symbol, excluding the CP duration, shall be time aligned with 1pps timing pulse when measured at the antenna port.

At the MS, upon close-loop adjustments of transmit and receive timings from BS through CDMA ranging methods during network entry and periodic ranging, the MS obtains the system time reference. Thereafter, the MS shall maintain the relative time reference when measured at the antenna port.

### 8.4.13 Receiver requirements

***Insert new subclause 8.4.13.1 entitled "OFDMA PHY requirements for enhanced handover performance". The existing 8.4.13.1 Receiver sensitivity (along with the existing text under that subclause) shall become 8.4.13.1.1.***

### 8.4.13.1 OFDMA PHY requirements for enhanced handover performance

#### 8.4.13.1.1 Receiver sensitivity

***Change the first paragraph as indicated:***

The BER measured after FEC shall be less than $10^{-6}$ at the power levels ~~shown in Table 337~~ given by Equation (149b) for standard message and test conditions. ~~If the implemented bandwidth is not listed, then the values for the nearest smaller listed bandwidth shall apply.~~ The minimum input levels are measured as follows:

- ~~At the antenna connector or through a calibrated radiated test environment.~~
- Using the defined standardized message packet formats.
- Using an AWGN channel.

***Delete Table 337.***

***Change the paragraph below Table 337 as indicated:***

~~Table 337 (as well as Table 336) are derived assuming 5 dB implementation loss, a Noise Figure of 7 dB, and receiver SNR and $E_b/N_0$ values as listed in Table 338.~~

The receiver minimum sensitivity level, RSS, is derived according to Equation (149b):

$$R_{SS} = -114 + SNR_{Rx} - 10 \times \log 10(R) + 10 \times \log 10\left(\frac{F_S \times N_{Used}}{N_{FFT}}\right) + ImpLoss + NF \qquad (149b)$$

where

| | |
|---|---|
| $SNR_{Rx}$ | is the receiver SNR as per Table 338, |
| $R$ | is the repetition factor, as described in 8.4.9, |
| $F_S$ | is the sampling frequency in MHz as defined in 8.4.2.4, |
| *ImpLoss* | is the implementation loss, which includes non-ideal receiver effects such as channel estimation errors, tracking errors, quantization errors, and phase noise. The assumed value is 5 dB. |
| *NF* | is the receiver noise figure, referenced to the antenna port. The assumed value is 8 dB. |

*Change Table 338 as indicated:*

**Table 338—Receiver SNR ~~and $E_b/N_0$~~ assumptions**

| Modulation | ~~$E_b/N_0$ (dB)~~ | Coding rate | Receiver SNR (dB) |
|---|---|---|---|
| QPSK | ~~10.5~~ | 1/2 | ~~9.4~~ 5 |
| | | 3/4 | ~~11.2~~ 8 |
| 16-QAM | ~~14.5~~ | 1/2 | ~~16.4~~ 10.5 |
| | | 3/4 | ~~18.2~~ 14 |
| 64-QAM | ~~19.0~~ | 1/2 | 16 |
| | | 2/3 | ~~22.7~~ 18 |
| | | 3/4 | ~~24.4~~ 20 |

***Insert the following sentence below Table 338:***

*Note that these SNR values are derived in an AWGN environment, and assume that a tail-biting convolutional code (CC) is used.*

***Insert two new subclauses 8.4.13.1.2 and 8.4.13.1.3:***

### 8.4.13.1.2 MS uplink transmit time tracking accuracy

With the time reference MS maintained in 8.4.12.3, MS shall autonomously adjust uplink transmit timing according to the timing advances and retards of the detected downlink earliest arrival path in the preamble symbol. The autonomous timing reference shall be tracked at antenna port without BS close-loop timing control.

At the MS, the transmitted radio frame shall be time-aligned with the network specified uplink frame boundary. At zero timing advance and retard setting, the start of the first uplink data symbol, excluding the CP duration, shall be time aligned with the specified uplink frame boundary relative to the downlink arrival time when measured at the antenna port without BS close-loop control.

### 8.4.13.1.3 MS autonomous neighbor cell scanning

If an MS supports FBSS/MDHO capability as defined in 11.7.11, the MS shall support autonomous neighbor cell scanning procedure according to the following. The MS may also perform normal scanning procedures as defined in 6.3.20.1.2.

For autonomous scanning procedure, the MS shall perform neighbor cell scanning via preamble detection for neighbor cells in the same carrier frequency. The MS shall maintain the signal quality database for neighbor cells without being instructed by the BS.

***Change the title of 8.4.13.2 as indicated:***

### 8.4.13.2 Receiver adjacent and ~~alternate~~non-adjacent channel rejection

### 8.4.13.3 Receiver maximum input signal

***Insert new subclause 8.4.13.3.1 immediately after the title of subclause 8.4.13.3:***

#### 8.4.13.3.1 SS receiver maximum input signal

***Move the text of subclause 8.4.13.3 to subclause 8.4.13.3.1 with the following changes:***

The SS receiver shall be capable of decoding a maximum on-channel signal of –30 dBm.

***Insert new subclause 8.4.13.3.2:***

#### 8.4.13.3.2 BS receiver maximum input signal

The BS receiver shall be capable of decoding a maximum on-channel signal of –45 dBm.

### 8.4.14 Frequency control requirements

### 8.4.14.1 Center frequency and symbol clock frequency tolerance

***Change the second paragraph as indicated:***

~~At the SS, both the transmitted center frequency and the symbol clock frequency shall be synchronized to the BS with a tolerance of maximum 2% of the subcarrier spacing.~~ At the SS, both the transmitted center frequency and the sampling frequency shall be derived from the same reference oscillator. Thereby, the SS uplink transmission shall be locked to the BS, so that its center frequency shall deviate no more than 2% of the subcarrier spacing, compared to the BS center frequency.

***Change the last paragraph as indicated:***

During the synchronization period, the SS shall acquire frequency synchronization within the specified tolerance before attempting any uplink transmission. During normal operation, the SS shall track the frequency changes by estimating the downlink frequency offset and shall defer any transmission if synchronization is lost. To determine the transmit frequency, the SS shall accumulate the frequency offset corrections transmitted by the BS (for example in RNG-RSP message), and may add to the accumulated offset, an estimated UL frequency offset based on the downlink signal.

***Insert a new subclause 8.4.15:***

### 8.4.15 Optional HARQ support

The following optional modes exist for HARQ

- Incremental redundancy for CTC—specified in 6.3.17 and in 8.4.9.2.3.5.
- Incremental redundancy for CC (convolutional code)—specified in 8.4.15.2 and 8.4.9.2.1.2
- Chase combining for all coding schemes specified in 8.4.15.1

These modes can be supposed by the normal map and the HARQ map.

***Insert a new subclause 8.4.15.1:***

### 8.4.15.1 Optional Chase HARQ support

The optional Chase HARQ scheme enables BS and SS to enhance performance of HARQ enabled connection by means of chase combining scheme. This scheme is supported for all coding schemes. Each burst is appended with a CRC that is checked by the receiver. An uplink and a downlink ACK channels are defined (see 8.4.5.4.13 and 8.4.5.4.24). The receiver replies with an ACK in the corresponding ACK channel if the decoding succeeded and with a NACK if the decoding failed.

If the burst was not ACK-ed, the transmitter may transmit a burst with exactly the same data contents again. The receiver may combine the newly received burst with the formerly received burst(s) to enhance decoding performance.

***Insert a new subclause 8.4.15.1.1:***

#### 8.4.15.1.1 HARQ Retransmission process

The process of retransmissions is controlled by the BS using the ACID (ARQ Channel ID) and AI_SN fields in the DL and UL maps. Each HARQ channel (indicated by specific ACID of 0–15) is managed separately.

When the AI_SN field in the HARQ channel remains the same between two HARQ burst allocations, it indicates retransmission. In this case, the transmitter is required to retransmit the same data that was transmitted using the same ACID and AI_SN. The burst profile of the retransmission must be the same as in the first transmission; however, the level of boosting and repetition may be changed.

When the AI_SN field in the HARQ channel is changed, it indicates transmission of new data. In this case, the data stored in the transmitter and receiver for this ACID and the previously used AI_SN may be discarded.

***Insert a new subclause 8.4.15.1.2:***

#### 8.4.15.1.2 CRC

Bursts transmitted using Chase HARQ shall include CRC of 16 bits. The CRC is appended to MAC data after padding (before partitioning to FEC blocks and encoding as defined in 8.4.9). Padding is done so that the total length after CRC concatenation matches the size of the burst indicated by the map.

The CRC shall be CRC16-CCITT, as defined in ITU-T Recommendation X.25, and it is calculated over all the bits in the burst, including data and padding.

This CRC shall be used for error detection and for ACK/NACK transmission.

***Insert a new subclause 8.4.15.1.3:***

#### 8.4.15.1.3 Concurrent transmission of UL HARQ bursts

The BS may allocate more than one UL HARQ burst for an SS (see 8.4.4.5). The maximal number of UL bursts supported by an HARQ enabled SS is indicated by the capability field in 11.8.3.7.11 and includes both HARQ and non-HARQ bursts.

***Insert a new subclause 8.4.15.1.4:***

#### 8.4.15.1.4 Encoding

When using Chase-HARQ with HARQ DL/UL IE in the normal maps, the encoding scheme is indicated by DIUC/UIUC code and the encoding process shall be the same as in non-HARQ transmission with the same DIUC/UIUC.

***Insert a new subclause 8.4.15.2:***

### 8.4.15.2 Optional IR HARQ for CC (convolutional code)

This mode of operation is similar to Chase HARQ (see 8.4.15.1). The specifications in 8.4.15.1 apply to this mode, except for the following differences:

1) An SPID field is supplied by the HARQ DL/UL MAP IE.
2) The value of SPID may be arbitrarily changed by the BS between retransmissions.
3) The encoding process is based on the non-HARQ coding scheme, except for the changes indicated in 8.4.9.2.1.2.

# 9. Configuration

*Change the title of subclause 9.1 as indicated:*

## 9.1 SS IP addressing used on secondary management connection

*Insert the following after 9.1.1:*

### 9.1.2 Mobile IP v4 fields used by the MS

If Mobile IP v4 is used, the following fields shall be present in the Mobile IP registration request from the MS and shall be set as described below and encoded according to IETF RFC 3344.

a) When the MS (or Mobile Node) attempts to obtain an IP address dynamically, the home address field shall be set to “0.0.0.0”.
b) When the MS attempts to obtain an IP address in the visited network, the home agent address field shall be set to “0.0.0.0”. On the other hand, when the MS attempts to obtain an IP address in the home network, the home agent address field shall be set to “255.255.255.255”.
c) The Network Access Identifier (NAI) extension [IETF RFC 2789] shall be included for identifying the Mobile IP user.
d) The Challenge extension shall be included [IETF RFC 3012], if the Challenge extension is included in the Agent Advertisement message.
e) A 128-bit key may be shared between an MS and an ASA server during the initial Mobile IP registration, and the MS-ASA Authentication extension may be generated based on the shared key [IETF RFC 3012].

The following fields are expected in the Mobile IP registration response returned to the MS. The MS shall configure itself based on the Mobile IP registration response

- The home address to be used by the MS.
- The MS’s NAI extension to identify a Mobile IP user [IETF RFC 2789]
- The challenge extension if the foreign agent supports more strong security.
- The MS and home agent authentication extension for authenticating the home agent.
- The key reply extensions for security between the MS and the home agent, and between the MS and foreign agent, if the MS requests keys between the MS and the home agent, and between the MS and the foreign agent.

# 10. Parameters and constants

## 10.1 Global values

*Change Table 342 as indicated:*

**Table 342—Parameters and constants**

| System | Name | Time reference | Minimum value | Default value | Maximum value |
|---|---|---|---|---|---|
| BS | UCD Transition | ~~The time~~ The number of frames from the end of the frame carrying the UCD message the BS shall wait after repeating a UCD message with an incremented Configuration Change Count before issuing a UL-MAP message referring to Uplink_Burst_Profiles defined in that UCD message. | ~~2 MAC frames~~ 20ms following the last fragment of the message | | |
| BS | DCD Transition | ~~The time~~ The number of frames from the end of the frame carrying the DCD message the BS shall wait after repeating a DCD message with an incremented Configuration Change Count before issuing a DL-MAP message referring to Downlink_Burst_Profiles defined in that DCD message. | ~~2 MAC frames~~ 20ms following the last fragment of the message | | |
| ~~SS,~~ BS | Invited Ranging Retries | Number of retries on inviting Ranging Requests. | 16 | | |
| BS, SS | $T_{proc}$ | Time provided between arrival of the last bit of a UL-MAP at an SS and effectiveness of that map. For OFDMA mode, the time shall be counted starting from the end of the burst carrying the UL-MAP. | SC:<br>200 µs<br>OFDM:<br>1 ms<br>OFDMA:<br>~~10 OFDMA symbols~~<br>$T_{proc}=T_f$ | | |
| SS, MS | T3 | Ranging Response reception timeout following the transmission of a Ranging Request. | — | ~~200 ms~~<br>50 ms | 200 ms |
| SS | T4 | Wait for ~~unicast~~ ranging opportunity or data grant. If the pending-until-complete field was used earlier by this SS, then the value of that field shall be added to this interval. | ~~30 s~~ | | 35 s |
| ~~BS~~ | ~~T5~~ | ~~Wait for Uplink Channel Change response~~ | | | ~~2 s~~ |
| ~~SS~~ | ~~T16~~ | ~~Wait for bandwidth request grant~~ | ~~10 ms~~ | | ~~service QoS dependent~~ |

### Table 342—Parameters and constants *(continued)*

| System | Name | Time reference | Minimum value | Default value | Maximum value |
|---|---|---|---|---|---|
| ~~SS~~ | ~~T19~~ | ~~Time DL channel remains unusable~~ | | | |
| SS | ~~SS downlink management message~~FPC processing time | Max. time between reception of Fast Power Control management message and compliance to its instructions by SS. | | | ~~200 µs (OFDM only)~~2.5 ms from the start of the frame ($n$+1) were frame $n$ is the frame containing the FPC. If there is an UL allocation to the SS before the 2.5 ms in frame $n$+1 then the power change shall be applied before the end of the frame $n$+1. |
| SS | T21 | Time the SS searches for decodable DL-MAP on a given channel. | | | 11 ~~10~~ s |
| BS | Ranging Correction Retries | | | 16 | |
| SS | RNG-RSP processing time | Time allowed for an SS following receipt of a RNG-RSP before it is expected to apply the corrections instructed by the BS Minimum value. | | | 2.5 ms from the start of the frame ($n$+1) were frame n is the frame containing the RNG_RSP. If there is an UL allocation to the SS before the 2.5 ms in frame $n$+1 then the power change shall be applied before the end of the frame $n$+1. |
| SS | Power control IE processing time | Time allowed for an SS following receipt of a UL-MAP including a power control IE before it is expected to apply the corrections instructed by the BS. | | | 2.5 ms from the start of the frame ($n$+1) were frame n is the frame containing the UL map containing the power control IE. If there is an UL allocation to the SS before the 2.5 ms in frame $n$+1 then the power change shall be applied before the end of the frame $n$+1. |

### Table 342—Parameters and constants *(continued)*

| System | Name | Time reference | Minimum value | Default value | Maximum value |
|---|---|---|---|---|---|
| SS | T28 | DBPC-REQ re-try timer for requesting less robust burst profile after rejection by the BS. | 200 ms | 1s | 1 min |
| SS | T29 | RNG-REQ/DBPC-REQ re-try timer for requesting more robust burst profile after rejecting by the BS. | 200 ms | 1s | 30 s |
| SS | T30 | DBPC-RSP reception timeout following the transmission of a DBPC-REQ. | 200 ms | 200 ms | 200 ms |
| MS | Min_Sleep_Interval | Minimum sleeping time allowed to MS. | 2 frames | — | — |
| MS | Max_Sleep_Interval | Maximum sleeping time allowed to MS. | — | — | 1024 frames |
| MS | Listening_Interval | The time duration during which the MS, after waking up and synchronizing with the DL transmissions, can demodulate downlink transmissions and decide whether to stay awake or go back to sleep. | — | — | 64 frames |
| BS | MOB-NBR-ADV interval | Nominal time between transmission of MOB-NBR-ADV messages. | — | — | 30 s |
| MS | NBR_BS_Index_ Validity_Time | Time duration during which the MS can use the neighbor BS list in MOB_NBR-ADV message for the compression of neighbor BSIDs. | 1 s | — | 5 s |
| BS, MS | ASC-AGING-TIMER | Nominal time for aging of MS associations | 0.1 s | — | 10 s |
| MS | Serving BS ID AGING-TIMER | Nominal time for aging of serving BS association. Timer recycles on successful serving BS DL-MAP read | — | — | 5 s |
| MS | T42 | MOB_HO-IND timeout when sent with HO_IND_type = 0b10. | — | — | — |
| BS | Paging Retry Count | Number of retries on paging transmission. If the BS does not receive RNG-REQ from the MS until this value decreases to zero, it determines that the MS is unavailable. | — | 3 | 16 |

**Table 342—Parameters and constants *(continued)***

| System | Name | Time reference | Minimum value | Default value | Maximum value |
|---|---|---|---|---|---|
| MS | Fast-Tracking Response Processing Time | Time allowed for an MS following receipt of a UL-MAP Fast tracking indication response before it is expected to apply the corrections instructed by the BS. | — | One DL subframe duration | 25 ms |
| BS, MS | Mode Selection Feedback processing time | The time allowed between the end of the burst carrying the Mode Selection Feedback subheader and the start of the UL-subframe carrying the Mode Selection Feedback response. | TDD: Frame duration<br>FDD: 1/2 Frame duration | — | — |
| MS | Idle Mode Timer | MS timed interval to conduct Location Update. Set timer to MS Idle Mode Timeout capabilities setting. Timer recycles on successful Idle Mode Location Update. | 128 s | 4096 s | 65536 s |
| BS | Idle Mode System Timer | For BS acting as Paging Controller, timed interval to receive notification of MS Idle Mode Location Update. Set timer to MS Idle Mode Timeout. Timer recycles on successful Idle Mode Location Update. | 128 s | 4096 s | 65536 s |
| MS | T43 | Time the MS waits for MOB_SLP-RSP. | — | — | — |
| MS | T44 | Time the MS waits for MOB_SCN-RSP. | — | — | — |
| MS | T45 | Time the MS waits for DREG-CMD. | — | 250 ms | 500 ms |
| BS | Management Resource Holding Timer | Time the BS maintain connection information with the MS after the BS send DREG-CMD to the MS. | — | 500 ms | 1 s |
| MS | DREG Request Retry Count | Number of retries on DREG Request Message. | 3 | 3 | 16 |
| BS | DREG Command Retry Count | Number of retries on DREG Command Message. | 3 | 3 | 16 |
| BS | T46 | Time the BS waits for DREG-REQ in case of unsolicited Idle Mode initiation from BS. | — | — | — |

### Table 342—Parameters and constants *(continued)*

| System | Name | Time reference | Minimum value | Default value | Maximum value |
|---|---|---|---|---|---|
| MS | HO Process Optimization MS Timer Retries | Number of SBC-REQ and/or REG-REQ retries while waiting for unsolicited SBC-RSP and/or REG-RSP as part of MS network re-entry and as indicated by HO Process Optimization message element of RNG-RSP. | 3 | — | — |
| BS | T47 | PMC_RSP Timer: BS shall send the PMC_RSP before T47 + 1 frames after BS receives PMC_REQ (confirmation = 0) correctly. | 8 frames | 64 frames | 1024 frames |
| MS, BS | Paging Interval Length | Time duration of Paging Interval of the BS. | 2 frames | — | 5 frames |
| MS | Max Dir Scan Time | Maximum scanning time of neighbor BSs by MS before reporting any results. | — | — | — |
| BS, MS | SAChallengeTimer | Time prior to re-send of SA-TEK-Challenge (in seconds). | 0.5 | 1.0 | 2.0 |
| BS, MS | SAChallenge-MaxResends | Maximum number of transmissions of SA-TEK-Challenge. | 1 | 3 | 3 |
| MS, BS | SATEKTimer | Time prior to re-send of SA-TEK-Request (in seconds). | 0.1 | 0.3 | 1.0 |
| MS, BS | SATEKRequest-MaxResends | Maximum number of transmissions of SA-TEK-Request. | 1 | 3 | 3 |
| BS | Second EAP Timeout | Time, in seconds, to wait for PKMv2_EAP_Start or PKMv2_Authenticated_EAP_Start after the success of the first EAP in double EAP mode. | 0.3 | 1.0 | 1.0 |
| BS | EAP Complete Resend | Total number of sending PKMv2_EAP_Complete message in double EAP mode. | 1 | 3 | 3 |

## 10.2 PKM parameter values

***Insert rows in 10.2 Table 343 as indicated:***

**Table 343—Operational ranges for privacy configuration settings**

| System | Name | Description | Minimum value | Default value | Maximum value |
|---|---|---|---|---|---|
| MS, BS | PMK or PAK pre-handshake lifetime | The lifetime assigned to PMK when created. | 5 s | 10 s | 15 min |
| BS | PMK lifetime | If MSK lifetime is unspecified (i.e., by AAA server), PMK lifetime shall be set to this value. (in seconds). | 60 | 3600 | 86400 |
| BS, MS | SAChallengeTimer | Time prior to re-send of SA-TEK-Challenge (in seconds). | 0.5 | 1.0 | 2.0 |
| BS, MS | SaChallenge-MaxResends | Maximum number of transmissions of SA-TEK-Challenge. | 1 | 3 | 3 |
| MS, BS | SATEKTimer | Time prior to re-send of SA-TEK-Request (in seconds). | 0.1 | 0.3 | 1.0 |
| MS, BS | SATEKRequest-MaxResends | Maximum number of transmissions of SA-TEK-Request. | 1 | 3 | 3 |

## 10.3 PHY-specific values

### 10.3.3 WirelessMAN-OFDM parameters and constant definitions

### 10.3.3.1 Uplink Allocation Start Time

***Change the subclause as indicated:***

Unit of Allocation Start Time shall be PSs from the start of the downlink frame in which the UL-MAP message occurred~~.~~, or from the start of the AAS zone in case the UL MAP was transmitted in AAS zone. The minimum value specified for this parameter shall correspond to a point in the frame 1 ms after the last symbol of the UL-MAP.

In the case the UL-MAP is included in the STC zone, the allocation start time refers to the beginning of the STC zone including the STC preamble.

### 10.3.4 WirelessMAN-OFDMA parameters and constant definitions

### 10.3.4.1 Uplink Allocation Start Time

***Change the subclause as indicated:***

Unit of Allocation Start Time shall be PSs from the start of the downlink frame in which the UL-MAP message occurred. The minimum value specified for this parameter shall ~~correspond to 10 OFDMA symbols~~ refer to the time indicated by $T_{proc}$, defined in Table 342.

## 10.4 Well-known addresses and identifiers

***Change 10.4 as indicated.***

**Table 345—CIDs**

| CID | Value | Description |
|---|---|---|
| Initial Ranging | 0x0000 | Used by SS and BS during initial ranging process. |
| Basic CID | 0x0001 - *m* | The same value is assigned to both the DL and UL connection. |
| Primary management | *m*+1 - 2*m* | The same value is assigned to both the DL and UL connection. |
| Transport CIDs, Secondary Mgt CIDs | 2*m*+1 - FE~~FE~~9F | For the secondary management connection, the same value is assigned to both the DL and UL connection. |
| Multicast CIDs | 0xFEA0 - 0xFEFE | For the downlink multicast service, the same value is assigned to all MSs on the same channel that participate in this connection. |
| AAS initial ranging CID | 0xFEFF | A BS supporting AAS shall use this CID when allocating ~~a~~ an ~~ASS~~ AAS ~~Initial~~ Ranging period (using AAS Ranging Allocation IE) ~~for AAS devices~~. |
| Multicast polling CIDs | 0xFF00 - 0xFFF~~C~~9 | A BS may be included in one or more multicast polling groups for the purposes of obtaining bandwidth via polling. These connections have no associated service flow. |
| Normal mode multicast CID | 0xFFFA | Used in DL-MAP to denote bursts for transmission of DL broadcast information to normal mode MS. |
| Sleep mode multicast CID | 0xFFFB | Used in DL-MAP to denote bursts for transmission of DL broadcast information to Sleep mode MS. May also be used in MOB_TRF-IND messages. |
| Idle mode multicast CID | 0xFFFC | Used in DL-MAP to denote bursts for transmission of DL broadcast information to Idle mode MS. May also be used in MOB_PAG-ADV messages. |
| Fragmentable Broadcast CID | 0xFFFD | Used by the BS for transmission of management broadcast information with fragmentation. The fragment sub header shall use 11-bit long FSN on this connection. |
| Padding CID | 0xFFFE | Used for transmission of padding information by SS and BS. |
| Broadcast CID | 0xFFFF | Used for broadcast information that is transmitted on a downlink to all SS. |

It is noted that the multicast CID may have a format with Reduced CID on HARQ region.

# 11. TLV Encodings

## 11.1 Common encodings

### 11.1.1 Current transmit power

*Change the first paragraph as indicated:*

The average parameter indicates the transmitted power used for the burst which carried the message. The parameter is reported in dBm and is quantized in 0.5 dBm steps ranging from ~~–64~~84 dBm (encoded 0x00) to ~~63.5~~43.5 dBm (encoded 0xFF). Values outside this range shall be assigned the closest extreme. The parameter is only applicable to systems supporting the SCa, OFDM, or OFDMA PHY specifications. However, for the OFDM or OFDMA PHY, this value indicates the average transmitted power of each subcarrier for the burst which carried the message.

***Insert a new subclause "Authentication Tuples" before 11.1.2 HMAC Tuple and change 11.1.2 to be 11.1.2.1***

### 11.1.2 Authentication Tuples

An authentication tuple shall be the last item in identified management messages.

### 11.1.2.1 HMAC Tuple

*Change the first paragraph as indicated:*

This parameter contains the HMAC Key Sequence Number concatenated with an HMAC-Digest used for message authentication. The HMAC Key Sequence Number is stored in the four least significant bits of the first byte of the HMAC Tuple, and the most significant four bits are reserved. The HMAC-Tuple attribute format is shown in Table 347 and Table 348. When PKM is disabled (see 11.7.8.7), the content of this field shall be ignored and the message considered authenticated.

*Change the contents of Table 347 as indicated:*

| Type | Length | Value | Scope |
|---|---|---|---|
| 149 | 21 | See Table 348 | DSx-REQ, DSx-RSP,<br>DSx-ACK, REG-REQ,<br>REG-RSP, RES-CMD,<br>DREG-REQ, DREG-CMD, TFTP-CPLT,<br>MOB_SLP-REQ, MOB_SLP-RSP,<br>MOB_SCN-REQ, MOB_SCN-RSP,<br>MOB_BSHO-REQ, MOB_MSHO-REQ,<br>MOB_BSHO-RSP,MOB HO-IND, DREG-REQ |

*Insert new subclause 11.1.2.2:*

### 11.1.2.2 CMAC Tuple

This parameter contains the CMAC key sequence number, the CMAC Packet Number Counter (CMAC_PN_*), and the CMAC value used for message authentication. The CMAC Tuple attribute format is shown in Table 348a and Table 348b.

A message received, that contains an CMAC Tuple, shall not be considered authentic if the length field of the tuple is incorrect, or if the locally computed value of the digest does not match the digest in the message.

NOTE—It would be appropriate for a MIB to increment an error count on receipt of a non authentic message, so that management can detect an active attack.

**Table 348a—CMAC Tuple definition**

| Type | Length | Value | Scope |
|---|---|---|---|
| 150 | 13 or 19 | See Table 348b | DSx-REQ, DSx-RSP, DSx-ACK, REG-REQ, REG-RSP, RES-CMD, DREG-CMD, TFTP-CPLT, PKM-REQ, PKM-RSP, MOB_SLP-REQ, MOB_SLP-RSP, MOB_SCN-REQ, MOB_SCN-RSP, MOB_BSHO-REQ, MOB_MSHO-REQ, MOB_BSHO-RSP, MOB_HO-IND, DREG-REQ |

**Table 348b—CMAC Tuple definition**

| Field | Length (bits) | Note |
|---|---|---|
| Reserved | 4 | Set to 0 |
| CMAC Key Sequence Number | 4 | CMAC key sequence number |
| BSID | 48 | Only used in case of MDHO zone—optional |
| CMAC Packet Number Counter, CMAC_PN_* | 32 | This context is different UL, DL |
| CMAC Value | 64 | CMAC with AES 128 |

***Insert new subclause 11.1.2.3:***

### 11.1.2.3 Short-HMAC Tuple

This parameter contains the HMAC Key Sequence Number concatenated with an HMAC Digest used for message authentication. The HMAC Key Sequence Number is stored in the four least significant bits of the first byte of the HMAC Tuple, and the most significant four bits are reserved. The HMAC Tuple attribute format is shown in Table 348c and Table 348d.

**Table 348c—Short-HMAC Tuple definition**

| Type | Length | Value | Scope |
|---|---|---|---|
| 151 | *variable* | See Table 348d | MOB_SLP-REQ, MOB_SLP-RSP, MOB_SCN-REQ, MOB_SCN-RSP, MOB_MSHO-REQ, MOB_BSHO-RSP, MOB_HO-IND, RNG-REQ, RNG-RSP, PKM-REQ, PKM-RSP |

### Table 348d—Short-HMAC Tuple definition

| Field | Length (bits) | Note |
|---|---|---|
| Reserved | 4 | — |
| HMAC Key Sequence Number | 4 | — |
| HMAC Packet Number Counter HMAC_PN_* | 32 | Replay counter |
| Short-HMAC Digest | *variable* | 0—Truncate HMAC to 8 bytes in Short HMAC Tuple<br>1—Truncate to 10 bytes<br>2—Truncate to 12 bytes |

## 11.1.3 MAC version encoding

***Change the TLV definition for MAC version encoding as follows:***

| Type | Length | Value | Scope |
|---|---|---|---|
| 148 | 1 | Version number of IEEE 802.16 supported on this channel.<br>1: Indicates conformance with IEEE Std 802.16-2001<br>2: Indicates conformance with IEEE Std 802.16c-2002 and its predecessors<br>3: Indicates conformance with IEEE Std 802.16a-2003 and its predecessors<br>4: Indicates conformance with IEEE Std 802.16-2004<br>5: Indicates conformance with IEEE Std 802.16-2004 and IEEE Std 802.16e-2005<br>~~5~~6-255: *Reserved* | PMP:<br>DCD, RNG-REQ<br>MESH:<br>REG-REQ, REG-RSP |

## 11.1.5 Vendor ID encoding

***Insert the following scoped messages into the table in 11.1.5:***

SBC-REQ (see 6.3.2.3.23)

SBC-RSP (see 6.3.2.3.24)

### 11.1.6 Vendor-specific information

***Change the example at the end of the subclause as indicated:***

*Example:*

Configuration with vendor A specific fields and vendor B specific fields:

VSIF (143) + *n* (number of bytes inside this VSIF)
~~8~~144 (Vendor ID Type) + 3 (length field) + Vendor ID of Vendor A
Vendor A Specific Type #1 + length of the field + Value #1
Vendor A Specific Type #2 + length of the field + Value #2

VSIF (143) + *n* (number of bytes inside this VSIF)
~~8~~144 (Vendor ID Type) + 3 (length field) + Vendor ID of Vendor B
Vendor B Specific Type + length of the field + Value

***Insert a new subclause 11.1.7:***

### 11.1.7 MOB-NBR-ADV message encodings

**Table 348e—MOB-NBR-ADV encodings**

| Name | Type (1 byte) | Length (1 byte) | Value (variable-length) |
|---|---|---|---|
| DCD_settings | 1 | *variable* | The DCD_settings is a compound TLV value that encapsulates a DCD message that may be transmitted in the advertised BS downlink channel. This information is intended to enable fast synchronization of the MS with the advertised BS downlink. The DCD settings fields shall contain only neighbor's DCD TLV values that are different from the serving BS corresponding values. For values that are not included, the MS shall assume they are identical to the serving BSs corresponding values. |
| UCD_settings | 2 | *variable* | The UCD_settings is a compound TLV value that encapsulates a UCD message that may be transmitted in the advertised BS downlink channel. This information is intended to enable fast synchronization of the MS with the advertised BS uplink. The UCD settings fields shall contain only neighbor's UCD TLV values that are different from the serving BS's corresponding values. For values that are not included, the MS shall assume they are identical to the serving BS's corresponding values. |
| Neighbor BS trigger | 4 | *variable* | The Neighbor BS trigger is a compound TLV value that indicates the trigger being applied to this neighbor BS (Table 358a). The Neighbor BS trigger is included in MOB_NBR-ADV message, only if it is different from Trigger that is defined for the neighbor BS in DCD message or from the Neighbor BS trigger for the preceding neighbor BS. |

The neighbor BS trigger TLV (type 4) in Table 348e is encoded using the description in Table 348f.

**Table 348f—Neighbor BS Trigger TLV description**

| Name | Type | Length (1 byte) | Value |
|---|---|---|---|
| Type/function/action | 4.1 | 1 | See Table 348g for description. |
| Trigger value | 4.2 | 1 | Trigger value is the value used in comparing measured metric for determining a trigger condition. |
| Trigger averaging duration | 4.3 | 1 | Trigger averaging duration is the time in ms over which the metric measurements are averaged. When the mean value of the measurement meets the trigger condition, the MS reacts using the specified action. |

The Type/function/action byte field of the Neighbor BS Trigger TLV in Table 348f is described in Table 348g.

**Table 348g—Neighbor BS Trigger; Type/Function/Action**

| Name | Length (1 byte) | Value |
|---|---|---|
| Type | 2 bits (MSB) | Trigger metric type:<br>0x0: CINR metric<br>0x1: RSSI metric<br>0x2: RTD metric<br>0x3: *Reserved* |
| Function | 3 bits | Computation defining trigger condition:<br>0x0: *Reserved*<br>0x1: Metric of neighbor BS is greater than absolute value<br>0x2: Metric of neighbor BS is less than absolute value<br>0x3: Metric of neighbor BS is greater than serving BS metric by relative value<br>0x4: Metric of neighbor BS is less than serving BS metric by relative value<br>0x5-0x7: *Reserved* |
| Action | 3 bits (LSB) | Action performed upon reaching trigger condition:<br>0x0: *Reserved*<br>0x1: Respond on trigger with MOB_SCN-REP<br>0x2: Respond on trigger with MOB_MSHO-REQ<br>0x3-0x7: *Reserved* |

## 11.3 UCD management message encodings

### 11.3.1 UCD channel encodings

***Delete the entry with 'Bandwidth request opportunity size' under the Name column from Table 349.***

***Delete the entry with 'Ranging request opportunity size' under the Name column from Table 349.***

***Insert the following rows to Table 349:***

## Table 349—UCD channel encodings

| Name | Type (1 byte) | Length (1 byte) | Value (variable-length) | PHY scope |
|---|---|---|---|---|
| HO_ranging_start[a] | 7 | 1 | Initial backoff window size for MS performing initial ranging during handover process, expressed as a power of 2. Range: 0-15 (the highest order bits shall be unused and set to 0). | SCa, OFDM, OFDMA (mobile only) |
| HO_ranging_end[a] | 8 | 1 | Final backoff window size for MS performing initial ranging during handover process, expressed as a power of 2. Range: 0-15 (the highest order bits shall be unused and set to 0). | SCa, OFDM, OFDMA (mobile only) |

***Insert the following table footnote immediately below Table 349:***

[a] SCa, OFDM, OFDMA (mobile only).

***Insert the following entries into Table 350 and Table 351:***

| Name | Type (1 byte) | Length | Value |
|---|---|---|---|
| Bandwidth request opportunity size | 157 | 2 | Size (in units of PS) of PHY payload that SS may use to format and transmit a bandwidth request message in a contention request opportunity. The value includes all PHY overhead as well as allowance for the MAC data the message may hold. |
| Contention ranging request opportunity size | 158 | 2 | Size (in units of PS) of the transmission opportunity that an SS may use to transmit a RNG-REQ message in a contention ranging request opportunity. The value includes all PHY overhead as well as the maximum SS/BS round trip propagation delay. |
| Contention ranging request burst size | 159 | 2 | Size (in units of PS) of PHY bursts that an SS shall use to transmit a RNG-REQ message in a contention ranging request opportunity. |

***Insert the following entries to Table 352:***

| Name | Type (1 byte) | Length | Value |
|---|---|---|---|
| Subchannelized Initial Ranging capable BS | 152 | 1 | Indicator that the BS is capable of receipt of subchannelized Initial Ranging requests (see 8.3.7.2).<br>Value 0 (default) indicates the BS is not capable of receiving subchannelized Initial Ranging Request.<br>Value 1 indicates the BS is capable of receiving subchannelized Initial Ranging Request. All subchannelization capable BSs shall be capable of receiving the subchannelized Initial Ranging Request.<br>Values 2–255 *Reserved.* |
| Contention ranging request opportunity size | 153 | 2 | Size (in units of PS) of the transmission opportunity that an SS may use to transmit a RNG-REQ message in a contention ranging request opportunity. The value includes all PHY overhead as well as the maximum SS/BS round trip propagation delay. |
| Contention ranging request burst size | 154 | 2 | Size (in OFDM symbols) of PHY bursts that an SS shall use to transmit a RNG-REQ message in a contention ranging request opportunity.<br>Default value: 4. |

***Change Table 353 as indicated:***

**Table 353—UCD PHY-specific channel encodings—WirelessMAN-OFDMA**

| Name | Type (1 byte) | Length | Value |
|---|---|---|---|
| Start of ranging codes group | 155 | 1 | Indicates the starting number, S, of the group of codes used for this uplink. If not specified, the default value shall be set to zero. All the ranging codes used on this uplink will be between $S$ and $((S+O+N+M+L) \bmod 256)$. Where,<br>$N$ is the number of initial-ranging codes<br>$M$ is the number of periodic-ranging codes<br>$L$ is the number of bandwidth-request codes<br>$O$ is the number of handover-ranging codes<br>The range of values is $0 \le S \le 255$. |
| Permutation base | 156 | 1 | Determines the ~~UL_IDcell~~ UL_PermBase parameter for the subcarrier permutation to be used on this uplink channel.<br>UL_PermBase = 7 LSBs of Permutation base. |
| UL allocated subchannels bitmap | 157 | 9 | This is a bitmap describing the physical subchannels allocated to the segment in the UL, when using the uplink PUSC permutation. The LSB of the first byte shall correspond to subchannel 0. For any bit that is not set, the corresponding subchannel shall not be used by the SS on that segment. When this TLV is not present, BS may allocate any subchannels to an SS. |

**Table 353—UCD PHY-specific channel encodings—WirelessMAN-OFDMA *(continued)***

| Name | Type (1 byte) | Length | Value |
|---|---|---|---|
| Optional permutation UL allocated subchannels bitmap | 158 | 13 | This is a bitmap describing the physical subchannels allocated to the segment in the UL, when using the uplink optional PUSC permutation (see 8.4.6.2.5). The LSB of the first byte shall correspond to subchannel 0. For any bit that is not set, the corresponding subchannel shall not be used by the SS on that segment. When this TLV is not present, BS may allocate any subchannels to an SS. |
| Band AMC Allocation Threshold | 159 | 1 | dB unit<br>threshold of the maximum of the standard deviations of the individual bands CINR measurements over time to trigger mode transition from normal subchannel to Band AMC |
| Band AMC Release Threshold | 160 | 1 | dB unit<br>threshold of the maximum of the standard deviations of the individual bands CINR measurements over time to trigger mode transition from Band AMC to normal subchannel |
| Band AMC Allocation Timer | 161 | 1 | Frame unit<br>Minimum required number of frames to measure the average and standard deviation for the event of Band AMC triggering |
| Band AMC Release Timer | 162 | 1 | Frame unit<br>Minimum required number of frames to measure the average and standard deviation for the event triggering from Band AMC to normal subchannel |
| Band Status Reporting MAX Period | 163 | 1 | Frame unit<br>Maximum period between refreshing the Band CINR measurement by the unsolicited REP-RSP |
| Band AMC Retry Timer | 164 | 1 | Frame unit<br>Backoff timer between consecutive mode transitions from normal subchannel to Band AMC when the previous request is failed |
| H-ARQ ACK delay for ~~U~~DL burst | 171 | 1 | 1 = one frame offset<br>2 = two frames offset<br>3 = three frames offset |
| UL AMC Allocated physical bands bitmap | 18 | 6 | A bitmap describing the physical bands allocated to the segment in the UL. When using the optional AMC permutation with regular MAPs (see 8.4.6.3). The LSB of the first byte shall correspond to the physical band 0. For any bit that is not set, the corresponding physical bands shall not be used by the SS on that segment. When this TLV is not present, BS may allocate any physical bands to an SS. |
| Maximum retransmission | 174 | 1 | Maximum number of retransmission in UL HARQ.<br>Default value shall be 4 retransmissions. |
| Normalized C/N override | 175 | 8 | This is a list of numbers, where each number is encoded by one nibble, and interpreted as a signed integer. The nibbles correspond in order to the list define by Table 334, starting from the second line, such that the LS nibble of the first byte corresponds to the second line in the table. The number encoded by each nibble represents the difference in normalized C/N relative to the previous line in the table. |

### Table 353—UCD PHY-specific channel encodings—WirelessMAN-OFDMA *(continued)*

| **Name** | **Type (1 byte)** | **Length** | **Value** |
|---|---|---|---|
| Size of CQICH_ID field | 176 | 1 | 0 = 0 bits(default)<br>1 = 3 bits<br>2 = 4 bits<br>3 = 5 bits<br>4 = 6 bits<br>5 = 7 bits<br>6 = 8 bits<br>7 = 9 bits<br>8...255 = *Reserved* |
| Normalized C/N override 2 | 177 | 8 | Bit#0–7: It shall be interpreted as signed integer in dB. It corresponds to the normalized C/N value in the first line (counting except for header cell of table)<br>Bit#8–63: This is a list of numbers, where each number is encoded by one nibble, and interpreted as a signed integer. The nibbles correspond in order to the list define by Table 334, starting from the second line (counting except for the header cell of table), such that the LS nibble of the first byte corresponds to the second line in the table. The number encoded by each nibble represents the difference in normalized C/N relative to the previous line in the table. |
| Band AMC Entry Average CINR | 185 | 1 | dB unit<br>Threshold of the average CINR of the whole bandwidth to trigger mode transition from normal subchannel to AMC |
| $\text{UpperBound}_{\text{AAS\_PREAMBLE}}$ | 186 | 1 | Signed in units of 0.25 dB |
| $\text{LowerBound}_{\text{AAS\_PREAMBLE}}$ | 187 | 1 | Signed in units of 0.25 dB |
| Allow AAS Beam Select Messages | 188 | 1 | Boolean to indicate whether unsolicited AAS Beam Select messages (see 6.3.2.3.41) should be sent by the MS. The default value is 1, with possible values of 0-1:<br>0 – MS should not send AAS Beam Select Messages<br>1 – MS may send AAS Beam Select Messages |
| Use CQICH indication flag | 189 | 1 | The N MSB values of this field represents the *N*-bit payload value on the Fast-Feedback channel reserved as indication flag for MS to initiate feedback on the Feedback header, where *N* is the number of payload bits used for S/N measurement feedback on the Fast-Feedback channel.<br>The value shall not be set to all zeros. |
| MS-specific up power offset adjustment step | 190 | 1 | Unsigned in units of 0.01 dB |
| MS-specific down power offset adjustment step | 191 | 1 | Unsigned in units of 0.01 dB |
| Minimum level of power offset adjustment | 192 | 1 | Signed in units of 0.1 dB |
| Maximum level of power offset adjustment | 193 | 1 | Signed in units of 0.1 dB |
| Handover Ranging Codes | 194 | 1 | Number of handover ranging CDMA codes. Possible values are 0-255. |
| Initial ranging interval | 195 | 1 | Number of frames between initial ranging interval allocation. |

**Table 353—UCD PHY-specific channel encodings—WirelessMAN-OFDMA *(continued)***

| Name | Type (1 byte) | Length | Value |
|---|---|---|---|
| Tx Power Report | 196 | 3 | Bit#0–3: Tx_Power_Report_Threshold, It is unsigned integer and shall be read in dB scale. When “0b1111” it means infinite.<br>Bit#4–7: It is unsigned integer whose value is d. Its value ‘d’ shall be interpreted as Tx_Power_Report_Interval =2^d. When “0b1111” it means infinite.<br>Bit#8–11: $\alpha_{p\_avg}$ in multiples of 1/16 (range [1/16,16/16])<br>Bit#12–15: Tx_Power_Report_Threshold, It is unsigned integer and shall be read in dB scale. When “0b1111” it means infinite. It shall be used when CQICH is allocated to the SS.<br>Bit#16–19: It is unsigned integer whose value is d. Its value ‘d’ shall be interpreted as Tx_Power_Report_Interval =2^d. When “0b1111” it means infinite. It shall be used when CQICH is allocated to the SS.<br>Bit#20–24: $\alpha_{p\_avg}$ in multiples of 1/16 (range [1/16,16/16]), It shall be used when CQICH is allocated to the SS. |
| Normalized C/N for Channel Sounding | 197 | 1 | Signed integer for the required C/N (dB) for Channel Sounding. This value shall override C/N for the channel sounding in Table 334a. |
| Initial_ranging_backoff_start | 198 | 1 | Initial backoff window size for initial ranging contention, expressed as a power of 2. Values of n range 0-15 (the highest order bits shall be unused and set to 0) This TLV shall be used in NBR-ADV message only to represent corresponding values that appear in UCD message fields. |
| Initial_ranging_backoff_end | 199 | 1 | Final backoff window size for initial ranging contention, expressed as a power of 2. Values of n range 0-15 (the highest order bits shall be unused and set to 0) This TLV shall be used in NBR-ADV message only to represent corresponding values that appear in UCD message fields. |
| Bandwidth_request_backoff_start | 200 | 1 | Initial backoff window size for contention BW requests, expressed as a power of 2. Values of n range 0-15 (the highest order bits shall be unused and set to 0). This TLV shall be used in NBR-ADV message only to represent corresponding values that appear in UCD message fields. |
| Bandwidth_request_backoff_end | 201 | 1 | Final backoff window size for contention BW requests, expressed as a power of 2. Values of n range 0-15 (the highest order bits shall be unused and set to 0). This TLV shall be used in NBR-ADV message only to represent corresponding values that appear in UCD message fields. |
| Uplink_burst_profile for multiple FEC types | 202 | 1 | May appear more than once (see 6.3.2.3.3 and 8.4.5.5). The length is the number of bytes in the overall object, including embedded TLV items. |

### 11.3.1.1 Uplink burst profile encodings

***Change Table 357 in 11.3.1.1 "Uplink burst profile encodings" as shown:***

**Table 357—UCD burst profile encodings WirelessMAN-OFDMA**

| Name | Type | Length | Value |
|---|---|---|---|
| FEC Code type and modulation type | 150 | 1 | ~~0 = QPSK (CC) 1/2~~<br>~~1 = QPSK (CC) 3/4~~<br>~~2 = 16-QAM (CC) 1/2~~<br>~~3 = 16-QAM (CC) 3/4~~<br>~~4 = 64-QAM (CC) 2/3~~<br>~~5 = 64-QAM (CC) 3/4~~<br>~~6 = QPSK (BTC) 1/2~~<br>~~7 = QPSK (BTC) 2/3~~<br>~~8 = 16-QAM (BTC) 3/5~~<br>~~9 = 16-QAM (BTC) 4/5~~<br>~~10 = 64-QAM (BTC) 5/8~~<br>~~11 = 64-QAM (BTC) 4/5~~<br>~~12 = QPSK (CTC) 1/2~~<br>~~13 = QPSK (CTC) 2/3~~<br>~~14 = QPSK (CTC) 3/4~~<br>~~15 = 16-QAM (CTC) 1/2~~<br>~~16 = 16-QAM (CTC) 3/4~~<br>~~17 = 64-QAM (CTC) 2/3~~<br>~~18 = 64-QAM (CTC) 3/4~~<br>~~19 = 64-QAM (CTC) 5/6~~<br>~~20 = QPSK (ZT CC) 1/2~~<br>~~21 = QPSK (ZT CC) 3/4~~<br>~~22= 16-QAM (ZT CC) 1/2~~<br>~~23= 16-QAM (ZT CC) 3/4~~<br>~~24= 64-QAM (ZT CC) 2/3~~<br>~~25= 64-QAM (ZT CC) 3/4~~<br>~~26..255 = *Reserved*~~<br><br>0 = QPSK (CC) 1/2<br>1 = QPSK (CC) 3/4<br>2 = 16-QAM (CC) 1/2<br>3 = 16-QAM (CC) 3/4<br>4 = 64-QAM (CC) 1/2<br>5 = 64-QAM (CC) 2/3<br>6 = 64-QAM (CC) 3/4<br>7 = QPSK (BTC) 1/2<br>8 = QPSK (BTC) 3/4<br>9 = 16-QAM (BTC) 3/5<br>10 = 16-QAM (BTC) 4/5<br>11 = 64-QAM (BTC) 5/8<br>12 = 64-QAM (BTC) 4/5<br>13 = QPSK (CTC) 1/2<br>14 = *Reserved*<br>15 = QPSK (CTC) 3/4<br>16 = 16-QAM (CTC) 1/2<br>17 = 16-QAM (CTC) 3/4<br>18 = 64-QAM (CTC) 1/2<br>19 = 64-QAM (CTC) 2/3<br>20 = 64-QAM (CTC) 3/4<br>21 = 64-QAM (CTC) 5/6<br>22 = QPSK (ZT CC) 1/2<br>23 = QPSK (ZT CC) 3/4<br>24= 16-QAM (ZT CC) 1/2<br>25= 16-QAM (ZT CC) 3/4<br>26= 64-QAM (ZT CC) 1/2<br>27= 64-QAM (ZT CC) 2/3<br>28= 64-QAM (ZT CC) 3/4<br>29 = QPSK (LDPC) 1/2<br>30= QPSK (LDPC) 2/3 A code<br>31= QPSK (LDPC) 3/4 A code<br>32 = 16-QAM (LDPC) 1/2<br>33 = 16-QAM (LDPC) 2/3 A code<br>34 = 16-QAM (LDPC) 3/4 A code<br>35 = 64-QAM (LDPC) 1/2<br>36 = 64-QAM (LDPC) 2/3 A code |

### Table 357—UCD burst profile encodings WirelessMAN-OFDMA *(continued)*

| Name | Type | Length | Value |
|---|---|---|---|
| | | | 37 = 64-QAM (LDPC) 3/4 A code<br>38 = QPSK (LDPC) 2/3 B code<br>39 = QPSK (LDPC) 3/4 B code<br>40= 16-QAM (LDPC) 2/3 B code<br>41 = 16-QAM (LDPC) 3/4 B code<br>42 = 64-QAM (LDPC) 2/3 B code<br>43 = 64-QAM (LDPC) 3/4 B code<br>44 = QPSK (CC with optional interleaver) 1/2<br>45 = QPSK (CC with optional interleaver) 3/4<br>46 = 16-QAM (CC with optional interleaver) 1/2<br>47 = 16-QAM (CC with optional interleaver) ¾<br>48 = 64-QAM (CC with optional interleaver) 2/3<br>49= 64-QAM (CC with optional interleaver) 3/4<br>50 = QPSK (LDPC) 5/6<br>51 = 16-QAM(LDPC) 5/6<br>52 = 64-QAM(LDPC) 5/6<br>53..255 = *Reserved* |
| Ranging data ratio | 151 | 1 | Reducing factor in units of 1 dB, between the power used for this burst and power should be used for CDMA Ranging. It shall be encoded as signed integer. |
| ~~Normalized C/N override~~ | ~~152~~ | ~~5~~ | ~~This is a list of numbers, where each number is encoded by one nibble, and interpreted as a signed integer. The nibbles correspond in order to the list define by Table 334, starting from the second line, such that the LS nibble of the first byte corresponds to the second line in the table. The number encoded by each nibble represents the difference in normalized C/N relative to the previous line in the table.~~ |

## 11.4 DCD management message encodings

### 11.4.1 DCD channel encodings

***Change Table 358 as indicated:***

### Table 358—DCD channel encoding

| Name | Type (1 byte) | Length | Value (variable length) | PHY scope |
|---|---|---|---|---|
| TTG | 7 | ~~1~~2 | TTG (in PSs).<br>Used on TDD systems only. | SCa,<br>~~OFDM~~,<br>OFDMA |
| RTG | 8 | 1 | RTG (in PSs).<br>Used on TDD systems only. | SCa,<br>~~OFDM,~~<br>OFDMA |
| ~~*RSS*~~*EIRxP*$_{\mathrm{IR,max}}$ | 9 | 2 | Initial Ranging ~~Max. Received Signal Strength~~ maximum equivalent isotropic received power at BS Signed in units of 1 dBm. | All |

### Table 358—DCD channel encoding *(continued)*

| Name | Type (1 byte) | Length | Value (variable length) | PHY scope |
|---|---|---|---|---|
| Frame Number | 15 | 3 | The number of the frame containing the DCD message or the number of the frame of the last fragment of the DCD message if the DCD is fragmented. | OFDM |
| ~~Size of CQICH_ID field~~ | ~~16~~ | ~~1~~ | ~~0 = Reserved~~0 bits<br>~~1 = 3 bits~~<br>~~2 = 4 bits~~<br>~~3 = 5 bits~~<br>~~4 = 6 bits~~<br>~~5 = 7 bits~~<br>~~6 = 8 bits~~<br>~~7 = 9 bits~~<br>~~8...255 = Reserved~~ | ~~OFDMA~~ |
| H-ARQ ACK delay for ~~D~~UL burst | 17 | 1 | 1 = 1 frame offset<br>2 = 2 frame offset<br>3 = 3 frame offset | OFDMA |

***Insert the following entries into Table 358:***

### Table 358—DCD channel encoding

| Name | Type (1 byte) | Length | Value (variable length) | PHY scope |
|---|---|---|---|---|
| Permutation type for broadcast region in HARQ zone | 19 | 1 | 0 = PUSC<br>1 = FUSC<br>2 = optional FUSC<br>3 = AMC | OFDMA |
| Maximum retransmission | 20 | 1 | Maximum number of retransmission in DL HARQ. Default value shall be 4 retransmissions. | OFDMA |
| Default RSSI and CINR averaging parameter | 21 | 1 | Bit #0-3: Default averaging parameter $\alpha_{avg}$ for physical CINR measurements, in multiples of 1/16 (range [1/16, 16/16], 0x0 for 1/16, 0xF for 16/16).<br>Bit #4-7: Default averaging parameter $\alpha_{avg}$ for RSSI measurements, in multiples of 1/16 (range [1/16, 16/16], 0x0 for 1/16, 0xF for 16/16).<br>Default value shall be 0x3. | OFDMA |
| DL AMC allocated physical bands bitmap | 22 | 6 | A bitmap describing the physical bands allocated to the segment in the DL, when allocating AMC subchannels through the HARQ MAP, or through the Normal MAP, or for Band-AMC CINR reports, or using the optional AMC permutation (see 8.4.6.3). The LSB of the first byte shall correspond to band 0. For any bit that is not set, the corresponding band shall not be used by the SS on that segment.<br>When this TLV is not present, BS may allocate any physical bands to an SS | OFDMA |

### Table 358—DCD channel encoding *(continued)*

| Name | Type (1 byte) | Length | Value (variable length) | PHY scope |
|---|---|---|---|---|
| DL region definition | 34 | *variable* | Num_ region (6 bits for the number of regions, 2 bit reserved)<br>For (i = 0; i<Num_ region;i++){<br>OFDMA symbol offset (8 bits)<br>Subchannel offset (6 bits)<br>No. OFDMA symbols (8 bits)<br>No. subchannels (6 bits)<br>}<br>padding bits to align boundary of byte | — |
| HO type support | 50 | 1 | Bit 0: HO<br>Bit 1: MDHO<br>Bit 2: FBSS HO<br>Bit 3-7: *Reserved* | OFDMA |
| H_Add Threshold | 31 | 1 | Threshold used by the MS to add a neighbor BS to the diversity set. When the CINR of a neighbor BS is higher than H_Add, the MS should send MOB_MSHO-REQ to request adding this neighbor BS to the diversity set. This threshold is used for the MS that is perform MDHO/FBSS HO.<br>It is in the unit of dB If the BS does not support FBSS HO/MDHO, this value is not set. | OFDMA |
| H_Delete Threshold | 32 | 1 | Threshold used by the MS to drop a BS from the diversity set. When the CINR of a BS is lower than H_Delete., the MS should send MOB_MSHO-REQ to request dropping this BS from the diversity set. This threshold is used for the MS that is performing MDHO/FBSS HO. It is in the unit of dB. If the BS does not support FBSS HO/MDHO, this value is not set. | OFDMA |
| ASR(Anchor Switch Report) Slot Length (M) and Switching Period (L) | 33 | 1 | Bit #0 - #3: M, in units of frames<br>Bit #4 - #7: L, in units of ASR slots | OFDMA |
| Paging Group ID | 35 | 2 | One or more logical affiliation grouping of BS (see 6.3.2.3.55) | — |
| TUSC1 permutation active subchannels bitmap | 36 | 9 | This is a bitmap describing the subchannels allocated to the segment in the DL, when using the TUSC1 permutation (see 8.4.6.1.2.4). The LSB of the first byte shall correspond to subchannel 0. For any bit that is not set, the MS on that segment shall not use the corresponding subchannel. The active subchannels are renumbered consecutively starting from 0. | — |
| TUSC2 permutation active subchannels bitmap | 37 | 13 | This is a bitmap describing the subchannels allocated to the segment in the DL, when using the TUSC2 permutation (see 8.4.6.1.2.5). The LSB of the first byte shall correspond to subchannel 0. For any bit that is not set, the MS on that segment shall not use the corresponding subchannel. The active subchannels are renumbered consecutively starting from 0. | — |

**Table 358—DCD channel encoding *(continued)***

| Name | Type (1 byte) | Length | Value (variable length) | PHY scope |
|---|---|---|---|---|
| Hysteresis margin | 51 | 1 | Hysteresis margin is used by the MS to include a neighbor BS to a list of possible target BSs. When the CINR of a neighbor BS is larger than the sum of the CINR of the current serving BS and the hysteresis margin for the time-to-trigger duration, then the neighbor BS is included in the list of possible target BSs in MOB_MSHO-REQ. It is the unit of dB and applicable for only HHO. | All |
| Time-to-Trigger duration | 52 | 1 | Time-to-Trigger duration is the time duration for MS decides to select a neighbor BS as a possible target BS. It is the unit of ms and applicable only for HHO. | All |
| Trigger | 54 | *variable* | The Trigger is a compound TLV value that indicates trigger metrics. The trigger in this encoding is defined for serving BS or commonly applied to neighbor BSs. | — |
| N+I | 60 | 1 | The operator will define the N+I (Noise + Interference) based on the related RF system design calculations. | OFDM |
| Downlink_burst_profile for multiple FEC types | 153 | 1 | May appear more than once (see 6.3.2.3.1 and 8.4.5.5). The length is the number of bytes in the overall object, including embedded TLV items. | OFDMA |
| BS Restart Count | 154 | 1 | The value is incremented by one whenever BS restarts (see 6.3.9.11). The value rolls over from 0 to 255. | All |

***Insert the following to the end of 11.4.1:***

The trigger TLV (type 54) in Table 358 is encoded using the description in Table 358a.

**Table 358a—Trigger TLV description**

| Name | Type | Length (1 byte) | Value |
|---|---|---|---|
| Type/Function/Action | 54.1 | 1 | See Table 358b for description |
| Trigger value | 54.2 | 1 | Trigger value is the value used in comparing measured metric for determining a trigger condition |
| Trigger averaging duration | 54.3 | 1 | Trigger averaging duration is the time in ms over which the metric measurements are averaged. When the mean value of the measurement meets the trigger condition, the MS reacts using the specified action. |

The Type/function/action byte field of the trigger description in Table 358a is described in Table 358b.

**Table 358b—Trigger; Type/function/action description**

| Name | Length | Value |
|---|---|---|
| Type | 2 bits(MSB) | Trigger metric type:<br>0x0: CINR metric<br>0x1: RSSI metric<br>0x2: RTD metric<br>0x3: *Reserved* |
| Function | 3 bits | Computation defining trigger condition:<br>0x0: *Reserved*<br>0x1: Metric of neighbor BS is greater than absolute value<br>0x2: Metric of neighbor BS is less than absolute value<br>0x3: Metric of neighbor BS is greater than serving BS metric by relative value<br>0x4: Metric of neighbor BS is less than serving BS metric by relative value<br>0x5: Metric of serving BS greater than absolute value<br>0x6: Metric of serving BS less than absolute value<br>0x7: *Reserved*<br>*NOTE—0x1-0x4 not applicable for RTD trigger metric* |
| Action | 3 bits (LSB) | Action performed upon reaching trigger condition:<br>0x0: *Reserved*<br>0x1: Respond on trigger with MOB_SCN-REP after the end of each scanning interval<br>0x2: Respond on trigger with MOB_MSHO-REQ<br>0x3: On trigger, MS starts neighbor BS scanning process by sending MOB_SCN-REQ<br>0x4-0x7: *Reserved*<br>*NOTE—0x3 is not applicable when neighbor BS metrics are defined (i.e., only Function values 0x5-6 are applicable).* |

The CINR, RSSI, and RTD metric fields are encoded according to the descriptions found within 6.3.2.3.50 for the MOB_SCN-REP message and 6.3.2.3.53 for the MOB_MSHO-REQ message.

The RTD trigger shall only be measured on the serving BS rather than relative to or from neighbor BSs. The trigger functions 0x5 and 0x6 shall be the only applicable ones for the RTD trigger. When the Type is set to RTD metric (i.e., 0x2), only either of the trigger functions 0x5 or 0x6 shall be applicable.

### 11.4.2 Downlink burst profile encodings

***Delete the first paragraph and Table 359.***

***Delete the fields 'DIUC mandatory exit threshold' and 'DIUC minimum entry threshold' from Table 360, Table 361, Table 362, and Table 363.***

*Change Table 363 as indicated:*

### Table 363—DCD burst profile encodings—WirelessMAN-OFDMA

| Name | Type (1 byte) | Length | Value (variable length) |
|---|---|---|---|
| ~~FEC Code type~~ | ~~150~~ | ~~1~~ | ~~0 = QPSK (CC) 1/2~~<br>~~1 = QPSK (CC) 3/4~~<br>~~2 = 16-QAM (CC) 1/2~~<br>~~3 = 16-QAM (CC) 3/4~~<br>~~4 = 64-QAM (CC) 2/3~~<br>~~5 = 64-QAM (CC) 3/4~~<br>~~6 = QPSK (BTC) 1/2~~<br>~~7 = QPSK (BTC) 3/4 or 2/3~~<br>~~8 = 16-QAM (BTC) 3/5~~<br>~~9 = 16-QAM (BTC) 4/5~~<br>~~10 = 64-QAM (BTC) 2/3 or 5/8~~<br>~~11 = 64-QAM (BTC) 5/6 or 4/5~~<br>~~12 = QPSK (CTC) 1/2~~<br>~~13 = QPSK (CTC) 2/3~~<br>~~14 = QPSK (CTC) 3/4~~<br>~~15 = 16-QAM (CTC) 1/2~~<br>~~16 = 16-QAM (CTC) 3/4~~<br>~~17 = 64-QAM (CTC) 2/3~~<br>~~18 = 64-QAM (CTC) 3/4~~<br>~~19 = 64-QAM (CTC) 5/6~~<br>~~20 = QPSK (ZT CC) 1/2~~<br>~~21 = QPSK (ZT CC) 3/4~~<br>~~22= 16-QAM (ZT CC) 1/2~~<br>~~23= 16-QAM (ZT CC) 3/4~~<br>~~24= 64-QAM (ZT CC) 2/3~~<br>~~25= 64-QAM (ZT CC) 3/4~~<br>~~26..255 = *Reserved*~~ |
| FEC Code type | 150 | 1 | 0 = QPSK (CC) 1/2<br>1 = QPSK (CC) 3/4<br>2 = 16-QAM (CC) 1/2<br>3 = 16-QAM (CC) 3/4<br>4 = 64-QAM (CC) 1/2<br>5 = 64-QAM (CC) 2/3<br>6 = 64-QAM (CC) 3/4<br>7 = QPSK (BTC) 1/2<br>8 = QPSK (BTC) 3/4 or 2/3<br>9 = 16-QAM (BTC) 3/5<br>10 = 16-QAM (BTC) 4/5<br>11 = 64-QAM (BTC) 2/3 or 5/8<br>12 = 64-QAM (BTC) 5/6 or 4/5<br>13 = QPSK (CTC) 1/2<br>14 = *Reserved*<br>15 = QPSK (CTC) ¾<br>16 = 16-QAM (CTC) 1/2<br>17 = 16-QAM (CTC) 3/4<br>18 = 64-QAM (CTC) 1/2<br>19 = 64-QAM (CTC) 2/3<br>20 = 64-QAM (CTC) 3/4<br>21 = 64-QAM (CTC) 5/6<br>22 = QPSK (ZT CC) 1/2<br>23 = QPSK (ZT CC) 3/4<br>24= 16-QAM (ZT CC) 1/2<br>25= 16-QAM (ZT CC) 3/4<br>26= 64-QAM (ZT CC) 1/2<br>27= 64-QAM (ZT CC) 2/3<br>28= 64-QAM (ZT CC) 3/4<br>29..43 = *Reserved*<br>44 = QPSK (CC with optional interleaver) 1/2<br>45 = QPSK (CC with optional interleaver) 3/4<br>46 = 16-QAM (CC with optional interleaver) 1/2<br>47 = 16-QAM (CC with optional interleaver) ¾<br>48 = 64-QAM (CC with optional interleaver) 2/3<br>49 = 64-QAM (CC with optional interleaver) 3/4<br>50..255 = *Reserved* |

## 11.5 RNG-REQ message encodings

*Insert the following rows into Table 364:*

**Table 364—RNG-REQ message encodings**

| Name | Type (1 byte) | Length | Value (variable-length) |
|---|---|---|---|
| Serving BS ID | 5 | 6 | The unique identifier of the former serving BS |
| Ranging Purpose Indication | 6 | 1 | Bit #0: HO indication (when this bit is set to 1 in combination with other included information elements indicates the MS is currently attempting to HO or Network Re-entry from Idle Mode to the BS)<br>Bit #1: Location Update Request (when this bit is set to 1, it indicates MS action of Idle Mode Location Update Process)<br>Bits 2-7: *Reserved* |
| HO ID | 7 | 1 | ID assigned by the target BS for use in initial ranging during MS handover to it (see 6.3.20.5) |
| Paging Controller ID | 9 | 6 | This is a logical network identifier for the serving BS or other network entity retaining MS service and operational information and/or administering paging activity for the MS while in Idle Mode |
| MAC Hash Skip Threshold | 10 | 2 | Maximum number of successive MOB_PAG-ADV messages that may be sent from a BS without individual notification for an MS, including MAC address hash of an MS for which Action Code is 00, 'No Action Required'. |
| Power_Saving_Class_ Parameters | 21 | *variable* | Compound TLV to specify Power Saving Class definition and/or operation |
| Power down Indicator | 8 | 1 | Presence of item in message indicates the MS is currently attempting to switch power off, regardless of value |
| Enabled-Action-Triggered | 11 | 1 | Indicates action performed upon reaching trigger condition in sleep mode<br>If bit#0 is set to 1, respond on trigger with MOB_SCN-REPORT<br>If bit#1 is set to 1, respond on trigger with MOB_MSHO-REQ<br>If bit#2 is set to 1, on trigger, MS starts neighboring BS scanning process by sending MOB_SCN-REQ<br>bit#3-bit#7: *Reserved*. Shall be set to 0. |
| Requested downlink repetition coding level | 12 | 1 | This parameter indicates repetition coding level Indication requested by the MS for downlink traffic. If this TLV is not present in the RNG-REQ, it shall be assumed that repetition coding is not requested.<br>Bit 0–1: Repetition coding level:<br>0b00 – no repetition<br>0b01 – Repetition coding of 2<br>0b10 – Repetition coding of 4<br>0b11 – Repetition coding of 6<br>The BS shall ignore this field if the DIUC requested in the 'requested downlink burst profile' TLV refers to modulations higher than QPSK.<br><br>Bits 2–7: *Reserved* |

***Insert new text and Table 364a:***

Power_Saving_Class_Parameters Value field is composed from a number of encapsulated TLV fields as specified in Table 364a.

**Table 364a—Power saving class parameters**

| Name | Type (1 byte) | Length | Value (variable-length) |
|---|---|---|---|
| Flags | 1 | 1 | Bit 0: Definition<br>1 = Definition of Power Saving Class present<br>Bit 1: Operation (RNG-RSP only)<br>0 = Deactivation of Power Saving Class (for<br>1 = Activation of Power Saving Class<br>types 1 and 2 only)<br>Bit 2: TRF-IND_Required<br>For Power Saving Class Type I only.<br>1 = BS shall transmit at least one TRF-IND message during each listening window of the Power Saving Class. This bit shall be set to 0 for another types<br>Bits 3–7: *Reserved* |
| Power_Saving_Class_ID | 2 | 1 | Assigned Power Saving Class identifier<br>Not used for RNG-REQ message |
| Power_Saving_Class_Type | 3 | 1 | Power Saving Class Type as specified in 6.3.2.3 |
| Start_frame_number | 4 | 1 | Start frame number for first sleep window<br>Not used for RNG-REQ message |
| initial-sleep window | 5 | 1 | Initial-sleep window |
| listening window | 6 | 1 | Assigned Duration of MS listening interval (measured in frames) |
| final-sleep window base | 7 | 1 | Assigned final value for sleep interval (measured in frames)—base |
| final-sleep window exponent | 8 | 1 | Assigned final value for sleep interval (measured in frames)—exponent |
| SLPID | 9 | 1 | A number assigned by the BS whenever an MS is instructed to enter sleep mode |
| CID | 10 | 2 | CID of connection to be included into the Power Saving Class. There may be several TLVs of this type in a single compound Power_Saving_Class_Parameters TLV |
| Direction | 11 | 1 | Direction for management connection, which is added to Power Saving Class |

## 11.6 RNG-RSP management message encodings

***Change subclause 11.6 as indicated:***

CID update encodings (11.7.9) and SAID update encodings (11.7.18) may be used in RNG-RSP for re-establishment of connections.

***Change the following rows in Table 367 as indicated:***

**Table 367—RNG-RSP message encodings**

| Name | Type (1 byte) | Length | Value (variable-length) | PHY Scope |
|---|---|---|---|---|
| Timing Adjust | 1 | 4 | Tx timing offset adjustment (signed 32-bit). The amount of time required to ~~advance~~adjust SS transmission so ~~frames~~the bursts will arrive at the expected time instance at the BS. Units are PHY specific (see 10.3). The SS shall advance its burst transmission time if the value is negative and delay its burst transmission if the value is positive. | All |
| Offset Frequency Adjust | 3 | 4 | Tx frequency offset adjustment (signed 32-bit, Hz units)<br>Specifies the relative change in transmission frequency that the SS is to make in order to better match the BS. (This is fine-frequency adjustment within a channel, not reassignment to a different channel.). The SS shall increase its transmit frequency if the value is positive and decrease its transmit frequency if the value is negative. | All |
| Ranging Status | 4 | 1 | Used to indicate whether uplink messages are received within acceptable limits by BS.<br>1 = continue, 2 = abort, 3 = success~~, 4 = rerange~~ | All |
| Uplink channel ID override | 6 | 1 | ~~Licensed bands: The identifier of the uplink channel with which the SS is to redo initial ranging (not used with PHYs without channelized uplinks).~~<br>License-exempt bands: The Channel Nr (see 8.5.1) where the SS should redo initial ranging. | All |

***Insert the following rows to Table 367:***

**Table 367—RNG-RSP message encodings**

| Name | Type (1 byte) | Length | Value (variable-length) | PHY Scope |
|---|---|---|---|---|
| Service Level Prediction | 17 | 1 | This value indicates the level of service the MS can expect from this BS. The following encodings apply:<br>0 = No service possible for this MS<br>1 = Some service is available for one or several service flows authorized for the MS.<br>2 = For each authorized service flow, a MAC connection can be established with QoS specified by the AuthorizedQoSParamSet.<br>3 = No service level prediction available. | All |
| Global Service Class Name | 18 | 4 | — | All |
| QoS Parameters | [145/146] | *variable* | Compound TLV incorporating one or more 11.13 QoS Parameter Set definition encodings | All |

**Table 367—RNG-RSP message encodings *(continued)***

| Name | Type (1 byte) | Length | Value (variable-length) | PHY Scope |
|---|---|---|---|---|
| SFID | [145/146].1 | 4 | — | All |
| Resource Retain Flag | 20 | 1 | This value indicates whether the former serving BS retains the connection information of the MS.<br>0 = the connection information for the MS is deleted<br>1 = the connection information for the MS is retained | All |
| HO Process Optimization | 21 | 2 | For each Bit location, a value of ‘0’ indicates the associated re-entry management messages shall be required, a value of ‘1’ indicates the re-entry management message may be omitted.<br>Bit #0: Omit SBC-REQ management messages during current re-entry processing<br>Bit #1: Omit PKM Authentication phase except TEK phase during current re-entry processing<br>Bit #2: Omit PKM TEK creation phase during re-entry processing<br>Bit #3: Omit Network Address Acquisition management messages during current reentry processing<br>Bit #4: Omit Time of Day Acquisition management messages during current reentry processing<br>Bit #5: Omit TFTP management messages during current re-entry processing<br>Bit #6: Full service and operational state transfer or sharing between Serving BS and Target BS (ARQ, timers, counters, MAC state machines, etc.)<br>Bit #7: post-HO re-entry MS DL data pending at target BS<br>Bit #8: BS shall send an unsolicited SBC-RSP management message with updated capabilities information in case capabilities of Target BS are different from the ones of Serving BS<br>Bit #9: Omit REG-REQ management message during current re-entry processing<br>Bit #10: BS shall send an unsolicited REG-RSP management message with updated capabilities information<br>Bit #11: (Target) BS supports virtual SDU SN. If Bit#11=1 and MS supports SDU SN, it shall issue SN_REPORT upon completion of HO to this BS.<br>Bit #12: MS shall send Bandwidth Request header with zero BR as a notification of MS’s successful re-entry registration.<br>Bit #13: If this bit is set to 1, MS shall trigger a higher layer protocol required to refresh its traffic IP address (e.g. DHCP Discover [IETF RFC 2131] or Mobile IPv4 re-registration [IETF RFC 3344]).<br>#14–15: *Reserved* | All |
| HO ID | 22 | 1 | ID assigned by the target BS for use in initial ranging during MS handover to it (see 6.3.20.5) | All |

**Table 367—RNG-RSP message encodings *(continued)***

| Name | Type (1 byte) | Length | Value (variable-length) | PHY Scope |
|---|---|---|---|---|
| SBC-RSP encodings | 29 | variable | SBC-RSP TLV items for HO optimization<br>Only transmitted if HO Process Optimization[bit#8]==1 | All |
| REG-RSP encodings | 30 | variable | REG-RSP TLV items for HO optimization<br>Only transmitted if HO Process Optimization[bit#9]==1. | All |
| Location Update Response | 23 | 1 | 0x00= Failure of Location Update. The MS shall perform Network Re-entry from Idle Mode<br>0x01= Success of Location Update<br>0x10, 0x11: *Reserved* | All |
| Paging Information | 24 | 5 | Paging Information shall only be included if Location Update Response=0x01 and if Paging Information has changed<br>Bits 15:0 – PAGING_CYCLE—Cycle in which the paging message is transmitted within the paging group<br>Bits 23:16 – PAGING OFFSET—Determines the frame within the cycle in which the paging message is transmitted. Must be smaller than PAGING CYCLE value<br>Bits 39:24 – Paging Group ID—ID of the paging group the MS is assigned to | All |
| Paging Controller ID | 25 | 6 | This is a logical network identifier for the serving BS or other network entity retaining MS service and operational information and/or administering paging activity for the MS while in Idle Mode. Paging Controller ID shall only be included if Location Update Response=0x01 and if Paging Controller ID has changed | All |
| MAC Hash Skip Threshold | 28 | 2 | Maximum number of successive MOB_PAG-ADV messages that may be sent from a BS without individual notification for an MS, including MAC address hash of an MS for which Action Code for the MS is 0b00, 'No Action Required'. | All |
| Next Periodic Ranging | 26 | 2 | This value indicates offset of the frame in which the periodic ranging will be performed with respect to the frame where RNG-RSP is transmitted.<br>This TLV encoding is included in RNG-RSP message only when its ranging status is 'success'<br>If MS receives RNG-RSP message with 'Next Periodic Ranging' = 0, it shall terminate sleep mode and return to Normal Opeation. | All |
| Power_Saving_Class_ Parameters | 27 | *variable* | Compound TLV to specify Power Saving Class definition and/or operation | All |

**Table 367—RNG-RSP message encodings *(continued)***

| Name | Type (1 byte) | Length | Value (variable-length) | PHY Scope |
|---|---|---|---|---|
| Enabled-Action-Triggered | 32 | 1 | Indicates action performed upon reaching trigger condition in sleep mode<br>If bit#0 is set to 1, respond on trigger with MOB_SCN-REPORT<br>If bit#1 is set to 1, respond on trigger with MOB_MSHO-REQ<br>If bit#2 is set to 1, on trigger, MS starts neighboring BS scanning process by sending MOB_SCN-REQ<br>bit#3–bit#7: *Reserved*. Shall be set to 0. | All |
| Downlink Operational Burst Profile for OFDMA | 33 | 2 | This parameter is sent in response to the RNG-REQ Requested Downlink Burst Profile parameter.<br>Byte 0:<br>Bits 0–3: Specifies the least robust DIUC that may be used by the BS for transmissions to the MS.<br>Bits 4–7: Specifies Repetition Coding Indication<br>0b0000 – No repetition coding<br>0b0001 – Repetition coding of 2<br>0b0010 – Repetition coding of 4<br>0b0011 – Repetition coding of 6The repetition coding indication shall be 0b0000if the DIUC refers to modulations higher than QPSK.<br>Byte 1: Configuration Change Count value of DCD defining the burst profile associated with DIUC. | OFDMA |

***Insert the following text below Table 367:***

Power_Saving_Class_Parameters Value field is composed from a number of encapsulated TLV fields as specified in Table 364a.

***Insert new subclause 11.6.1:***

### 11.6.1 SA Challenge Tuple

This compound TLV enables the BS to abbreviate the 3-way handshake during handover by appending the initial challenge to the RNG-RSP message.

| Name | Type | Length | Value | Scope |
|---|---|---|---|---|
| SA Challenge | 31 | variable | Compound | RNG-RSP |

The following TLV values shall appear in each SA Challenge TLV:

| Name | Type | Length | Value |
|---|---|---|---|
| BS_Random | 31.1 | 8 bytes | — |
| AKId | 31.2 | 8 bytes | — |

## 11.7 REG-REQ/RSP management message encodings

***Insert new Table 369a:***

Table 369a—REG-REQ/RSP management message encodings

| Type | Parameter | Type | Parameter |
|---|---|---|---|
| 1 | ARQ Parameters | 23 | Maximum Number of Bursts Transmitted Concurrently to the MS |
| 2 | SS Management Support | 24 | CID Update Encodings |
| 3 | IP Management Support | 25 | Compressed CID Update Encodings |
| 4 | IP Version | 26 | Method for Allocating IP Address for the Secondary Management Connection |
| 5 | Secondary Management CID | 27 | Handover Supported |
| 6 | The Number of Uplink Transport-CID Supported | 28 | System Resource Retain Timer |
| 7 | Classification, PHS Options, SDU Encapsulation Support | 29 | HO Process Optimization MS Timer |
| 8 | Maximum Number of Classifiers | 30 | MS Handover Retransmission Timer |
| 9 | PHS Support | 31 | Mobility Features Supported |
| 10 | ARQ Support | 32 | Sleep Mode Recovery Time |
| 11 | DSx Flow Control | 33 | MS-PREV-IP-ADDR |
| 12 | MAC CRC Support | 34 | SKIP-ADDR-ACQUISTION |
| 13 | MCA Flow Control | 35 | SAID Update Encodings |
| 14 | Multicast Polling Group CID Support | 36 | Total Number of Provisional Service Flow |
| 15 | The Number of Downlink Transport CID Supported | 37 | Idle Mode Timeout |
| 16 | *Reserved* | 38 | SA TEK Update |
| 17 | *Reserved* | 39 | GKEK Parameters |
| 18 | SS MAC Address (in Mesh mode only) | 40 | ARQ-ACK Type |
| 19 | *Reserved* | 41 | MS HO Connections Parameters Processing Time |

**Table 369a—REG-REQ/RSP management message encodings *(continued)***

| Type | Parameter | Type | Parameter |
|---|---|---|---|
| 20 | Maximum MAC Data per Frame Support | 42 | MS HO TEK Processing Time |
| 21 | Packing Support | 43 | MAC Header and Subheader Support |
| 22 | MAC Extended rtPS Support | 44 | SN Reporting Base |

### 11.7.2 SS management support

***Change the subclause as indicated***

This field indicates whether or not the SS is managed by standard-based IP messages over the secondary management connection. When the SS indicates in the REG-REQ that it is managed, the BS shall respond with this field in the REG-RSP message to indicate if the BS supports SS management. If BS also supports SS management, the BS and SS shall perform stages g), h), and i) of the initial network entry process (see 6.3.9). Otherwise, if the BS or the SS does not support SS management, these stages shall be skipped by the BS and SS.

| Type | Length | Value | Scope |
|---|---|---|---|
| 2 | 1 | 0: no secondary management connection<br>1: secondary management connection | REG-REQ<br>REG-RSP |

### 11.7.6 Number of ~~uplink~~ CIDs supported

***Change the title of 11.7.6 and include subclauses 11.7.6.1 and 11.7.6.2 as indicated:***

#### 11.7.6.1 Number of uplink transport CIDs supported

This field shows the number of Uplink transport CIDs the SS can support. ~~The minimum value is three for managed SSs and two for unmanaged SSs. An SS shall support a Basic CID, a Primary Management CID, and 0 or more Transport CIDs. A managed SS shall also support a Secondary Management CID~~.

| Type | Length | Value | Scope |
|---|---|---|---|
| 6 | 2 | Number of Uplink transport CIDs the SS can support. | REG-REQ, REG-RSP |

#### 11.7.6.2 Number of downlink transport CIDs supported

This field shows the number of Downlink transport CIDs the SS can support.

| Type | Length | Value | Scope |
|---|---|---|---|
| 15 | 2 | Number of Downlink transport CIDs the SS can support. | REG-REQ, REG-RSP |

### 11.7.7 Convergence sublayer capabilities

***Change subclause 11.7.7.1 as indicated:***

#### 11.7.7.1 Classification/PHS options and SDU encapsulation support

This parameter indicates which classification/PHS options and SDU encapsulation the SS supports. By default, Packet, IPv4 and IEEE 802.3/Ethernet shall be supported, thus absence of this parameter in REG-REQ means that named options are supported by the SS. When the length field of the TLV is 2 or 4, it indicates that bits 16-31 are zero.

| Type | Length | Value | Scope |
|---|---|---|---|
| 7 | 2 or 4 | Bit #0: ATM<br>Bit #1: Packet, IPv4<br>Bit #2: Packet, IPv6<br>Bit #3: Packet, IEEE 802.3/Ethernet<br>Bit #4: Packet, IEEE 802.1/Q VLAN<br>Bit #5: Packet, IPv4 over IEEE 802.3/Ethernet<br>Bit #6: Packet, IPv6 over IEEE 802.3/Ethernet<br>Bit #7: Packet, IPv4 over IEEE 802.1Q VLAN<br>Bit #8: Packet, IPv6 over IEEE 802.1Q VLAN<br>~~Bits #9-15: *Reserved*; Shall be set to zero~~<br>Bit #9: Packet, IEEE 802.3/Ethernet (with optional IEEE 802.1Q VLAN tags) and ROHC header compression<br>Bit 10: Packet, IEEE 802.3/Ethernet (with optional IEEE 802.1Q VLAN tags) and ECRTP header compression<br>Bit 11: Packet, IP (v4 or v6) with ROHC header compression<br>Bit 12: Packet, IP (v4 or v6) with ECRTP header compression<br>Bits #13–31: *Reserved*; Shall be set to zero | REG-REQ<br>REG-RSP |

#### 11.7.7.3 PHS support

***Change the table in the subclause as indicated:***

| Type | Length | Value | Scope |
|---|---|---|---|
| 9 | ~~2~~1 | 0: no PHS support<br>1: ATM PHS<br>2: Packet PHS<br>3: ATM and Packet PHS | REG-REQ<br>REG-RSP |

### 11.7.8 SS capabilities encodings

***Delete 11.7.8.3 MAC CRC support.***

***Change 11.7.8.6 to 11.8.4 and change its scope to SBC-REQ SBC-RSP.***

***Change 11.7.8.7 to 11.8.5, change its scope to SBC-REQ SBC-RSP and change the first paragraph as indicated:***

This field indicates authorization policy that both SS and BS need to negotiate and synchronize. A bit value of 0 indicates “not supported” while 1 indicates “supported.” If this field is omitted, then both SS and BS shall use the IEEE 802.16 security, constituting X.509 digital certificates and the RSA public key encryption algorithm, as authorization policy. If this field is present and equal to 0, PKM shall be considered disabled.

***Change 11.7.8.8 to 11.8.6 and change its scope to SBC-REQ SBC-RSP***

***Insert new subclause 11.7.8.10:***

#### 11.7.8.10 Maximum MAC data per frame support

This compound TLV defines the maximum amount of MAC level data including MAC headers and HARQ retransmission bursts the MS is capable of processing in the DL/UL part of a single MAC frame. A value of 0 indicates such limitation does not exist, except the limitation of the physical medium. If those TLVs are absent then the default value (0) should be used.

| Name | Type | Length | Value | Scope |
|---|---|---|---|---|
| Maximum MAC Data per Frame Support | 20 | *variable* | Compound | REG-REQ<br>REG-RSP (OFDMA-PHY only) |

##### 11.7.8.10.1 Maximum amount of MAC level data per DL frame

| Name | Type | Length | Value | Scope |
|---|---|---|---|---|
| Maximum amount of MAC level data per DL frame | 20.1 | 2 | Maximum amount of MAC level data per DL frame (in unites of 256 Bytes). A value of 0 means unlimited. | REG-REQ<br>REG-RSP (OFDMA-PHY only) |

### 11.7.8.10.2 Maximum amount of MAC level data per UL frame

| Name | Type | Length | Value | Scope |
|---|---|---|---|---|
| Maximum amount of MAC level data per UL frame | 20.2 | 2 | Maximum amount of MAC level data per UL frame (in unites of 256 Bytes). A value of 0 means unlimited. | REG-REQ<br>REG-RSP (OFDMA-PHY only) |

*Insert new subclause 11.7.8.11:*

### 11.7.8.11 Packing support

The ‘Packing support’ field indicates the availability of MS support for Packing. Packing support for the BS is mandatory.

| Type | Length | Value | Scope |
|---|---|---|---|
| 21 | 1 | 0: No packing support capability<br>1: Packing supported<br>2-255: Reserved | REG-REQ<br>REG-RSP |

*Insert new subclause 11.7.8.12:*

### 11.7.8.12 MAC Extended rtPS support

The ‘MAC Extended rtPS support’ field indicates the availability of SS support for Extended rtPS.

| Type | Length | Value | Scope |
|---|---|---|---|
| 22 | 1 | 0 = No Extended rtPS support (default)<br>1 = Extended rtPS support | REG-REQ<br>REG-RSP |

*Insert new subclause 11.7.8.13:*

### 11.7.8.13 Maximum number of bursts transmitted concurrently to the MS

| Name | Type (1 byte) | Length (1 byte) | Value (variable length) |
|---|---|---|---|
| Max_Num_Bursts | 23 | 1 | Valid values: 1–16<br>Maximum number of bursts transmitted concurrently to the MS.<br>Includes all bursts without CID or with CIDs matching then MS’s CIDs |

***Insert subclause 11.7.9:***

### 11.7.9 SS MAC Address

This field specifies the MAC address of the SS, used in MESH modes.

| Type | Length | Value | Scope |
|---|---|---|---|
| 18 | 6 | The MAC address of the SS. | MESH:<br>REG-REQ,<br>REG-RSP |

***Insert new subclause11.7.10:***

### 11.7.10 CID update encodings

The ‘CID update encodings’ field provides a translation table that allows an MS to update its service flow and connection information so that it may continue service after a handover to a new serving BS.

| Name | Type (1 byte) | Length (1 byte) | Value (variable length) | Scope |
|---|---|---|---|---|
| CID_update | 24 | *variable* | Compound | REG-RSP |

These TLV values shall appear in each CID_update TLV.

| Name | Type (1 byte) | Length (1 byte) | Value (variable length) |
|---|---|---|---|
| New_CID | 24.1 | 2 | New CID after handover to new BS. |
| SFID | 24.2 | 4 | Service flow ID |

The following TLV element may appear in a CID_update TLV.

| Name | Type (1 byte) | Length (1 byte) | Value (variable length) |
|---|---|---|---|
| Connection Info | 24.3 | *variable* | If any of the service flow parameters change, then those service flow parameter encoding TLVs that have changed will be added. Connection_Info is a compound TLV value that encapsulates the service flow parameters that have changed for the service. All the rules and settings that apply to the parameters when used in the DSC-RSP message apply to the contents encapsulated in this TLV. |

***Insert new subclause 11.7.10.1:***

#### 11.7.10.1 Compressed CID update encodings

The ‘Compressed CID update encodings’ field provides a translation table that allows an MS to update its connection ID. Only CIDs that have no parameter change can be translated by this TLV.

| Name | Type | Length | Value | Scope |
|---|---|---|---|---|
| Compressed CID update | 25 | *variable* | The first byte indicates the length of the following BITMAP in bytes. The *n*-th bit, starting from the MSB of the BITMAP is set to 1 when the *n*-th SFID is to be updated to a new CID. Where, the SFIDs are sorted with increasing order.<br>After the BITMAP, a list of new CID follows. The number of new CID is equal to the number of ones in the BITMAP. | REG-RSP |

***Insert new subclause11.7.11:***

### 11.7.11 Method for allocating IP address for the secondary management connection

| Type | Length | Value | Scope |
|---|---|---|---|
| 26 | 1 | Bit #0: DHCP<br>Bit #1: Mobile IPv4<br>Bit #2: DHCPv6<br>Bit #3: IPv6 Stateless Address Autoconfiguration<br>Bits #4–7: *Reserved;* shall be set to zero | REG-REQ/REG-RSP |

***Insert new subclause 11.7.12:***

### 11.7.12 Handover supported

The ‘Handover supported’ field indicates what type(s) of HO the BS and the MS supports. A bit value of 0 indicates “not supported” while 1 indicates it is supported.

| Type | Length | Value | Scope |
|---|---|---|---|
| 27 | 1 | Bit #0: MDHO/FBSS HO not supported when it is set to 1. When this bit is set to 1, the BS shall ignore all other bits.<br>Bit #1: FBSS/MDHO DL RF Combining supported with monitoring MAPs from active BSs when this bit is set to 1<br>Bit #2: MDHO DL soft Combining supported with monitoring single MAP from anchor BS when this bit is set to 1.<br>Bit #3: MDHO DL soft combining supported with monitoring MAPs from active BSs when this bit is set to 1<br>Bit #4: MDHO UL Multiple transmission<br>Bits #5-7: *Reserved*, shall be set to zero | REG-REQ<br>REG-RSP |

***Insert new subclause 11.7.13:***

### 11.7.13 HO Support

***Insert new subclause11.7.13.1:***

#### 11.7.13.1 System Resource_Retain_Time

The Resource_Retain_Time is the duration for MS's connection information that will be retained in serving BS. BS shall start Resource_Retain_Time timer at MS notification of pending HO attempt through MOB_HO-IND or by detecting an MS drop. The unit of this value is 100 milliseconds.

| Type | Length | Value | Scope |
|---|---|---|---|
| 28 | 2 | Multiple of 100 milliseconds<br>200 milliseconds is recommended as default | REG-RSP |

***Insert new subclause 11.7.13.2:***

#### 11.7.13.2 HO Process Optimization MS Timer

During network re-entry, the HO Process Optimization MS Timer is the duration in frames the MS shall wait until receipt of the next unsolicited network re-entry MAC management message as indicated in the HO Process Optimization element of the RNG-RSP message. MS shall start HO Process Optimization MS Timer on receipt of RNG-RSP with HO Process Optimization message element indicating one or more unsolicited network re-entry MAC management messages are pending and required to complete network re-entry and establish MS Normal Operation with target BS. HO Process Optimization MS Timer shall recycle on MS receipt of any unsolicited network re-entry MAC management message and shall terminate on MS establishment of Normal Operation with the target BS. On HO Process Optimization MS Timer timeout and while HO Process Optimization MS Timer Retries is valid, MS shall send the network re-entry MAC management request message corresponding to the expected and pending network re-entry MAC management response message as indicated in HO Process Optimization and recycle HO Process Optimization MS Timer.

| Type | Length | Value | Scope |
|---|---|---|---|
| 29 | 1 | In frames | REG-REQ;<br>REG-RSP |

***Insert new subclause 11.7.13.3:***

#### 11.7.13.3 MS Handover Retransmission Timer

After an MS transmits MOB_MSHO-REQ to initiate a handover process, it shall start MS Handover Retransmission Timer and shall not transmit another MOB_MSHO-REQ until the expiration of the MS Handover Retransmission Timer.

| Type | Length | Value | Scope |
|---|---|---|---|
| 30 | 1 | In frames | REG-RSP |

***Insert new subclause 11.7.14:***

### 11.7.14 Mobility parameters support

The following parameters are associated with mobile operations.

***Insert new subclause 11.7.14.1:***

#### 11.7.14.1 Mobility features supported

The 'Mobility features supported' field indicates whether or not the MS supports mobility handover, sleep mode, and idle mode. A bit value of 0 indicates "not supported" while 1 indicates "supported".

| Type | Length | Value | Scope |
|---|---|---|---|
| 31 | 1 | Bit #0: Mobility (handover) support<br>Bit #1: Sleep mode support<br>Bit #2: Idle mode support | REG-REQ<br>REG-RSP |

***Insert new subclause 11.7.15:***

### 11.7.15 Sleep mode recovery time

The 'Sleep mode recovery time' field indicates the time required for an MS that is in a sleep mode to return to awake-mode. This parameter is optional and may be used by the BS to determine sleep interval window sizes when initiating sleep mode with an MS.

| Type | Length | Value | Scope |
|---|---|---|---|
| 32 | 1 | Number of frames required for the MS to switch from sleep mode to awake-mode | REG-REQ |

***Insert new subclause 11.7.16:***

### 11.7.16 MS-PREV-IP-ADDR

The 'MS-PREV-IP-ADDR' parameter specifies the IP address that the MS was assigned on the secondary management connection based on an association with its last serving BS. An IPv4 address shall be specified in conventional dotted format; e.g., '134.234.2.3'. An IPv6 address may be expressed in abridged or unabridged form; however, the form chosen shall be consistent with RFC 2373.

| Type | Length | Value | String |
|---|---|---|---|
| 33 | *variable* | string | REG-REQ |

***Insert new subclause 11.7.17:***

### 11.7.17 SKIP-ADDR-ACQUISITION

The ‘SKIP-ADDR-ACQUISITION’ parameter indicates to an MS whether it should reacquire its IP address on the secondary management connection and related context or reuse its prior context.

| Type | Length | Value | Scope |
|---|---|---|---|
| 34 | 1 | 0: No IP address change<br>1: Re-acquire IP address | REG-RSP |

***Insert new subclause 11.7.18:***

### 11.7.18 SAID update encodings

The ‘SAID update encodings’ field provides a translation table that allows an MS to update its security associations so that it may continue security service after a handover to a new serving BS.

| Name | Type | Length (1 byte) | Value | Scope |
|---|---|---|---|---|
| SAID update | 35 | *variable* | Compound | REG-RSP,<br>RNG-RSP |

The following TLV values shall appear in each SAID_update TLV.

| Name | Type (1 byte) | Length (1 byte) | Value (variable length) |
|---|---|---|---|
| New SAID | 35.1 | 2 | New SAID after handover to new BS |
| Old SAID | 35.2 | 2 | Old SAID before handover from Old BS |

***Insert new subclause 11.7.19:***

### 11.7.19 Total number of provisioned service flow

When a BS shall transmit multiple DSA transactions for provisioned service flows, BS may include this TLV in REG-RSP message for provisioned service flows in order to indicate how many DSA transactions with provisioned service flows will be transmitted.

| Type | Length | Value | Scope |
|---|---|---|---|
| 36 | 1 | Total number of DSA transactions for provisioned service flows for an MS | REG-RSP |

***Insert new subclause 11.7.20:***

### 11.7.20 Idle Mode

***Insert new subclause 11.7.20.1:***

#### 11.7.20.1 Idle Mode Timeout

MS reported default timer value for MS Idle Mode Timer

| Type | Length | Value | Scope |
|---|---|---|---|
| 37 | 2 | Max time interval between MS Idle Mode Location Updates in seconds (default = 4096 seconds) | REG-REQ<br>REG-RSP |

***Insert new subclause 11.7.20.2:***

#### 11.7.20.2 Paging Interval Length

MS reported default timer value for MS Idle Mode Timer

| Type | Length | Value | Scope |
|---|---|---|---|
| 45 | 1 | Max duration in frames of Paging Listening Interval; used in calculation of Paging Listening Interval; value must be between 1 and 5 frames (default=2) | DCD |

***Insert new subclause 11.7.21:***

### 11.7.21 SA TEK Update

The ‘SA TEK Update’ field provides a translation table that allows an MS to update its security associations and TEK pairs so that it may continue security service after a handover to a new serving BS.

The ‘SA TEK Update’ field is a compound TLV list where each entry identifies the primary and static SAs, their SA identifiers (SAID) and additional properties of the SA (e.g., type, cryptographic suite) that the MS is authorized to access. In case of HO, the details of any Dynamic SAs that the requesting MS was authorized in the previous serving BS are also included.

Additionally, in case of HO, for each active SA in previous serving BS, corresponding TEK, GTEK, and GKEK parameters are also included. Thus, SA_TEK_Update provides a shorthand method for renewing active SAs used by the MS in its previous serving BS. The TLVs specify SAID in the target BS that shall replace active SAID used in the previous serving BS and also “older” TEK-Parameters and “newer” TEKParameters relevant to the active SAIDs. The update may also include multicast/broadcast Group SAIDs (GSAIDs) and associated GTEK-Parameters pairs.

In case of unicast SAs, the TEK-Parameters attribute contains all of the keying material corresponding to a particular generation of an SAID’s TEK. This would include the TEK, the TEK’s remaining key lifetime, its key sequence number, and the cipher block chaining (CBC) initialization vector. The TEKs are encrypted with KEK.

In case of group or multicast SAs, the TEK-Parameters attribute contains all of the keying material corresponding to a particular generation of a GSAID's GTEK. This would include the newer GTEK parameter pairs, GTEK's remaining key lifetime, the GTEK's key sequence number, and the cipher block chaining (CBC) initialization vector. The type and length of the GTEK are equal to the ones of the TEK. The GKEK should be identically shared within the same multicast group or the broadcast group. The GTEKs are encrypted with GKEK and GKEKs are encrypted with KEK.

Multiple iterations of these TLVs may occur suitable to re-creating and re-assigning all active SAs and their (G)TEK pairs for the MS from its previous serving BS. If any of the Security Associations parameters change, then those Security Associations parameters encoding TLVs that have changed will be added.

This TLV may be sent in a single frame along with unsolicited REG-RSP.

The following TLV values shall appear in each SA TEK Update TLV

| Name | Type | Length (1 byte) | Value | Scope |
|---|---|---|---|---|
| SA TEK Update | 38 | *variable* | Compound | REG-RSP |

| Name | Type | Length (1 byte) | Value |
|---|---|---|---|
| SA TEK Update Type | 38.1 | 1 | 1: TEK parameters for a SA<br>2: GTEK parameters for a GSA<br>3–255: *Reserved* |
| New SAID | 38.2 | 2 | New SAID after handover to new BS |
| Old SAID | 38.3 | 2 | Old SAID before handover from old BS. In case of initial network entry, old SAID is same as new SAID. |
| Old TEK Parameters | 13/GTEK Type 38.4 | *variable* | "Older" generation of key parameters relevant to SAID. The Compound field contains the sub-attributes as defined in Table 372. |
| New TEK/GTEK Parameters | 13/GTEK Type 38.5 | *variable* | "Newer" generation of key parameters relevant to (G)SAID. The Compound field contains the sub-attributes as defined in Table 372. |
| GKEK Parameters | GKEK Type 38.6 | *variable* | GKEK and its lifetime for the corresponding GTEK pair if this TLV is for a GSA. |

***Insert new subclause 11.7.22:***

### 11.7.22 GKEK Parameters

*Description:* This attribute is a compound attribute, consisting of a collection of sub-attributes. These sub-attributes represent all security parameters relevant to a particular generation of an GSAID's GKEK. A summary of the KEK-Parameters attribute format is shown as follows

| Name | Type | Length (1 byte) | Value | Scope |
|---|---|---|---|---|
| GKEK Parameters | 39 | *variable* | Compound | REG-RSP |

| Attribute | Contents |
|---|---|
| GKEK | GKEK, encrypted with KEK |
| Key-Lifetime | GKEK remaining lifetime |

***Insert new subclause 11.7.23:***

### 11.7.23 ARQ-ACK Type

The value of this parameter specifies the ARQ ACK type supported by the MS. The MS shall transmit this parameter if ARQ is supported. The requester includes its desired setting in the REQ message. The receiver of the REQ message shall take the common part of the values it prefers and values in the REQ message. Those common values are included in the RSP message and become the agreed upon the values set. Absence of the parameter during a REG dialog shall indicate the originator of the message desires all the possible ACK type to be supported.

| Type | Length | Value | Scope |
|---|---|---|---|
| 40 | 1 | Bit 0 Selective ACK entry<br>Bit 1 Cumulative ACK entry<br>Bit 2 Cumulative with Selective ACK entry<br>Bit 3 Cumulative ACK with Block Sequence ACK<br>Bits 4-7 *Reserved* | REG-REQ, REG-RSP |

***Insert new subclause 11.7.24:***

### 11.7.24 HO parameters processing time

| Name | Type | Length | Value | Scope |
|---|---|---|---|---|
| MS HO connections parameters processing time | 41 | 1 | Time in ms the MS needs to process information on connections provided in RNGRSP or REG-RSP message during HO | REGREQ/ RSP |
| MS HO TEK processing time | 42 | 1 | Time in ms the MS needs to completely process TEK information during HO | REGREQ/ RSP |

***Insert new subclause 11.7.25:***

### 11.7.25 MAC header and extended subheader support

The ‘MAC header and subheader support’ field indicates whether or not the MS and BS support various types of MAC header and extended subheaders. This field may be sent by either BS or MS. Omission of this field from the REG-REQ/RSP message indicates that none of the headers or subheaders are supported.

| Type | Length | Value | Scope |
|---|---|---|---|
| 43 | 3 | Bit #0: Bandwidth request and UL Tx Power Report header support<br>Bit #1: Bandwidth request and CINR report header support<br>Bit #2: CQICH Allocation Request header support<br>Bit #3: PHY channel report header support<br>Bit #4: Bandwidth request and uplink sleep control header support<br>Bit #5: SN report header support<br>Bit #6: Feedback header support<br>Bit #7-10: SDU_SN extended subheader support and parameter<br>Bit #7: SDU_SN extended subheader support<br>Bit #8-10 (=p): period of SDU_SN transmission for connection with ARQ disabled = once every $2^p$ MAC PDUs<br>Bit #11: DL sleep control extended subheader<br>Bit #12: Feedback request extended subheader<br>Bit #13: MIMO mode feedback extended subheader<br>Bit #14: UL Tx Power Report extended subheader<br>Bit #15: Mini-feedback extended subheader<br>Bit #16: SN request extended subheader<br>Bit #17: PDU SN(short) extended subheader<br>Bit #18: PDU SN(long) extended subheader<br>Bit #19–23: *Reserved* | REG-REQ,<br>REG-RSP |

A bit value of 0 indicates “not supported” while 1 indicates “supported”.

***Insert new subclause 11.7.26:***

### 11.7.26 SN Reporting Base

SN Reporting Base indicates the (negative of the) base value that the MS shall use in sending fast DL measurement feedback on an enhanced fast-feedback channel.

| Type | Length | Value | Scope |
|---|---|---|---|
| 44 | 1 | A positive integer in the range 0–255; the base value used in reporting shall be the negative of this value. | REG-RSP |

## 11.8 SBC-REQ/RSP management message encodings

### 11.8.2 Capabilities for construction and transmission of MAC PDUs

*Change the table as indicated:*

| Type | Length | Value | Scope |
|---|---|---|---|
| 4 | 1 | Bit #0: Ability to receive requests piggybacked with data<br>Bit #1: Ability to use 3-bit FSN values ~~Specifies the size of FSN values~~ used when forming MAC PDUs on non-ARQ connections<br>~~0: Only 3-bit FSN values are supported~~<br>~~1: Only 11-bit FSN values are supported~~<br>Bits #2-7: *Reserved;* shall be set to zero. | ~~REG-REQ~~<br>~~REG-RSP~~<br>SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

### 11.8.3 Physical parameters supported

### 11.8.3.6 WirelessMAN-OFDM specific parameters

### 11.8.3.6.2 OFDM SS demodulator

*In 11.8.3.6.2, change the TLV table as indicated:*

| Type | Length | Value | Scope |
|---|---|---|---|
| 151 | 1 | Bit #0: 64-QAM<br>Bit #1: BTC<br>Bit #2: CTC<br>Bit #3: STC<br>Bit #4: AAS<br>Bit #5: Subchannelization<br>~~Bit #6: H-ARQ with SPID=0 only~~<br>Bit~~s~~ #~~57~~6: *Reserved*; shall be set to zero. | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

### 11.8.3.6.3 OFDM SS modulator

*In 11.8.3.6.3, change the TLV table as indicated:*

| Type | Length | Value | Scope |
|---|---|---|---|
| 152 | 1 | Bit# 0: 64-QAM<br>Bit# 1: BTC<br>Bit# 2: CTC<br>Bit# 3: Subchannelization<br>Bit# 4: Focused contention BW request<br>Bit# 5: UL preamble / Midamble cyclic delay<br>Bits# ~~5~~6–7: *Reserved*. Set to 0 | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

***Delete subclause 11.8.3.6.4.***

***Insert new subclause 11.8.3.6.6:***

#### 11.8.3.6.6 OFDM private map support

The ‘OFDM private map support’ field indicates the private map parameters supported by a WirelessMAN-OFDM SS.

| Type | Length | Value | Scope |
|---|---|---|---|
| 155 | 1 | Bit #0: regular private map support<br>Bit #1: compressed and reduced private map support<br>Bit #2–7: *Reserved* | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

### 11.8.3.7 WirelessMAN-OFDMA specific parameters

***Change subclause 11.8.3.7.1 as indicated:***

#### 11.8.3.7.1 OFDMA MS FFT sizes

The ‘OFDMA MS FFT sizes’ field indicates the FFT sizes supported by the MS. For each FFT size, a bit value of 0 indicates “not supported” while 1 indicates “supported”.

| Type | Length | Value | Scope |
|---|---|---|---|
| 150 | 1 | Bit #0: FFT-256<br>Bit #1: FFT-2048<br>Bit #2: FFT-128<br>Bit #3: FFT-512<br>Bit #4: FFT-1024<br>Bits #~~2~~5–7: *Reserved* | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

#### 11.8.3.7.2 OFDMA SS demodulator

***Change the table and following text as indicated:***

| Type | Length | Value | Scope |
|---|---|---|---|
| 151 | *variable* | Bit #0: 64-QAM<br>Bit #1: BTC<br>Bit #2: CTC<br>Bit #3: STC<br>Bit #4: ~~AAS Diversity Map Scan~~CC with optional interleacer<br>Bit #5: ~~AAS Direct Signaling~~HARQ Chase<br>Bit #6: HARQ CTC_IR<br>Bit #7: *Reserved*; shall be set to zero<br>Bit #8: HARQ CC IR<br>Bit #9: LDPC<br>Bit #10 Dedicated pilots<br>Bits #11–15: *Reserved*; shall be set to zero. | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

This field specifies the number of downlink H-ARQ channels (*n*) the SS supports, where *n* = 1..16. The value of the TLV shall be set to (*n*–1).When the length of the TLV 1 byte, it indicates that bits 8–15 are zero.

| | | | |
|---|---|---|---|
| 161 | 1 | The number of DL H-ARQ channels | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

*Change 11.8.3.7.3 as indicated:*

### 11.8.3.7.3 OFDMA SS modulator

This field indicates the different modulator options supported by a WirelessMAN-OFDMA PHY SS for uplink transmission This field is not used for other PHY specifications. A bit value of 0 indicates “not supported” while 1 indicates “supported”.

| Type | Length | Value | Scope |
|---|---|---|---|
| 152 | 1 | Bit# 0: 64-QAM<br>Bit# 1: BTC<br>Bit# 2: CTC<br>Bit #3:~~ AAS Diversity Map Scan~~STC<br>Bit# 4: ~~AAS Direct Signaling~~HARQ Chase<br>Bit# 5: ~~H-ARQ~~ CTC_IR<br>Bit# 6: CC_IR<br>Bit# 7: LDPC<br>~~Bits# 6–7: *Reserved*; shall be set to zero~~ | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |
| ~~153~~ | ~~1~~ | T~~he number of HARQ ACK Channel~~ | ~~SBC-REQ (see 6.3.2.3.23)~~<br>~~SBC-RSP (see 6.3.2.3.24)~~ |

This field specifies the number of uplink H-ARQ channels (*n*) the SS supports, where *n* = 1..16. The value of the TLV shall be set to (*n*–1).

| **Type** | **Length** | **Value** | **Scope** |
|---|---|---|---|
| 153 | 1 | The number of UL_H-ARQ channels | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

*Change the numbering of subclause 11.8.3.7.5 to 11.8.3.7.4 and change the title as indicated:*

### 11.8.3.7.4 OFDMA SS ~~P~~permutation support

This field indicates the different optional OFDMA permutation modes (optional PUSC, optional FUSC and AMC) supported by a WirelessMAN-OFDMA SS. A bit value of 0 indicates “not supported” while 1 indicates “supported.”

| Type | Length | Value | Scope |
|---|---|---|---|
| 154 | 1 | Bit# 0: Optional PUSC support<br>Bit# 1: Optional FUSC support<br>Bit# 2: AMC 1x6 support<br>Bit# 3: AMC 2x3 support<br>Bit# 4: AMC 3x2 support<br>Bit# 5: AMC support with HARQ map<br>Bit# 6: TUSC1 support<br>Bit# 7: TUSC2 support | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

NOTE—AMC support (bits #2-4) refers to support of AMC subchannelization using DL-MAP_IE or ULMAP_IE. When AMC support using HARQ map (Bit #5) is indicated, all AMC types indicated in format configuration IE (6.3.2.3.43.2) are supported when using AMC with HARQ map.

***Insert new subclause 11.8.3.7.5:***

### 11.8.3.7.5 OFDMA SS demodulator for MIMO support

This field indicates the different MIMO options supported by a WirelessMAN-OFDMA PHY SS in the downlink. This field is not used for other PHY specifications. A bit value of 0 indicates “not supported” while 1 indicates “supported”.

| Type | Length | Value | Scope |
|---|---|---|---|
| 156 | 2 | Bit #0: 2-antenna STC matrix A<br>Bit #1: 2-antenna STC matrix B, vertical coding<br>Bit #2: 2-antenna STC matrix B, horizontal coding<br>Bit #3: 4-antenna STC matrix A<br>Bit #4: 4-antenna STC matrix B vertical coding<br>Bit #5: 4-antenna STC matrix B, horizontal coding<br>Bit #6: 4-antenna STC matrix C, vertical coding<br>Bit #7: 4-antenna STC matrix C, horizontal coding<br>Bit #8–16: *Reserved* | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

The ‘OFDMA SS Demodulator for MIMO Support’ field that follows indicates the MIMO capability of OFDMA MS demodulator. A bit value of 0 indicates “not supported” while 1 indicates “supported”.

| Type | Length | Value | Scope |
|---|---|---|---|
| 176 | 3 | Bit #0 2-antenna STC matrix A<br>Bit #1 2-antenna STC matrix B, vertical coding<br>Bit #2 Four receive antennas<br>Bit #3: 4-antenna STC matrix A<br>Bit #4: 4-antenna STC matrix B, vertical coding<br>Bit #5: 4-antenna STC matrix B, horizontal coding<br>Bit #6: 4-antenna STC matrix C, vertical coding<br>Bit #7: 4-antenna STC matrix C, horizontal coding<br>Bit #8: 3-antenna STC matrix A<br>Bit #9: 3-antenna STC matrix B<br>Bit #10: 3-antenna STC matrix C, vertical coding<br>Bit #11: 3-antenna STC matrix C, horizontal coding<br>Bit #12: Capable of calculating precoding weight<br>Bit #13: Capable of adaptive rate control<br>Bit #14: Capable of calculating channel matrix<br>Bit #15: Capable of antenna grouping<br>Bit #16: Capable of antenna selection<br>Bit #17: Capable of codebook based precoding<br>Bit #18: Capable of long-term precoding<br>Bit #19: Capable of MIMO Midamble<br>Bit #20–23: *Reserved* | SBC-REQ (See 6.3.2.3.23)<br>SBC-RSP (See 6.3.2.3.24) |

***Insert new subclause 11.8.3.7.6:***

### 11.8.3.7.6 OFDMA SS MIMO uplink support

This field indicates the different MIMO options supported by a WirelessMAN-OFDMA PHY SS in the uplink. This field is not used for other PHY specifications. A bit value of 0 indicates “not supported” while 1 indicates “supported”.

| Type | Length | Value | Scope |
|---|---|---|---|
| 157 | 1 | Bit #0: 2-antenna STTD<br>Bit #1: 2-antenna SM with vertical coding<br>Bit #2: single-antenna cooperative SM<br>Bit #3–7: *Reserved* | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

***Insert new subclause 11.8.3.7.7:***

### 11.8.3.7.7 OFDMA AAS private map support

This field indicates the AAS private map parameters supported by a WirelessMAN-OFDMA SS.

- Private map chain enable indicates if a private map is allowed to point to another private map. If not enabled, private map chains are not allowed.
- The frame offset value indicates the frame offset the SS can support with private maps. A value of 0 indicates the private map allocations are for the subsequent frame (one frame in the future), a value of 1 indicates it is for two frames in the future. When used with compressed private maps, these fields are required to be used. When used with reduced private maps, these are minimum values and the actual frame offset is defined by the frame offset field in the private map.
- The concurrency field indicates how many parallel private map chains can be supported by an SS.

| Type | Length | Value | Scope |
|---|---|---|---|
| 158 | 1 | Bit #0: HARQ MAP capability<br>Bit #1: private map support<br>Bit #2: Reduced private map support<br>Bit #3: Private Map Chain Enable<br>Bit #4: Private Map DL frame offset<br>0: support compressed private maps with Frame Offset = 0<br>1: support compressed private maps with Frame Offset = 1<br>Bit #5: Private Map UL frame offset<br>0: support compressed private maps with Frame Offset = 0<br>1: support compressed private maps with Frame Offset = 1<br>Bits #6-7: private map chain concurrency<br>0: indicates no limit<br>1–3: indicate maximum concurrent private map chains | SBC-REQ (see 6.3.2.3.23<br>SBC-RSP (see 6.3.2.3.24) |

***Insert new subclause 11.8.3.7.8:***

### 11.8.3.7.8 OFDMA AAS capabilities

This field indicates the different AAS options supported by a WirelessMAN-OFDMA PHY SS in the downlink. This field is not used for other PHY specifications. A bit value of 0 indicates “not supported” while 1 indicates “supported”.

| Type | Length | Value | Scope |
|---|---|---|---|
| 159 | 2 | Bit# 0: AAS Zone<br>Bit# 1: AAS Diversity Map Scan (AAS-DLFP)<br>Bit# 2: AAS-FBCK-RSP support<br>Bit# 3: Downlink AAS preamble<br>Bit# 4: Uplink AAS preamble<br>Bit #5-16: *Reserved* | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

A subscriber supporting any mode of AAS should set Bit #0 to indicate support of AAS zone (as specified in 8.4.5.3.3). It may, in addition, use Bit #1 to indicate use of the AAS-DLFP channel specified in 8.4.4.6. The SS may indicate support of AAS preamble. An SS not supporting the preamble in downlink/uplink expects a preamble length of 0. Support of the AAS zone as well as support of the signaling methods “AAS Diversity Map Scan” and “AAS Direct Signaling” is relevant to both UL and DL.

***Insert new subclause 11.8.3.7.9:***

### 11.8.3.7.9 OFDMA SS CINR measurement capability

| Type | Length | Value | Scope |
|---|---|---|---|
| 160 | 1 | Bit #0:Physical CINR measurement from the preamble<br>Bit #1:Physical CINR measurement for a permutation zone from pilot subcarriers<br>Bit #2:Physical CINR measurement for a permutation zone from data subcarriers<br>Bit #3:Effective CINR measurement from the preamble<br>Bit #4:Effective CINR measurement for a permutation zone from pilot subcarriers<br>Bit #5:Effective CINR measurement for a permutation zone from data subcarriers<br>Bit #6:Support for 2 concurrent CQI channels<br>Bit #7:Frequency selectivity characterization report | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

***Insert new subclause 11.8.3.7.10:***

### 11.8.3.7.10 OFDM SS uplink power control support

The ‘OFDM SS uplink power control support’ field indicates the uplink power control options supported by a WirelessMAN-OFDM PHY SS for uplink transmission This field is not used for other PHY specifications. A bit value of 0 indicates “not supported” while 1 indicates “supported”.

| Type | Length | Value | Scope |
|---|---|---|---|
| 156 | 1 | Bit #0: Uplink open loop power control support<br>Bit #1: Uplink AAS preamble power control support.<br>Bits #2–7: *Reserved*, shall be set to zero. | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |
| 157 | 1 | The minimum number of frames that SS takes to switch from the open loop power control scheme to the closed loop power control scheme or vice versa. | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

***Insert new subclause 11.8.3.7.11:***

### 11.8.3.7.11 OFDMA SS uplink power control support

The ‘OFDMA SS uplink power control support’ field indicates the uplink power control options supported by a WirelessMAN-OFDMA PHY SS for uplink transmission This field is not used for other PHY specifications. A bit value of 0 indicates “not supported” while 1 indicates “supported”.

***Insert new subclause 11.8.3.7.12:***

### 11.8.3.7.12 OFDMA MAP Capability

The ‘OFDMA MAP Capability’ field indicates the different MAP options supported by a WirelessMAN-OFDMA PHY. This field is not used for other PHY specifications. A bit value of 0 indicates “not supported” while 1 indicates “supported”.

| Type | Length | Value | Scope |
|---|---|---|---|
| 170 | 1 | Bit #0: Uplink open loop power control support<br>Bit #1: Uplink AAS preamble power control support.<br>Bits #2–7: *Reserved*, shall be set to zero | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |
| 171 | 1 | The minimum number of frames that SS takes to switch from the open loop power control scheme to the closed loop power control scheme or vice versa | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

Support for Extended HARQ IE in mandates a support for SUB-DL-UL-MAP for first zone.

| Type | Length | Value | Scope |
|---|---|---|---|
| 172 | 1 | Bit #0: HARQ MAP Capability<br>Bit #1: Extended HARQ IE capability<br>Bit #2: Sub MAP capability for first zone<br>Bit #3: Sub MAP capability for other zones<br>Bit #4: DL region definition support<br>Bits #5-7: *Reserved* | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

***Insert new subclause 11.8.3.7.13:***

### 11.8.3.7.13 Uplink control channel support

The ‘Uplink control channel support’ indicates the different uplink control channels supported by a WirelessMAN-OFDMA PHY MS for uplink transmission. A bit value of 0 indicates “not supported” while 1 indicates “supported”.

| Type | Length | Value | Scope |
|---|---|---|---|
| 173 | 1 | Bit #0: 3 bit-MIMO Fast-feedback<br>Bit #1: Enhanced FAST_FEEDBACK<br>Under negotiation for SBC fast feedback, if enhanced feature is enabled, the SS should use only the enhanced fast-feedback channel in the CQICH allocation IE (see 8.4.5.4.15 and 8.4.5.4.16).<br>Bit #2: UL ACK<br>Bit #3: *Reserved.* Shall be set to zero.<br>Bit #4: UEP fast-feedback<br>Bit #5: A measurement report shall be performed on the last DL burst, as described in 8.4.5.4.10.1<br>Bit #6: Primary/Secondary FAST_FEEDBACK<br>Bit #7: DIUC-CQI Fast-feedback | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

***Insert new subclause 11.8.3.7.14:***

### 11.8.3.7.14 OFDMA MS CSIT capability

The ‘OFDMA MS CSIT capability’ indicates MS capability of supporting CSIT (uplink sounding). A bit value of 0 indicates “not supported” while 1 indicates “supported”. If this field is omitted, then by default MS is considered not supporting CSIT. Capability type A indicates sounding that does not use subcarrier permutations of the downlink.

Capability type B indicates sounding over subcarriers distributed according to permutations of the downlink.

| Type | Length | Value | Scope |
|---|---|---|---|
| 174 | 2 | Bit #0: CSIT compatibility type A.<br>Bit #1: CSIT compatibility type B.<br>Bit #2: Power assignment capability (indicate support for non equal power assignment)<br>Bits #3–5: Sounding response time capability<br>Bits #6–9: max number of simultaneous sounding instructions (0 = unlimited)<br>Bit #10: SS does not support P values of 9 and 18 when supporting CSIT type A<br>Bit #11–15: Reserved | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

The sounding response time capability encodings are as follows:

| Bits 3–5 | Time needed for SS to respond to a sounding command transmitted by the BS |
|---|---|
| 000 | 0.5 ms |
| 001 | 0.75 ms |
| 010 | 1 ms |
| 011 | 1.25 ms |
| 100 | 1.5 ms |
| 101 | min(2 ms, Next Frame) |
| 110 | min(5ms, Next Frame) |
| 111 | Next Frame |

***Insert new subclause 11.8.3.7.15:***

### 11.8.3.7.15 Maximum number of burst per frame capability in HARQ

The ‘Maximum number of burst per frame capability’ field indicates the maximum number of uplink/downlink data burst allocations for the SS in a single UL/DL subframe (note that the number of UL non-HARQ burst is always limited to 1).

| Type | Length | Value | Scope |
|---|---|---|---|
| 175 | 1 | Bits #0–2: Maximum number of UL HARQ bursts per HARQ enabled MS per frame. (0b000 = one, default)<br>Bit #3: Indicates whether the maximum number of UL HARQ bursts per frame (i.e., Bits #2–0) includes the one Non-HARQ burst. (0 = not included, default)<br>Bits #4–7: Maximum number of DL HARQ bursts per HARQ enabled MS per frame. (0b0000 = one, default) | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

***Insert new subclause 11.8.3.7.16:***

### 11.8.3.7.16 OFDMA SS Modulator for MIMO Support

The 'OFDMA SS Modulator for MIMO Support' field indicates the MIMO capability of OFDMA SS modulator. A bit value of 0 indicates "not supported" while 1 indicates "supported".

| Type | Length | Value | Scope |
|---|---|---|---|
| 177 | 1 | Bit #0: Two transmit antennas<br>Bit #1: Capable of transmit diversity<br>Bit #2: Capable of spatial multiplexing<br>Bit #3: Capable of beamforming<br>Bit #4: Capable of adaptive rate control<br>Bit #5: Capable of single antenna<br>Bit #6: Capable of two-antenna<br>Bit #7: *Reserved;* shall be set to zero | SBC-REQ (See 6.3.2.3.23)<br>SBC-RSP (See 6.3.2.3.24) |

***Insert new subclause 11.8.3.7.17:***

### 11.8.3.7.17 SDMA Pilot capability

| Type | Length | Value | Scope |
|---|---|---|---|
| 178 | 1 | Bit #0–#1:<br>SDMA pilot pattern support for AMC zone:<br>0b00 – no support<br>0b01 – support SDMA pilot patterns #A and #B<br>0b11 – support all SDMA pilot patterns<br>0b10 – *Reserved*<br>Bit #2–7 *Reserved* | SBC-REQ<br>SBC-RSP |

***Insert new subclause 11.8.3.7.18:***

### 11.8.3.7.18 OFDMA Multiple Downlink Burst Profile Capability

This value indicates Downlink/Uplink Burst Profile which shall be used for MS and BS. If this TLV is not included in SBCREQ message, BS shall not include this TLV in SBC-RSP message.

| Type | Length | Value | Scope |
|---|---|---|---|
| 179 | 1 | Bit #0: Downlink burst profile for multiple FEC types (Table 304a)<br>Bit #1: Uplink burst profile for multiple FEC types (Table 304b)<br>Bit #2–7: *Reserved* (shall be set to 0) | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

***Insert new subclause 11.8.3.7.19:***

### 11.8.3.7.19 HARQ buffer capability

Downlink/Uplink HARQ buffering capability indicates the maximal number of data bits the SS is able to store for downlink/uplink HARQ. The buffering capability is separately indicated for $N_{EP}/N_{SCH}$ based incremental redundancy used for CTC, and for DIUC/duration based HARQ methods (Chase combining and CC-IR), and separately for uplink and downlink transmissions. The buffering capability is indicated by two parameters:

1) Number of bits per channel—this is the total number of data bits that the SS may buffer per HARQ channel.
2) Aggregation flag—when this flag is clear, the number of bits is counted separately for each channel. When the flag is set, buffering capability may be shared between channels, as explained below.

The number of bits per channel is indicated as follows:

— For incremental redundancy CTC ($N_{EP}$ based): Number of bits is indicated by $N_{EP}$ code, according to Table 330.
— For Chase combining and CC-IR (DIUC based): Number of bits is indicated by a value $K$=0..63 according to the following equation: Number of bits = floor(512 × 2$K$/4) Bits.

When aggregation flag is clear, the number of bits that were allocated in each HARQ channel in the last transmission must not exceed “Number of bits per channel”.

When aggregation flag is set, the sum over all HARQ channels, of the number of bits that were allocated in the HARQ channel in the last transmission, must not exceed the “Number of bits per channel” multiplied by the maximum number channels supported by the SS. Note that sum total of the data bits supported is the same in both cases is the same. The number of channels supported by the SS is indicated in 11.8.3.7.3.

The IR-CTC HARQ buffer capability shall also be applied to bursts for which ACK channel is not allocated (ACK disable is set).

***Insert new subclause 11.8.3.7.19.1:***

### 11.8.3.7.19.1 HARQ incremental redundancy buffer capability

| Type | Length | Value | Scope |
|---|---|---|---|
| 162 | 2 | Bits #0–3: $N_{EP}$ value indicating downlink HARQ buffering capability for incremental redundancy CTC.<br>Bit #4: Aggregation Flag for DL<br>Bits #5–7: *Reserved*<br>Bits #8–11: $N_{EP}$ value indicating uplink HARQ buffering capability for incremental redundancy CTC.<br>Bit #12: Aggregation Flag for UL<br>Bits #13–15: *Reserved* | SBC-REQ<br>SBC-RSP |

***Insert new subclause 11.8.3.7.19.2:***

### 11.8.3.7.19.2 HARQ Chase combining and CC-IR buffer capability

| Type | Length | Value | Scope |
|---|---|---|---|
| 163 | 2 | Bits #0–5: Downlink HARQ buffering capability for chase combining (K)<br>Bit #6: Aggregation Flag for DL<br>Bit #7: *Reserved*.<br>Bits #8–13: Uplink HARQ buffering capability for chase combining (K)<br>Bit #14: Aggregation Flag for UL<br>Bit #15: *Reserved* | SBC-REQ<br>SBC-RSP |

***Insert new subclause 11.8.4:***

### 11.8.4 Security Negotiation Parameters

This field is a compound attribute indicating security capabilities to negotiate before performing the initial authorization procedure and the reauthorization procedure.

| Type | Length | Value | Scope |
|---|---|---|---|
| 25 | *variable* | The compound field contains the sub-attributes as defined in the table below. | SBC-REQ<br>SBC-RSP |

| Sub-attribute | Contents |
|---|---|
| PKM Version Support | Version of privacy sublayer supported |
| Authorization Policy Support | Authorization policy to support |
| Message Authentication Code Mode | Message authentication code to support |
| PN Window Size | Size capability of the receiver PN window per SAID |

### 11.8.4.1 PKM Version Support

The ‘PKM Version Support’ field indicates a PKM version. A bit value of 0 indicates “not supported” while 1 indicates “supported”. Both an SS and a BS should negotiate only one PKM version.

| Type | Length | Value |
|---|---|---|
| 25.1 | 1 | Bit #0: PKM version 1<br>Bit #1: PKM version 2<br>Bit #2-7: R*eserved.* Set to 0 |

#### 11.8.4.2 Authorization policy support

The ‘Authorization policy support’ field indicates authorization policy used by the MS and BS to negotiate and synchronize. A bit value of 0 indicates “not supported” while 1 indicates “supported”.

| Type | Length | Value |
|---|---|---|
| 25.2 | 1 | Bit #0: RSA-based authorization at the initial network entry<br>Bit #1: EAP-based authorization at the initial network entry<br>Bit #2: Authenticated EAP-based authorization at the initial network entry<br>Bit #3: Reserved. Set to 0<br>Bit #4: RSA-based authorization at re-entry<br>Bit #5: EAP-based authorization at re-entry<br>Bit #6: Authenticated EAP-based authorization at re-entry<br>Bit #7: *Reserved.* Set to 0 |

Authenticated EAP-based authorization basically means that a message containing EAP payload is protected by CMAC Digest. The CMAC_KEY_U and CMAC_KEY_D are generated with the EIK obtained from RSA-based authorization or EAP-based authorization.

The PKMv2 Auth-Request/Reply/Reject/Acknowledgement messages shall be used in the RSA-based authorization procedure.

The PKMv2 EAP-Transfer message shall be used in the EAP-based authorization procedure. The PKMv2 Authentication EAP-Transfer message shall be used in the Authenticated EAP-based authorization procedure.

Bits #4–6 are only applied to the SBC-REQ message. Those bits shall be set to 0 in the SBC-RSP message. MS and BS will execute the reauthorization procedure according to the authorization policy negotiated in current BS when AK lifetime is expired and so on. After MS moves into another BS, MS and target BS will execute the reauthorization procedure according to the authorization policy of HO re-entry negotiated in the target BS when the lifetime of AK, which is negotiated between MS and target BS, is expired and so on.

The MS should support at least one authorization policy and inform BS of all supportable authorization policies by the SBC-REQ message. The BS negotiates the authorization policy. If all bits of this attribute included in the SBC-RSP message are 0, then no authorization is applied. Both the BS and the MS shall not use the authorization function.

The following table shows possible authorization policies that the MS can support.

The table shows the bit representation of Bits #0–2 and Bits #4–6 in ‘Authorization Policy Support’ field in an SBC-REQ and a PKMv2 SA-TEK-Request messages.

| Value | | | Description | Scope |
|---|---|---|---|---|
| Bit #0 / Bit #4 | Bit #1 / Bit #5 | Bit #2 / Bit #6 | | |
| 0 | 0 | 0 | No Authorization (MS cannot support any authorization) | SBC-REQ, PKM-REQ |
| 0 | 0 | 1 | N/A | |
| 0 | 1 | 0 | Only EAP-based authorization | |
| 0 | 1 | 1 | Only EAP-based authorization or authenticated EAP-based authorization after EAP-based authorization | |
| 1 | 0 | 0 | Only RSA-based authorization | |
| 1 | 0 | 1 | Only RSA-based authorization or authenticated EAP-based authorization after RSA-based authorization | |
| 1 | 1 | 0 | Only RSA-based authorization or<br>Only EAP-based authorization or<br>EAP-based authorization after RSA-based authorization | |
| 1 | 1 | 1 | Only RSA-based authorization or<br>Only EAP-based authorization or<br>EAP-based authorization after RSA-based authorization or<br>authenticated EAP-based authorization after RSA-based authorization or<br>authenticated EAP-based authorization after EAP-based authorization | |

The following table shows the bit representation of Bit #0–2 in ‘Authorization Policy Support’ field in an SBC-RSP and a PKMv2 SA-TEK-Response messages.

| Value | | | Description | Scope |
|---|---|---|---|---|
| Bit #0 | Bit #1 | Bit #2 | | |
| 0 | 0 | 0 | No Authorization | SBC-RSP, PKM-RSP |
| 0 | 0 | 1 | N/A | |
| 0 | 1 | 0 | Only EAP-based authorization | |
| 0 | 1 | 1 | Authenticated EAP-based authorization after EAP-based authorization | |
| 1 | 0 | 0 | Only RSA-based authorization | |
| 1 | 0 | 1 | Authenticated EAP-based authorization after RSA-based authorization | |
| 1 | 1 | 0 | EAP-based authorization after RSA-based authorization | |
| 1 | 1 | 1 | N/A | |

If MS and BS decide “No authorization” as their authorization policy, the MS and BS shall perform neither SA-TEK handshake nor TEK exchange procedure.

#### 11.8.4.3 MAC (Message Authentication Code) Mode

This field indicates a MAC (Message Authentication Code) mode that MS supports. Both MS and BS shall determine and use a MAC mode. A bit value of 0 indicates “not supported” while 1 indicates “supported”. If this attribute is not present, only HMAC is supported.

| Type | Length | Value |
|---|---|---|
| 25.3 | 1 | Bit# 0: HMAC<br>Bit# 1: CMAC<br>Bit# 2: 64-bit short-HMAC[a]<br>Bit# 3: 80-bit short-HMAC[a]<br>Bit# 4: 96-bit short-HMAC[a]<br>Bit# 5-7: Reserved. Set to 0 |

[a] If the short-HMAC mode is selected, then the short-HMAC Tuple shall be applied to the following messages: MOB_SLP-REQ/RSP, MOB_SCN-REQ/RSP, MOB_MSHO-REQ, MOB_BSHO-REQ/RSP, MOB_HO-IND, RNG-REQ/RSP. Otherwise, the HMAC Tuple shall be applied.

The MS should support at least one MAC mode and inform BS of all supportable MAC modes by the SBC-REQ message. The BS negotiates the MAC mode. If all bits of this attribute included in the SBC-RSP message are 0, then no message authentication code is applied. Both the MS and the BS does not need to authenticate the MAC (Medium Access Control) messages.

Short HMAC can be used only for HMAC is enabled.

### 11.8.4.4 PN window size

Specifies the size capability of the receiver PN window for SAs and management connections. The receiver shall track PNs within this window to prevent replay attacks (see 7.5.1.2.4).

| Type | Length | Value |
|---|---|---|
| 25.4 | 2 | PN Window Size in PNs |

***Insert new subclause 11.8.5:***

### 11.8.5 Power save class types capability

For MS supporting sleep mode, this parameter defines the capability of the MS supporting different power save class types in sleep mode.

| Type | Length | Value | Scope |
|---|---|---|---|
| 26 | 1 | Bit #0: power save class type I supported.<br>Bit #1: power save class type II supported.<br>Bit #2: power save class type III supported.<br>Bits #3-4: number of power save class instances supported from class types 1 and 2<br>Bits #5–7: number of power save class instances supported from class type III | SBC-REQ,<br>SBC-RSP |

***Insert new subclause 11.8.6:***

### 11.8.6 Extension capability

Specifies extension capability supports:

| Type | Length | Value | Scope |
|---|---|---|---|
| 27 | 1 | Bit #0: Support Extended subheader format<br>Bit #1–7: Reserved | SBC-REQ/RSP |

***Insert new subclause 11.8.7:***

### 11.8.7 HO Trigger metric support

This field indicates trigger metrics that MS or BS supports. For each bit, a value of 0 indicates "not supported" while 1 indicates "supported".

| Type | Length | Value | Scope |
|---|---|---|---|
| 28 | 1 | Bit #0: BS CINR mean<br>Bit #1: BS RSSI mean<br>Bit #2: Relative delay<br>Bit #3: BS RTD<br>Bit #4–7: *Reserved*; shall be set to zero | SBC-REQ<br>SBC-RSP |

***Insert new subclause 11.8.8:***

### 11.8.8 Association type support

The *Association type support* field indicates the association level supported by the MS or the BS.

| Type | Length | Value | Scope |
|---|---|---|---|
| 167 | 1 | Bit #0: Scanning without Association: Association not supported<br>Bit #1: Association level 0: Scanning or association without coordination.<br>Bit #2: Association level 1: association with coordination.<br>Bit #3: Association level 2: network assisted association.<br>Bit #4: Directed association support.<br>Bits #5–7 *Reserved* | SBC-REQ (see 6.3.2.3.23)<br>SBC-RSP (see 6.3.2.3.24) |

If a bit is set to '1', then MS or BS indicates support at the respective association type and level. The MS may associate according to arrangements by the BS at levels up to and including the one for which the MS has indicated support.

## 11.9 PKM-REQ/RSP management message encodings

***Change Table 370 as indicated (only changed/new text is shown):***

**Table 370—PKM attribute types**

| Type | PKM attribute |
|---|---|
| 22 | ~~Version~~ *Reserved* |
| 25 | Security Negotiation Parameters |
| 28 | EAP Payload |
| 29 | Nonce |
| 30 | Auth Result Code |
| 31 | SA service type |
| 32 | Frame Number |
| 33 | SS_RANDOM |
| 34 | BS_RANDOM |
| 35 | pre-PAK |
| 36 | PAK/AK Sequence Number |
| 37 | BS-Certificate |
| 38 | SigBS |
| 39 | MS-MAC Address |
| 40 | CMAC-Digest |
| 41 | Key Push Modes |
| 42 | Key Push Counter |
| 43 | GKEK |
| 44 | SigSS |
| 45 | AKID |
| 46 | Associated GKEK Sequence Number |
| 47 | GKEK-Parameters |
| ~~28~~48–255 | *Reserved* |

### 11.9.3 TEK

*Change 11.9.3 as indicated:*

| Type | Length | Value (string) |
|---|---|---|
| 8 | 8<br>16<br>24 | Encrypted TEK for DES<br>Encrypted TEK for AES<br>Encrypted TEK for AES Key Wrap |

When the TEK encryption algorithm identifier in the SA is 0x01, the length shall be 8 and the TEK shall be encrypted with 3DES in EDE mode according to the procedure defined in 7.5.2.1.

When the TEK encryption algorithm identifier in the SA is 0x03, the length shall be 16 and the TEK shall be encrypted with AES in ECB mode according to the procedure in 7.5.2.3.

When the TEK encryption algorithm identifier in the SA is 0x04, the length shall be 24 and the TEK shall be encrypted with the AES Key Wrap algorithm according to the procedure in 7.5.2.4.

**Table 371a—TEK encryption algorithm identifiers**

| Value | Description |
|---|---|
| 0 | *Reserved* |
| 1 | 3-DES EDE with 128-bit key |
| 2 | RSA with 1024-bit key |
| 3 | ECB mode AES with 128-bit key |
| 4 | AES Key Wrap with 128-bit key |
| 5–255 | *Reserved* |

*Change 11.9.4 as indicated:*

### 11.9.4 Key lifetime

*Description*: This attribute contains the lifetime, in seconds, of an AK or a TEK or a PAK, or a PMK. It is a 32-bit unsigned quantity representing the number of remaining seconds for which the associated key shall be valid. Note that this attribute can be used as a single TLV or as part of a compound TLV ~~top level attribute (AK) as well as a subattribute (TEK)~~.

| Type | Length | Value (uint32) |
|---|---|---|
| 9 | 4 | 32-bit quantity representing key lifetime<br>A key lifetime of zero indicates that the corresponding key ~~AK or TEK~~ is not valid. |

***Change 11.9.5 as indicated:***

### 11.9.5 Key-Sequence-Number

*Description*: This attribute contains sequence number for a TEK or AK or a PAK, or a PMK. The 2-bit or 4-bit quantity, however, is stored in a single byte, with the high-order 6 or 4 bits set to 0. A summary of the Key-Sequence-Number attribute format is shown below. Note that this attribute can be used as a single TLV or as part of a compound TLV ~~top level attribute (AK) as well as a subattribute (TEK~~

| Type | Length | Value (uint8) |
|---|---|---|
| 10 | 1 | 2-bit sequence number (TEK)<br>4-bit sequence number (AK, PAK, PMK) |

### 11.9.6 HMAC Digest

***Insert new subclause 11.9.6.1:***

#### 11.9.6.1 Short-HMAC Digest

*Description:* This attribute contains the highest-order bytes of the keyed hash used for message authentication. The HMAC algorithm is defined in IETF RFC 2104. The 20 byte HMAC result is truncated to the length indicated by the BS in the Short-HMAC digest length parameter (see 11.1.2.3), or to 10 bytes if the Short-HMAC digest length parameter was not specified.

| Type | Length | Value (uint16) |
|---|---|---|
| 11 | variable(8, 10, or 12 bytes as described in 11.1.2.3) | The highest order bytes of the truncated HMAC-SHA1 keyed hash |

### 11.9.7 SAID

***Change text in 11.9.7 as indicated:***

*Description:* This attribute contains a 16-bit SAID used by the Privacy Protocol to identify the SA. The SAID for the multicast service or the broadcast service is the GSAID. Null SAID shall used when “No authorization” is applied. The value of Null SAID is 0xffff.

### 11.9.8 TEK parameters

***Change 11.9.8 as indicated:***

*Description:* This attribute is a compound attribute, consisting of a collection of subattributes. These subattributes represent all security parameters relevant to a particular generation of an SAID’s TEK. A summary of the TEK-Parameters attribute format is shown below. The GTEK and GKEK are defined only for the multicast service or the broadcast service. The GTEK is the TEK for the multicast service or the broadcast service.

Table 372—TEK-parameters subattributes

| Attribute | Contents |
|---|---|
| TEK | TEK, encrypted with the KEK<br>GTEK, encrypted with the GKEK |
| Key-Lifetime | TEK Remaining Lifetime |
| Key-Sequence-Number | TEK Sequence Number |
| CBC-IV | CBC Initialization Vector |
| Associated GKEK Sequence Number | Associated GKEK sequence number with this TEK-Parameters |

***Insert the following text at the end of the 11.9.8:***

The CBC-IV attribute is required when the data encryption algorithm identifier in the SA ciphersuite is 0x01 (DES in CBC mode).

The CBC-IV attribute is not required when the data encryption algorithm identifier in the SA ciphersuite is 0x02 (AES).

The CBC-IV attribute is required when the data encryption algorithm identifier in the SA ciphersuite is 0x03 (AES in CBC mode).

### 11.9.13 Security capabilities

***Change the text as indicated:***

*Description:* The Security-Capabilities attribute contains ~~is a compound attribute whose subattributes identify the version of PKM an SS supports and~~ the cryptographic suite(s) an SS supports.

| Type | Length | Value (compound) |
|---|---|---|
| 19 | *variable* | The Compound field contains the subattributes as defined in Table 374 |

Table 374—Security-capabilities subattributes

| Attribute | Contents |
|---|---|
| Cryptographic-Suite-List | List of supported cryptographic suites |
| ~~Version~~ | ~~Version of Privacy supported~~ |

### 11.9.14 Cryptographic suite

*Change the text as indicated:*

**Table 375—Data encryption algorithm identifiers**

| Value | Description |
|---|---|
| 0 | No data encryption |
| 1 | CBC-Mode, 56-bit DES |
| 2 | ~~AES, CCM mode~~CCM-Mode, 128-bit AES |
| 3 | CBC-Mode, 128-bit AES |
| 128 | CTR-Mode 128 bits AES for MBS with 8 bits ROC |
| ~~2~~4–127 and 129–255 | *Reserved* |

**Table 376—Data authentication algorithm identifiers**

| Value | Description |
|---|---|
| 0 | No data authentication |
| 1 | CCM-Mode, 128-bit AES |
| ~~1~~2–255 | *Reserved* |

**Table 377—TEK encryption algorithm identifiers**

| Value | Description |
|---|---|
| 0 | Reserved |
| 1 | 3-DES EDE with 128-bit key |
| 2 | RSA with 1024-bit key |
| 3 | ECB mode AES with 128-bit key |
| 4 | AES Key Wrap with 128-bit key |
| ~~3~~5–255 | *Reserved* |

**Table 378—Allowed cryptographic suites**

| Value | Description |
|---|---|
| 0x000001 | No data encryption, no data authentication and 3-DES, 128 |
| 0x010001 | CBC-Mode 56-bit DES, no data authentication and 3-DES, 128 |
| 0x000002 | No data encryption, no data authentication and RSA, 1024 |
| 0x010002 | CBC-Mode 56-bit DES, no data authentication and RSA, 1024 |
| 0x020103 | CCM-Mode 128-bit AES, CCM-Mode, 128-bit, ECB mode AES with 128-bit key |
| 0x020104 | CCM-Mode 128bits AES, CCM-Mode, AES Key Wrap with 128-bit key |
| 0x030003 | CBC-Mode 128-bit AES, no data authentication, ECB mode AES with 128-bit key |
| 0x800003 | MBS CTR Mode 128 bits AES, no data authentication, AES ECB mode with 128-bit key |
| 0x800004 | MBS CTR mode 128 bits AES, no data authentication, AES Key Wrap with 128-bit key |
| All remaining values | *Reserved* |

***Delete all of 11.9.16.***

### ~~11.9.16 Version~~

***Change 11.9.17 as indicated:***

### 11.9.17 SA-Descriptor

Description: The SA-Descriptor attribute is a compound attribute whose subattributes describe the properties of a Security Association (SA). These properties include the SAID, the SA type, the SA service type, and the cryptographic suite employed within the SA.

**Table 383—SA-Descriptor subattributes**

| Attribute | Contents |
|---|---|
| SAID | Security Association ID |
| SA-Type | Type of SA |
| SA service type | Service type of the corresponding SA type. This shall be defined only when SA type is Static SA or Dynamic SA. |
| Cryptographic-Suite | Cryptographic suite employed within the SA |

### 11.9.19 PKM configuration settings

***Change the table in 11.9.19 as indicated:***

| Type | Length | Value ~~(compound)~~ | Scope |
|---|---|---|---|
| 27 | *variable* | Compound | Auth Reply, PMKv2-rsa reply, sa-tek-response |

***Insert new subclause 11.9.20:***

### 11.9.20 Nonce

*Description:* A quantity used to protect message exchanges from Replay Attack. As always, values for nonces should be generated using reliable random or pseudo-random generators.

| Type | Length | Value (string) |
|---|---|---|
| 29 | 4 | Randomly generated value |

***Insert new subclause 11.9.21:***

### 11.9.21 SS_RANDOM

*Description:* This attribute contains a quantity that is pseudo random number generated from the MS and used as fresh number for mutual authorization message handshake.

| Type | Length | Value |
|---|---|---|
| 33 | 8 | MS generated random number |

***Insert new subclause 11.9.22:***

### 11.9.22 BS_RANDOM

*Description:* This attribute contains a quantity that is pseudo random number generated from the BS and used as fresh number for mutual authorization message handshake.

| Type | Length | Value |
|---|---|---|
| 34 | 8 | BS generated random number |

***Insert new subclause 11.9.23:***

### 11.9.23 Pre-PAK

*Description:* This PAK (Primary Authorization Key) is 16 byte quantity, from which annn AK, KEK, two MAC message authentication keys, and two EAP message protection keys are derived. This attribute contains a 128 byte quantity containing the PAK RSA-encrypted with the MS's 1024-bit RSA public key. Details of the RSA encryption procedure are given 7.x The ciphertext produced by the RSA algorithm shall be the length of the RSA modulus, i.e., 128 bytes.

| Type | Length | Value |
|---|---|---|
| 35 | 128 | 128 byte quantity representing an RSA-encrypted pre-PAK, which generates PAK |

***Insert new subclause 11.9.24:***

### 11.9.24 BS-Certificate

*Description:* This attribute is a string attribute containing an X.509 BS Certificate, as defined 7.x. A summary of the BS-Certificate attribute format is shown below. The fields are transmitted from left to right.

| Type | Length | Value |
|---|---|---|
| 37 | *variable*<br>Length shall not cause resulting MAC management message to exceed the maximum allowed size. | X.509 BS Certificate (DER-encoded ASN.1) |

***Insert new subclause 11.9.25:***

### 11.9.25 SigBS

*Description:* This attribute contains a RSA signature computed over the PKMv2 RSA Reply message or the PKMv2 RSA Reject message with the BS's private key.

| Type | Length | Value |
|---|---|---|
| 38 | 128 | An RSA signature computed over all attributes included in the PKMv2 RSA Reply message or the PKMv2 RSA Reject message with the BS's private key. This value is calculated using PKCS #1 OAEP 1.5 signing algorithm with SHA-1 hash. |

***Insert new subclause 11.9.26:***

### 11.9.26 MS-MAC address

*Description:* This attribute is the MAC address of MS.

| Type | Length | Value |
|---|---|---|
| 39 | 6 | The MAC address of the MS |

***Insert new subclause 11.9.27:***

### 11.9.27 CMAC Digest

*Description:* This attribute contains a packet number counter CMAC_PN_* incremented per packet on each direction and the Message Authentication Code value used for message authentication. The CMAC algorithm is defined in draft SP 800-38B.

The CMAC digest includes

| Type | Length | Value |
|---|---|---|
| 40 | 12 | See that follows |

| Field | Length (bits) | Note |
|---|---|---|
| CMAC Packet Number counter, CMAC_PN_* | 32 | This context is different in UL, DL |
| CMAC value | 64 | CMAC with AES 128 |

***Insert new subclause 11.9.28:***

### 11.9.28 Key Push Modes

*Description:* The field, key push modes, is used to distinguish usage code of a PKMv2 Group Key Update Command message.

| Type | Length | Value |
|---|---|---|
| 41 | 1 | 0, GKEK update mode<br>1, GTEK update mode<br>2–255, *Reserved* |

A PKMv2 Group Key Update Command message for the GKEK update mode is to distribute new GKEK to each SS carried on the Primary Management connection. The BS transmits this message before the M&B TEK Grace Time starts.

A PKMv2 Group Key Update Command message for the GTEK update mode is to distribute new GTEK to all SS carried on the Broadcast connection. The BS transmits this message after the M&B TEK Grace Time starts.

Attributes of a PKMv2 Group Key Update Command message are different according to the value of the Key Push Modes as shown in the following table.

| Attribute | GKEK update mode | GTEK update mode |
|---|---|---|
| Key-Sequence-Number | AK Sequence Number | GKEK Sequence Number |
| GSAID | Yes | Yes |
| Key Push Modes | Yes | Yes |
| Key Push Counter | Yes | Yes |
| GTEK-Parameters | No | Yes |
| GKEK-Parameters | Yes | No |
| HMAC/CMAC-Digest | Yes | Yes |

Key-Sequence-Number, GSAID, Key Push Modes, and HMAC/CMAC-Digest fields are included in two PKMv2 Group Key Update Command message regardless of the value of the Key Push Modes.

GKEK-Parameters attribute should be included in a PKMv2 Group Key Update Command message for the GKEK update mode. And GTEK-Parameters attribute should be included in that message for the GTEK update mode.

CBC-IV can be included only when the TEK encryption algorithm identifier in the cryptographic suite equal to 0x01.

One of HMAC Digest or CMAC-Digest shall be used to authenticate the Key Update Command messages.

***Insert new subclause 11.9.29:***

### 11.9.29 Key Push Counter

*Description:* Key Push Counter is used to protect for replay attack. This value is one greater than (modulo 65536) that of older generation.

| Type | Length | Value |
|---|---|---|
| 42 | 2 | 16-bit counter |

***Insert new subclause 11.9.30:***

### 11.9.30 GKEK (Group Key Encryption Key)

*Description:* 128-bit GKEK may be randomly generated in a BS or an ASA server. The 'GKEK (Group Key Encryption Key)' field is used to encrypt the GTEK for the multicast service or the broadcast service.

| Type | Length | Value |
|---|---|---|
| 43 | 16 | GKEK, encrypted with the KEK derived from AK |

***Insert subclause 11.9.31:***

### 11.9.31 SigSS

*Description*: This attribute contains an RSA signature computed over the PKMv2 RSA Request message or the PKMv2 RSA Acknowledgement message with the SS's private key.

| Type | Length | Value |
|---|---|---|
| 44 | 128 | An RSA signature computed over all attributes included in the PKMv2 RSA Request message or the PKMv2 RSA Acknowledgement message with the SS's private key. This value is calculated using RSASSA-PKCS-v1_5-Sign algorithm with SHA-1 hash. |

***Insert subclause 11.9.32:***

### 11.9.32 AKID

*Description*: This attribute identifies the AK as defined in Table 133.

| Type | Length | Value |
|---|---|---|
| 45 | 8 | AKID as defined in Table 133 |

***Insert subclause 11.9.33:***

### 11.9.33 EAP payload

*Description*: This attribute contains the payload used in the upper EAP authorization layer. The security sublayer does not interpret this attribute.

| Type | Length | Value |
|---|---|---|
| 28 | *variable* | EAP payload |

***Insert subclause 11.9.34:***

### 11.9.34 Auth result code

*Description*: This attribute contains the result code of the RSA-based authorization (only for PKMv2).

| Type | Length | Value |
|---|---|---|
| 30 | 1 | 0, Success<br>1, Reject<br>2-255, *Reserved.* |

***Insert subclause 11.9.35:***

### 11.9.35 SA service type

*Description*: This attribute indicates service types of the corresponding SA type. This attribute shall be defined only when the SA type is Static SA or Dynamic SA. The GTEK shall be used to encrypt connection for group multicast service. The MTK shall be used to encrypt connection for MBS service.

| Type | Length | Value |
|---|---|---|
| 31 | 1 | 0: Unicast service<br>1: Group multicast service<br>2: MBS service<br>3-255: *Reserved.* |

***Insert subclause 11.9.36:***

### 11.9.36 PKMv2 configuration settings

*Description*: This field defines the parameters associated with PKMv2 operation. It is composed of a number of encapsulated TLV fields.

| Type | Length | Value (compound) | Scope |
|---|---|---|---|
| 27 | Variable | | Auth Reply,PKMv2 SA-TEK-response |

***Insert new subclause 11.9.37:***

### 11.9.37 Frame number

*Description*: This attribute contains a 24-bit absolute frame number in which the old PMK and all its associate AKs should be discarded. The value is in most significant bit first order.

| Type | Length | Value |
|---|---|---|
| 32 | 3 | 24-bit Frame Number in MSB first order |

## 11.11 REP-REQ management message encodings

***Change third row of the second table in 11.11 as indicated:***

| Name | Type | Length | Value |
|---|---|---|---|
| Channel Type request | 1.~~1~~3 | 1 | 0b00 = Normal subchannel,<br>0b01 = Band AMC Channel,<br>0b10 = Safety Channel,<br>0b11 = ~~*Reserved*~~Sounding |

***Insert the following entries into the second table of 11.11:***

| Name | Type | Length | Value |
|---|---|---|---|
| Zone-specific physical CINR request | 1.4 | 3 | Bits #0-2: Type of zone on which CINR is to be reported<br>0b000: PUSC zone with 'use all SC=0'<br>0b001: PUSC zone with 'use all SC=1' / PUSC AAS zone<br>0b010: FUSC zone<br>0b011: Optional FUSC zone<br>0b100: Safety Channel region<br>0b101: AMC zone (only applicable to AAS mode)<br>0b110 – 0b111: *Reserved*<br>Bit #3: 1 if zone for which CINR should be estimated is STC zone, 0 otherwise.<br>Bit #4: 1 if zone for which CINR should be estimated is AAS zone, 0 otherwise.<br>Bits #5-6: PRBS_ID of the zone for which CINR should be estimated. Ignored for Safety Channel.<br>Bit #7: Data/pilot-based CINR measurement:<br>0 - Report the CINR estimate from pilot subcarriers,<br>1 - Report the CINR estimate from data subcarriers<br>Bits #8-13: Reported CINR shall only be estimated for the subchannels of PUSC major groups for which the corresponding bit is set. Bit #($k$+7) refers to major group $k$. Only applicable for CINR measurement on a PUSC zone<br>Bits #14-17: $\alpha_{avg}$ in multiples of 1/16 (range is [1/16,16/16])<br>Bit #18: 0 - report only mean of CINR<br>1 - report both mean and standard deviation of CINR<br>Bits #19-23: *Reserved,* shall be set to zero |
| Preamble physical CINR request | 1.5 | 1 | Bits #0-1: Type of preamble physical CINR measurement<br>0b00 - Report the estimation of CINR measured from preamble for frequency reuse configuration=1<br>0b01 - Report the estimation of CINR measured from preamble for frequency reuse configuration=3<br>0b10 - Report the estimation of CINR measured from preamble for band AMC<br>0b11 - *Reserved*<br>Bits #2-5: $\alpha_{avg}$ in multiples of 1/16 (range is [1/16,16/16])<br>Bit #6: 0 - report only mean of CINR<br>1 - report both mean and standard deviation of CINR<br>Bit #7: *Reserved*, shall be set to zero |

| Name | Type | Length | Value |
|---|---|---|---|
| Zone-specific effective CINR request | 1.6 | 2 | Bits #0-2: Type of zone on which effective CINR is to be reported<br>0b000: PUSC zone with 'use all SC=0'<br>0b001: PUSC zone with 'use all SC=1' / PUSC AAS zone<br>0b010: FUSC zone<br>0b011: Optional FUSC zone<br>0b100: Reserved<br>0b101: AMC zone (only applicable to AAS mode)<br>0b110 - 0b111: *Reserved*<br>Bit #3: 1 if zone for which effective CINR should be reported is STC zone, 0 otherwise.<br>Bit #4: 1 if zone for which effective CINR should be estimated is AAS zone, 0 otherwise.<br>Bits #5-6: PRBS_ID of the zone for which effective CINR should be reported. Ignored for Safety Channel.<br>Bit #7: Data/pilot-based effective CINR measurement:<br>0 - Report the CINR estimate from pilot subcarriers,<br>1 - Report the CINR estimate from data subcarriers<br>Bits #8-13:Reported effective CINR shall only be estimated for the subchannels of PUSC major groups for which the corresponding bit is set. Bit #($k$+7) refers to major group $k$. Only applicable for CINR measurement on a PUSC zone<br>Bit #14-15:*Reserved*, shall be set to zero |
| Preamble effective CINR request | 1.7 | 1 | Bits #0-1: Type of preamble-based effective CINR measurement<br>0b00 - Report the estimation of effective CINR measured from preamble for frequency reuse configuration=1<br>0b01 - Report the estimation of effective CINR measured from preamble for frequency reuse configuration=3<br>0b10-11 - *Reserved*<br>Bit #2-7: *Reserved*, shall be set to zero |
| Channel selectivity report | 1.8 | 1 | Bit #0: 1 - include frequency selectivity report<br>Bit #1-7: *Reserved*, shall be set to zero |

## 11.12 REP-RSP management message encodings

***Change the second table of the subclause as indicated:***

| REP-REQ Report type | Name | Type | Length | Value |
|---|---|---|---|---|
| Bit #0 = 1 | Start frame | 1.2 | 2 | 16 LSBs of Frame number in which measurement for this channel started |
| Bit #0 = 1 | Basic report | 1.4 | 1 | Bit #0: WirelessHUMAN detected on the channel<br>Bit #1: Unknown transmissions detected on the channel<br>Bit #2: ~~Primary~~ Specific Spectrum User detected on the channel<br>Bit #3: Unmeasured. Channel not measured |

***Change the 'Channel Type = 01' of the last table of the subclause as indicated:***

| REP-REQ Channel Type request | Name | Type | Length | Value |
|---|---|---|---|---|
| Channel Type = 01 | Band AMC Report | 2.2 | 4 | First 12 bits for the band indicating bitmap and Next 2~~5~~0 bits for CINR reports (5 bits per each band) |

***Insert the following rows into the third table as indicated:***

| REP-REQ Channel Type request (binary) | Name | Type | Length | Value |
|---|---|---|---|---|
| 01 | Enhanced Band AMC Report | 2.4 | 5 | First 12 bits for the band indicating bitmap and next 25 bits for CINR measurement (5 bits per each band) |
| 11 | Sounding Report | 2.5 | 1 | Average SINR.<br>8 bits in the same format used in 8.4.11.3 |

For REP-REQ Channel Type request type 1.3, with value 0b01 = Band AMC Channel, enhanced CQICH enabled MS shall report with type 2.4; otherwise, SS and MS shall report with type 2.2.

***Insert the following table at the end of the subclause:***

| REP-REQ Zone-specific physical CINR request | Name | Type | Length | Value |
|---|---|---|---|---|
| Bits #0-2 = 0b000 | PUSC zone with 'use all SC=0' | 3.1 | 1 or 2 | Bit #0-4: Mean of physical CINR estimate for PUSC zone with 'use all SC=0' and PRBS_ID indicated in 'zone-specific physical CINR request'.<br>Bit #5: Report type: 0–CINR estimated from pilot subcarriers, 1–CINR estimated from data subcarriers<br>Bit #6-7: *Reserved*, shall be set to zero<br>Bit #8-12: Standard deviation of CINR estimate for PUSC zone with 'use all SC=0' and PRBS_ID indicated in 'zone-specific CINR request'.<br>Bit #13-15: *Reserved*, shall be set to zero<br>NOTE—The second byte shall only be sent if length=2 |

| **REP-REQ Zone-specific physical CINR request** | **Name** | **Type** | **Length** | **Value** |
|---|---|---|---|---|
| Bits #0-2 = 0b001 | PUSC zone with 'use all SC=1' | 3.2 | 1 or 2 | Bit #0-4: Mean of physical CINR estimate for PUSC zone with 'use all SC=1' and PRBS_ID indicated in 'zone-specific physical CINR request'. CINR reported corresponds to a subset of major groups as specified in 'CINR type request'.<br>Bit #5: Report type: 0 - CINR estimated from pilot subcarriers, 1- CINR estimated from data subcarriers<br>Bit #6-7: *Reserved*, shall be set to zero<br>Bit #8-12: Standard deviation of CINR estimate for PUSC zone with 'use all SC=1' and PRBS_ID indicated in 'zone-specific CINR request'. CINR reported corresponds to a subset of major groups as specified in 'CINR type request'.<br>Bit #13-15: *Reserved*, shall be set to zero<br>NOTE—The second byte shall only be sent if length=2. |
| Bits #0-2 = 0b010 | FUSC zone | 3.3 | 1 or 2 | Bit #0-4: Mean of physical CINR estimate for FUSC zone with PRBS_ID indicated in 'zone-specific physical CINR request'.<br>Bit #5: Report type: 0 - CINR estimated from pilot subcarriers, 1- CINR estimated from data subcarriers<br>Bit #6-7: *Reserved*, shall be set to zero<br>Bit #8-12: Standard deviation of CINR estimate for FUSC zone with PRBS_ID indicated in 'zone-specific CINR request'.<br>Bit #13-15: *Reserved*, shall be set to zero<br>NOTE—The second byte shall only be sent if length=2. |
| Bits #0-2 = 0b011 | Optional FUSC zone | 3.4 | 1 or 2 | Bit #0-4: Mean of physical CINR estimate for Optional FUSC with PRBS_ID indicated in 'zone-specific physical CINR request'.<br>Bit #5: Report type: 0 - CINR estimated from pilot subcarriers, 1- CINR estimated from data subcarriers<br>Bit #6-7: *Reserved*, shall be set to zero<br>Bit #8-12: Standard deviation of CINR estimate for Optional FUSC with PRBS_ID indicated in 'zone-specific CINR request'.<br>Bit #13-15:*Reserved*, shall be set to zero<br>NOTE—The second byte shall only be sent if length=2. |
| Bits #0-2 = 0b100 | Safety channel | 3.5 | 5 | The first 20 bits for the reported bin indices and the next 20 bits for CINR reports (5 bits for each bin). |

| REP-REQ Zone-specific physical CINR request | Name | Type | Length | Value |
|---|---|---|---|---|
| Bits #0-2 = 0b101 | AMC zone | 3.6 | 1 or 2 | Bit #0-4: Mean of physical CINR estimate for AMC AAS zone with PRBS_ID indicated in 'zone specific physical CINR request'.<br>Bit #5: Report type: 0 - CINR estimated from pilot subcarriers, 1- CINR estimated from data subcarriers<br>Bit #6-7: *Reserved*, shall be set to zero<br>Bit #8-12: Standard deviation of CINR estimate for AMC AAS zone.<br>Bit #13-15:*Reserved*, shall be set to zero<br>NOTE—The second byte shall only be sent if length=2. |

| REP-REQ Preamble physical CINR request | Name | Type | Length | Value |
|---|---|---|---|---|
| Bits #0-1 = 0b00 | The estimation of physical CINR measured from preamble for frequency reuse configuration=1 | 4.1 | 1 or 2 | Bit #0-4: The mean of physical CINR estimation measured from preamble for frequency reuse configuration=1.<br>Bit #5-7: *Reserved*, shall be set to zero.<br>Bit #8-12: The standard deviation of CINR estimation measured from preamble for frequency reuse configuration=1.<br>Bit #13-15:*Reserved*, shall be set to zero<br>NOTE—The second byte shall only be sent if length=2. |
| Bits #0-1 = 0b01 | The estimation of physical CINR measured from preamble for frequency reuse configuration=3 | 4.2 | 1 or 2 | Bit #0-4: The mean of physical CINR estimation measured from preamble for frequency reuse configuration=3.<br>Bit #5-7: *Reserved*, shall be set to zero.<br>Bit #8-12: The standard deviation of CINR estimation measured from preamble for frequency reuse configuration=3.<br>Bit #13-15:*Reserved*, shall be set to zero<br>NOTE—The second byte shall only be sent if length=2. |
| Bits #0-1 = 0b10 | The estimation of physical CINR measured from preamble for Band AMC zone. | 4.3 | 4 | The estimation of physical CINR measured from preamble for band AMC subchannel. First 12 bits for the band indicating bitmap and Next 20 bits for CINR reports (5 bits per each band). |

| REP-REQ zone specific effective CINR request | Name | Type | Length | Value |
|---|---|---|---|---|
| Bits #0-2 = 0b000 | PUSC zone with ‘use all SC=0’ | 5.1 | 1 | Bit #0-3: Effective CINR for PUSC zone with ‘use all SC=0’ and PRBS_ID indicated by ‘Effective CINR request’. Encoding is defined in 8.4.5.4.10.5.<br>Bit #4: Report type: 0 - effective CINR estimated from pilot subcarriers, 1- effective CINR estimated from data subcarriers<br>Bit #5-7: 3 least significant bits of CQICH_ID |
| Bits #0-2 = 0b001 | PUSC zone with ‘use all SC=1’ / PUSC AAS zone | 5.2 | 1 | Bit #0-3: Effective CINR for PUSC zone with ‘use all SC=1’ (or PUSC AAS zone) and PRBS_ID indicated by ‘Effective CINR request’. Encoding is defined in 8.4.5.4.10.5.<br>Bit #4: Report type: 0 - effective CINR estimated from pilot subcarriers, 1- effective CINR estimated from data subcarriers<br>Bit #5-7: 3 least significant bits of CQICH_ID |
| Bits #0-2 = 0b010 | FUSC zone | 5.3 | 1 | Bit #0-3: Effective CINR for FUSC zone with PRBS_ID indicated by ‘Effective CINR request’. Encoding is defined in 8.4.5.4.10.5.<br>Bit #4: Report type: 0 - effective CINR estimated from pilot subcarriers, 1- effective CINR estimated from data subcarriers<br>Bit #5-7: 3 least significant bits of CQICH_ID |
| Bits #0-2 = 0b011 | Optional FUSC zone | 5.4 | 1 | Bit #0-3: Effective CINR for Optional FUSC zone with PRBS_ID indicated by ‘Effective CINR request’. Encoding is defined in 8.4.5.4.10.5.<br>Bit #4: Report type: 0 - effective CINR estimated from pilot subcarriers, 1- effective CINR estimated from data subcarriers<br>Bit #5-7: 3 least significant bits of CQICH_ID |
| Bits #0-2 = 0b101 | AMC AAS zone | 5.5 | 1 | Bit #0-3: Effective CINR for AMC AAS zone with PRBS_ID indicated by ‘Effective CINR request’. Encoding is defined in 8.4.5.4.10.5.<br>Bit #4: Report type: 0 - effective CINR estimated from pilot subcarriers, 1- effective CINR estimated from data subcarriers<br>Bit #5-7: 3 least significant bits of CQICH_ID |

NOTE—CQICH_ID applies to triggered update (see 6.3.18.2) for CQI channel allocated with a CQICH_ID, and shall be zero in all other cases.

| REP-REQ preamble effective-CINR request | Name | Type | Length | Value |
|---|---|---|---|---|
| Bits #0-1 = 0b00 | The estimation of effective CINR measured from preamble for frequency reuse configuration=1 | 6.1 | 1 | Bit #0-3: Effective CINR based on measurement from preamble with frequency reuse configuration=1. Encoding is defined in 8.4.5.4.10.5.<br>Bit #4-7: 4 least significant bits of CQICH_ID |
| Bits #0-1 = 0b01 | The estimation of effective CINR measured from preamble for frequency reuse configuration=3 | 6.2 | 1 | Bit #0-3: Effective CINR based on measurement from preamble with frequency reuse configuration=3. Encoding is defined in 8.4.5.4.10.5.<br>Bit #4-7: 4 least significant bits of CQICH_ID |

NOTE—CQICH_ID applies to triggered update (see 6.3.18.2) for CQI channel allocated with a CQICH_ID, and shall be zero in all other cases.

| REP-REQ Channel selectivity report | Name | Type | Length | Value |
|---|---|---|---|---|
| Bits #0 = 1 | Frequency selectivity report | 6.3 | 3 | Bit #0–7: *a*<br>Bit #8–15: *b*<br>Bit #16–23: *c* |

***Insert the following text at the end of 11.12:***

For the type ~~2.4, 2.5, 2.6,~~ 2.x, the following 5 bit, CINR measurement encoding shall be used:

$$n = \begin{cases} 0 & CINR \le -3dB \\ n & (n-4)dB < CINR \le (n-3)dB,\ 0 < n < 31 \\ 31 & CINR > 27dB \end{cases} \qquad (154a)$$

For the TLVs with type 3.x and 4.x, the following 5 bit physical CINR measurement encoding shall be used:

$$\text{Payload bits} = \begin{cases} 0 & CINR \le -3dB \\ n & (n-4) < CINR \le (n-3),\ 0 < n < 31 \\ 31 & CINR > 27dB \end{cases} \qquad (154b)$$

## 11.13 Service flow management encodings

***Change the text in the following table as indicated:***

**Table 383—Service flow encodings**

| Type | Parameter |
|---|---|
| 1 | Service Flow Identifier |
| 2 | CID |
| 3 | Service Class Name |
| 4 | ~~Reserved~~ MBS service |
| 5 | QoS Parameter Set Type |
| 6 | Traffic Priority |
| 7 | Maximum Sustained Traffic Rate |
| 8 | Maximum Traffic Burst |
| 9 | Minimum Reserved Traffic Rate |
| 10 | ~~Minimum Tolerable Traffic Rate~~ *Reserved* |
| 11 | Service Flow Scheduling Type |
| 12 | Request/Transmission Policy |
| 13 | Tolerated Jitter |
| 14 | Maximum Latency |
| 15 | Fixed-length versus Variable-length SDU Indicator |
| 16 | SDU Size |
| 17 | Target SAID |
| 18 | ARQ Enable |
| 19 | ARQ_WINDOW_SIZE |
| 20 | ARQ_RETRY_TIMEOUT - Transmitter Delay |
| 21 | ARQ_RETRY_TIMEOUT - Receiver Delay |
| 22 | ARQ_BLOCK_LIFETIME |
| 23 | ARQ_SYNC_LOSS |
| 24 | ARQ_DELIVER_IN_ORDER |
| 25 | ARQ_PURGE_TIMEOUT |
| 26 | ARQ_BLOCK_SIZE |
| 27 | Reserved |
| 28 | CS Specification |
| ~~30~~ 29 | Type of Data Delivery Services |
| ~~31~~ 30 | SDU Inter-arrival Interval |
| ~~32~~ 31 | Time Base |

**Table 383—Service flow encodings *(continued)***

| Type | Parameter |
|---|---|
| ~~33~~ 32 | Paging Preference |
| 33 | MBS zone identifier assignment |
| 34 | Traffic Indication Preference |
| 35 | Global Service Class Name |
| 36 | Reserved |
| 37 | SN Feedback Enabled |
| 38 | FSN size |
| 39 | CID allocation for Active BSs |
| 40 | Unsolicited Grant Interval |
| 41 | Unsolicited Polling Interval |
| 42 | PDU SN extended subheader for HARQ reordering |
| 43 | MBS contents ID |
| 44 | HARQ Service Flows |
| 45 | Authorization Token |
| 46 | HARQ Channel mapping |

***Change the fourth paragraph as indicated:***

The CC indicates the status for the dynamic service (DSx-xxx) messages. The value ~~may~~ appears in the Confirmation Code field of a DSx message ~~or as the value of a TLV-encoded error parameter~~.

***Delete the last paragraph:***

~~In the case CC = “reject-not-supported-parameter” or CC = “reject-not-supported-parameter-value”, the corresponding TLV(s) may be returned to caller in DSx-RSP message. In the case of CC = “reject-not-supported-parameter-value,” the value field of the returned TLV should contain the closest value that is supported.~~

### 11.13.4 QoS parameter set type

***Change the first paragraph as indicated:***

This parameter shall appear within every service flow encoding. It specifies the proper application of the QoS Parameter Set: to the Provisioned set, the Admitted set, and/or the Active set. The QoS Parameter Set is a subset of the following parameter set:

- Traffic priority (11.13.5)
- Maximum sustained traffic rate (11.13.6)
- Maximum traffic burst (11.13.7)
- Minimum Reserved traffic rate (11.13.8)
- Vendor specific QoS parameters (11.13.10)
- Tolerated jitter (11.13.13)

- Maximum latency (11.13.14)
- Unsolicited grant interval (11.13.20)
- Unsolicited polling interval (11.13.21)

When two QoS Parameter Sets are the same, a multibit value of this parameter may be used to apply the QoS parameters to more than one set. A single message may contain multiple QoS parameter sets in separate type 145/146 service flow encodings for the same service flow. This allows specification of the QoS Parameter Sets when their parameters are different. Non-QoS parameters shall appear only in the first Service Flow Management Encodings. Bit 0 is the LSB of the Value field.

### 11.13.5 Traffic priority

***Change the second paragraph as indicated:***

For uplink service flows, the BS shall use this parameter when determining precedence in request service and grant generation~~, and the SS shall preferentially select contention Request opportunities for Priority Request CIDs based on this priority and its Request/Transmission Policy (see 11.13.12)~~.

***Change the Table in the subclause as indicated:***

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].6 | 1 | 0 to 7—Higher numbers indicate higher priority<br>Default 0 | DSx-REQ<br>DSx-RSP<br>DSx-ACK<br>REG-RSP |

### 11.13.6 Maximum sustained traffic rate

***Change the first paragraph as indicated***

This parameter defines the peak information rate of the service. The rate is expressed in bits per second and pertains to the SDUs at the input to the Convergence Sublayer~~ system~~. Hence ~~Explicitly~~, this parameter does not include 802.16 MAC overhead such as MAC headers or CRCs. ~~This parameter does not limit the instantaneous rate of the service since this is governed by the physical attributes of the ingress port. However,~~ At the BS and SS ~~in the uplink direction~~, the service shall be policed to conform to this parameter, on the average, over time. ~~At the BS in the downlink direction, it may be assumed that the service was already policed at the ingress to the network and the BS is not required to do additional policing.~~ If this parameter is omitted or set to zero, then there is no explicitly mandated maximum rate. This field specifies only a bound, not a guarantee that the rate is available.

The algorithm for measuring whether a flow exceeds its Maximum Sustained Traffic Rate ~~policing to this parameter~~ is left to vendor differentiation and is outside the scope of the standard.

SDUs deemed to exceed the Maximum Sustained Traffic Rate may be, for instance, delayed or dropped according to the discretion of the vendor.

***Change the table as indicated:***

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].7 | 4 | Rate (in bits per second) | DSx-REQ<br>DSx-RSP<br>DSx-ACK<br>REG-RSP |

## 11.13.8 Minimum reserved traffic rate

***Change the content of the subclause as indicated***

This parameter specifies the minimum rate reserved for this service flow. The rate is expressed in bits per second and specifies the minimum amount of data to be transported on behalf of the service flow when averaged over time. The specified rate shall only be honored when sufficient data is available for scheduling. ~~When insufficient data exists, the requirement imposed by this parameter shall be satisfied by assuring that the available data is transmitted as soon as possible.~~

The BS and SS shall be able to transport traffic ~~satisfy bandwidth requests for a service flow~~ up to its Minimum Reserved Traffic Rate. If less ~~bandwidth~~ than the ~~its~~ Minimum Reserved Traffic Rate is available ~~requested~~ for a service flow, the BS and SS may reallocate the excess reserved bandwidth for other purposes. The data for this parameter is measured at the input of the Convergence Sublayer. The aggregate Minimum Reserved Traffic Rate of all service flows may exceed the amount of available bandwidth. ~~The value of this parameter is calculated from the byte following the MAC header HCS to the end of the MAC PDU payload.~~ If this parameter is omitted, then it defaults to a value of 0 bits per second (i.e., no bandwidth is reserved for the flow).

***Change the table as indicated:***

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].9 | 4 | Rate (in bits per second) | DSx-REQ<br>DSx-RSP<br>DSx-ACK<br>REG-RSP |

## 11.13.11 ~~Service flow~~ Uplink grant scheduling type

***Change the title and the content of the subclause as indicated:***

The value of this parameter specifies the Uplink grant scheduling ~~service~~ type that shall be enabled for the associated uplink service flow (see 6.3.5.2). If the parameter is omitted, BE ~~service~~ is assumed.

| Type | Length | Value | Scope |
|---|---|---|---|
| ~~[~~145~~/146]~~.11 | 1 | 0: *Reserved*<br>1: for Undefined (BS implementation-dependent[a])<br>2: for BE (default)<br>3: for nrtPS<br>4: for rtPS<br>5: ~~*Reserved*~~ for Extended rtPS<br>6: for UGS<br>7–255: *Reserved* | DSA-REQ<br>DSA-RSP<br>DSA-ACK |

[a] The specific implementation-dependent scheduling service type could be defined in a message of Type 145/~~146~~.143 (vendor-specific QoS parameters).

### 11.13.12 Request/transmission policy

***Change the content of the subclause as indicated***

The value of this parameter provides the capability to specify certain attributes for the associated service flow. These attributes include options for PDU formation and, for uplink service flows, restrictions on the types of bandwidth request options that may be used. An attribute is enabled by setting the corresponding bit position to 1. For attributes affecting uplink bandwidth request types, a value of zero indicates the default actions described in the scheduling service description in 6.3.5 shall be used. A value of one indicates that the action associated with the attribute bit overrides the default action.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].12 | ~~4~~ 1 | Bit #0 – Service flow shall not use broadcast bandwidth request opportunities. (Uplink only)<br>Bit #1 – ~~*Reserved*; shall be set to zero~~ Service flow shall not use multicast bandwidth request opportunities. (Uplink only)<br>Bit #2 – The service flow shall not piggyback requests with data. (Uplink only)<br>Bit #3 – The service flow shall not fragment data.<br>Bit #4 – The service flow shall not suppress payload headers (CS parameter)<br>Bit #5 – The service flow shall not pack multiple SDUs (or fragments) into single MAC PDUs<br>Bit #6 – The service flow shall not include CRC in the MAC PDU.<br>Bit #7 – *Reserved*; shall be set to zero | DSA-REQ<br>DSA-RSP<br>DSA-ACK |

### 11.13.14 Maximum latency

***Change the first paragraph as indicated:***

The value of this parameter specifies the maximum latency between the ingress of a packet to the Convergence Sublayer ~~reception of a packet by the BS or SS on its network interface~~ and the forwarding of the SDU ~~packet~~ to its ~~RF~~Air Interface.

***Change the Table in the subclause as indicated:***

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].14 | 4 | ms | DSx-REQ<br>DSx-RSP<br>DSx-ACK<br>REG-RSP |

### 11.13.17 Target SAID

***Change the first paragraph as indicated:***

The target SAID parameter indicates the SAID onto which the service flow that is being set up shall be mapped.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].17 | 2 | SAID onto which SF is mapped | DSA-REQ<br>DSA-RSP<br>DSC-REQ<br>DSC-RSP |

### 11.13.18 ARQ TLVs for ARQ-enabled connections

### 11.13.18.8 ARQ_BLOCK_SIZE

***Change the table as indicated:***

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].26<br>1.26 | 2 | 0-15: *Reserved*<br>~~1–2040~~16, 32, 64, 128, 256, 512, or 1024~~ or 2048~~: Desired/Agreed size in bytes<br>2041-65535: *Reserved* | DSA-REQ, DSA-RSP<br>REG-REQ, REG-RSP |

***Insert new subclause 11.8.18.9:***

### 11.13.18.9 RECEIVER_ARQ_ACK_PROCESSING_TIME

The BS or SS may provide this parameter. The DSA-REQ and DSA-RSP messages may contain the value of this parameter. This optional parameter indicates the number of ms required by the ARQ receiver to process the received ARQ blocks and provide a valid ACK or NAK. This does not mean that the receiver would actually transmit an ACK or NAK after this time, but rather it can be optionally used by the transmitter that receives an ACK bit-map to determine which bits are re-transmissions of historical NAKs or ACKs, that are not based on newly received ARQ blocks.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].27<br>1.27 | 1 | 0–255 | DSA-REQ, DSA-RSP<br>REG-REQ, REG-RSP |

### 11.13.19 CS specific service flow encodings

#### 11.13.19.1 CS specification

***Change the table in 11.13.19.1 as indicated:***

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].28 | 1 | 0: ~~No CS~~*Reserved*<br>1: Packet, IPv4<br>2: Packet, IPv6<br>3: Packet, IEEE 802.3/Ethernet<br>4: Packet, IEEE 802.1Q VLAN<br>5: Packet, IPv4 over IEEE 802.3/Ethernet<br>6: Packet, IPv6 over IEEE 802.3/Ethernet<br>7: Packet, IPv4 over IEEE 802.1Q VLAN<br>8: Packet, IPv6 over IEEE 802.1Q VLAN<br>9: ATM<br>10: Packet, IEEE 802.3/Ethernet[a] with ROHC header compression<br>11: Packet, IEEE 802.3/Ethernet[b] with ECRTP header compression<br>12: Packet, IP2 with ROHC header compression<br>13: Packet, IP2 with ECRTP header compression<br>~~10~~14–255: *Reserved* | DSx-REQ |

[a] Classifiers for IEEE 802.1Q VLAN tags may be applied to service flows of this CS type.
[b] SDUs for service flows of this CS type may carry either IPv4 or IPv6 in the header-compressed payload.

#### 11.13.19.2 CS parameter encoding rules

***Change the table in 11.13.19.2 as indicated:***

| cst | CS |
|---|---|
| 99 | ATM |
| 100 | Packet, IPv4 |
| 101 | Packet, IPv6 |
| 102 | Packet, IEEE 802.3/Ethernet |
| 103 | Packet, IEEE 802.1Q VLAN |
| 104 | Packet, IPv4 over IEEE 802.3/Ethernet |
| 105 | Packet, IPv6 over IEEE 802.3/Ethernet |
| 106 | Packet, IPv4 over ~~802.3/Ethernet~~IEEE 802.1Q VLAN |
| 107 | Packet, IPv6 over ~~802.3/Ethernet~~IEEE 802.1Q VLAN |
| 108 | Packet, IP with header ROHC compression |
| 109 | Packet, IP with ECRTP header compression |
| 110 | Packet, IP over IEEE 802.3/Ethernet with ROHC header compression |
| 111 | Packet, IP over IEEE 802.3/Ethernet with ECRTP header compression |

***Insert the following table at the end of the subclause:***

| Type | Length | Value |
|---|---|---|
| [145/146].cst | variable | Compound |

### 11.13.19.3 Packet CS encodings for configuration and MAC messaging

***Delete 11.13.19.3.3 and all its subclauses.***

### ~~11.13.19.3.3 Classifier error parameter set~~

### 11.13.19.3.4 Packet classification rule

### 11.13.19.3.4.3 Protocol

***Change content of 11.13.19.3.4.3 as indicated:***

The value of the field specifies a ~~list of~~ matching value~~s~~ for the IP Protocol field. For IPv6 (IETF RFC 2460), this refers to next header entry in the last header of the IP header chain. The encoding of the value field is that defined by the IANA document “Protocol Numbers.” If this parameter is omitted, then comparison of the IP header Protocol field for this entry is irrelevant.

| Type | Length | Value |
|---|---|---|
| [145/146].cst.3.3 | ~~*n*~~*1* | ~~prot1, prot2,...prot *n*~~ protocol |

### 11.13.19.3.4.4 IP masked source address

***Change content of 11.13.19.3.4.4 as indicated:***

This parameter specifies an ~~list of~~ IP source address~~es~~ (designated “src~~i~~”) and ~~their~~ its corresponding address mask~~s~~ (designated “smask~~i~~”). An IP packet with IP source address “ip-src” matches this parameter if src~~i~~ = (ip-src AND smask~~i~~) ~~for any i from 1 to n~~. If this parameter is omitted, then comparison of the IP packet source address for this entry is irrelevant.

| Type | Length | Value |
|---|---|---|
| [145/146].cst.3.4 | ~~*n**~~8 (IPv4) or<br>~~*n**~~32 (IPv6) | ~~src$_1$, smask$_1$,..., src$_i$, smask$_i$,..., src$_n$, smask$_n$~~<br>src, smask |

***Change the title of 11.13.19.3.4.5 as indicated:***

### 11.13.19.3.4.5 IP masked destination address

***Change content of 11.13.19.3.4.5 as indicated:***

This parameter specifies an ~~list of~~ IP destination address~~es~~ (designated “dst~~i~~”) and ~~their~~ its corresponding address mask~~s~~ (designated “dmask~~i~~”). An IP packet with IP destination address “ip-dst” matches this parameter if dst~~i~~ = (ip-dst AND dmask~~i~~) ~~for any i from 1 to n~~. If this parameter is omitted, then comparison of the IP packet destination address for this entry is irrelevant.

| Type | Length | Value |
|---|---|---|
| [145/146].cst.3.5 | ~~$n$*~~8 (IPv4) or<br>~~$n$*~~32 (IPv6) | ~~dst$_1$, dmask$_1$,..., dst$_i$, dmask$_i$,..., dst$_n$, dmask$_n$~~<br>dst, dmask |

### 11.13.19.3.4.6 Protocol source port range

***Change content of 11.13.19.3.4.6 as indicated:***

The value of the field specifies a ~~list of nonoverlapping~~ range~~s~~ of protocol source port values. Classifier rules with port numbers are protocol specific; i.e., a rule on port numbers without a protocol specification shall not be defined. An IP packet with protocol port value “src-port” matches this parameter if src-port is greater than or equal to sportlow and src-port is less than or equal to sporthigh. If this parameter is omitted, the protocol source port is irrelevant. This parameter is irrelevant for protocols without port numbers.

| Type | Length | Value |
|---|---|---|
| [145/146].cst.3.6 | ~~$n$*~~4 | ~~sportlow1, sporthigh2,..., sportlown, sporthighn,~~ sportlow, sporthigh |

### 11.13.19.3.4.7 Protocol destination port range

***Change content of 11.13.19.3.4.7 as indicated:***

The value of the field specifies a ~~list of nonoverlapping~~ range~~s~~ of protocol destination port values. Classifier rules with port numbers are protocol specific; i.e., a rule on port numbers without a protocol specification shall not be defined. An IP packet with protocol port value “dst-port” matches this parameter if dst-port is greater than or equal to dportlow and dst-port is less than or equal to dporthigh. If this parameter is omitted, the protocol destination port is irrelevant. This parameter is irrelevant for protocols without port numbers.

| Type | Length | Value |
|---|---|---|
| [145/146].cst.3.7 | ~~$n$*~~4 | ~~dportlow1, dporthigh2,..., dportlown, dporthighn,~~ dportlow, dporthigh |

### 11.13.19.3.4.8 IEEE 802.3/Ethernet destination MAC address

***Change content of 11.13.19.3.4.8 as indicated:***

This parameter specifies a ~~list of~~ MAC destination address~~es~~ (designated “dst~~i~~”) and ~~their~~ its corresponding address mask~~s~~ (designated “msk~~i~~”). An IEEE 802.3/Ethernet packet with MAC destination address “etherdst” corresponds to this parameter if dst~~i~~ = (etherdst AND msk~~i~~)~~ for any i from 1 to n~~. If this parameter is omitted, then comparison of the IEEE 802.3/Ethernet destination MAC address for this entry is irrelevant.

| Type | Length | Value |
|---|---|---|
| [145/146].cst.3.8 | ~~$n$*~~12 | ~~dst$_1$, msk$_1$,..., dst$_i$, msk$_i$,..., dst$_n$, msk$_n$~~ dst, msk |

### 11.13.19.3.4.9 IEEE 802.3/Ethernet source MAC address

***Change content of 11.13.19.3.4.9 as indicated:***

This parameter specifies a ~~list of~~ MAC source address~~es~~ (designated “src~~i~~”) and ~~their~~ its corresponding address mask~~s~~ (designated “msk~~i~~”). An IEEE 802.3/Ethernet packet with MAC source address “ethersrc” corresponds to this parameter if src~~i~~ = (ethersrc AND msk~~i~~)~~ for any i from 1 to n~~. If this parameter is omitted, then comparison of the IEEE 802.3/Ethernet source MAC address for this entry is irrelevant.

| Type | Length | Value |
|---|---|---|
| [145/146].cst.3.9 | ~~$n$*~~12 | ~~src$_1$, msk$_1$,..., src$_i$, msk$_i$,..., src$_n$, msk$_n$~~ src, msk |

***Insert new subclause 11.13.19.3.4.16:***

### 11.13.19.3.4.16 Large Context ID for ROHC- or ECRTP-compressed packet or ROHC feedback packet

The values of the field specify the context ID for ROHC- or ECRTP-compressed packets. The CS will attempt to match the context ID with the payload packet’s one-byte or two-byte embedded Context ID field according to the scheme described in RFC 3095 section 5.1.3.

| Type | Length | Value |
|---|---|---|
| [145/146].cst.3.16 | 2 | 0–65535: Context ID |

***Insert new subclause 11.13.19.3.4.17:***

### 11.13.19.3.4.17 Classifier Action Rule

The value of this field specifies an action associate with the classifier rule.

If this classification action rule exists, its action shall be applied on the packets that match this classifier rule.

| Type | Length | Value |
|---|---|---|
| [145/146].cst.3.19 | 1 | See below |

**Bit #0:**
0 = none.
1 = Discard packet
**Bit #1-7:** *Reserved.*

***Insert new subclause 11.13.19.3.4.18:***

### 11.13.19.3.4.18 Short-format Context ID for ROHC- or ECRTP-compressed packet or ROHC feedback packet

The values of the field specify a short-format context ID for ROHC- or ECRTP-compressed packets. The CS will attempt to match the context ID with the payload packet's zero- or one-byte prefix Context ID field according to the scheme described in RFC 3095 section 5.1.3.

| Type | Length | Value |
|---|---|---|
| [145/146].cst.3.18 | 1 | 0-15: Context ID |

***Delete 11.13.19.3.6 and all its subclauses.***

### ~~11.13.19.3.6 PHS error parameter set~~

### 11.13.19.3.7.1 PHSI

***Change the first paragraph as indicated:***

The PHSI has a value between 1 and 255, which uniquely references the suppressed byte string. The index is unique per service flow. ~~The uplink and downlink PHSI values are independent of each other.~~

### 11.13.19.3.7.4 PHSS

***Change the second paragraph as indicated:***

~~This TLV is used when a service flow is being created.~~ For all packets that get classified and assigned to a service flow with PHS enabled, suppression shall be performed over the specified number of bytes as indicated by the PHSS and according to the PHSM. A PHS rule shall contain the PHSS TLV. The range of valid values for PHSS is 1–255. ~~If this TLV is not included in a service flow definition, or is included with a value of 0 bytes, then PHS is disabled. A nonzero value indicates PHS is enabled.~~

***Change subclause 11.13.19.3.8 to 11.13.19.3.4.16 and change its contents as indicated, and renumber the following subclauses accordingly.***

### 11.13.19.3.8 IPv6 Flow label

***Change the subclause as indicated:***

The value of this field specifies a ~~list of~~ matching value~~s~~ for the IPv6 Flow label field. As the flow label field has a length of 20 bits, the first 4 bits of the most significant byte shall be set to 0x0 and disregarded.

| Type | Length | Scope |
|---|---|---|
| [145/146].[101/105/107].3.15 | ~~n*~~3 | Flow Label ~~#'1...Flow label#n~~ |

***Change the title of subclause 11.13.19.4 as indicated:***

### 11.13.19.4 ATM CS Encodings for ~~C~~configuration and MAC ~~M~~messaging

#### 11.13.19.4.2 ATM Classifier TLV

#### 11.13.19.4.2.3 ATM Classifier ID

***Change the 'Length' value in the Table from 16 to 2.***

***Delete subclause 11.13.19.4.4.***

#### ~~11.13.19.4.4 ATM Classifier Error Parameter Set~~

***Insert new subclause 11.13.20:***

### 11.13.20 Unsolicited grant interval

The value of this parameter specifies the nominal interval between successive data grant opportunities for this service flow. The ideal schedule for enforcing this parameter is defined by a reference time $t_0$, with the desired transmission time $t_i = t_0 + i \times$ interval. The actual grant time, $t'_i$ shall be in the range $t_i <= t'_i <= t_i +$ jitter, where interval is the value specified with this TLV, and jitter is the Tolerated Jitter.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].40 | 2 | ms | DSA-REQ,<br>DSA-RSP,<br>DSC-REQ,<br>DSC-RSP |

***Insert new subclause 11.13.21:***

### 11.13.21 Unsolicited polling interval

The value of this parameter specifies the maximal nominal interval between successive polling grants opportunities for this Service Flow. The ideal schedule for enforcing this parameter is defined by a reference time $t_0$, with the desired polling time $t_i = t_{(i-1)} +$ interval.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].41 | 2 | ms | DSA-REQ,<br>DSA-RSP,<br>DSC-REQ,<br>DSC-REP |

***Insert new subclause 11.13.22:***

### 11.13.22 FSN size

This TLV indicates the size of the FSN for the connection that is being setup. A value of 0 indicates that FSN is 3-bit long and a value of 1 indicates that FSN is 11-bit long.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].42 | 1 | 0 = 3-bit FSN<br>1 = 11-bit FSN<br>Default = 1 | DSA-REQ,<br>DSA-RSP,<br>DSA-ACK |

***Insert new subclause 11.13.23:***

### 11.13.23 MBS service

This TLV indicates whether or not the MBS service is being requested for the connection that is being setup. A value of 1 indicates Single-BS-MBS is requested and a value of 2 indicates Multi-BS-MBS is requested. If MS or BS want to initiate MBS service, DSA-REQ with MBS service shall be used. The DSA-RSP message shall contain the acceptance or rejection of request and if there is no available MBS, MBS service value may be set to 0. ARQ shall not be enabled for this connection.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].4 | 1 | 0: No available MBS<br>1: Single-BS-MBS<br>2: Multi-BS-MBS | DSx-REQ<br>DSx-RSP<br>DSx-ACK |

***Insert new subclause 11.13.24:***

### 11.13.24 Global Service Class Name

The value of this field refers to a predefined BS service configuration to be used for this service flow. The Global Service Class Name itself contains coded references to extensible tables defining QoS Parameters.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].35 | 6 | Variable: combination of ASCII characters and hex values | DSx-REQ<br>DSx-RSP<br>DSx-ACK |

When the Global Service Class Name is used in a service flow encoding, it indicates that all the unspecified QoS Parameters of the service flow need to be provided by the BS. Global Service Class Names are by definition synchronized among all BS.

***Insert new subclause 11.13.25:***

### 11.13.25 Type of Data Delivery Services

The value of this parameter specifies type of Data Delivery Service as defined in 6.3.18.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].29 | 1 | 0: Continuing Grant Service<br>1: Real Time–Variable Rate Service<br>2: Non-Real Time–Variable Rate Service<br>3: Best Efforts Service<br>4: Extended Real-Time Variable Rate Service | DSA-REQ, DSA-RSP<br>DSC-REQ, DSC-RSP<br>REG-REQ, REG-RSP |

***Insert new subclause 11.13.26:***

### 11.13.26 SDU Inter-arrival Interval

This parameter specifies nominal interval between consequent SDU arrivals as measured at MAC SAP.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].30 | 2 | SDU Inter-arrival Interval in the resolution of 0.5 milliseconds | DSA-REQ, DSA-RSP<br>DSC-REQ, DSC-RSP<br>REG-REQ, REG-RSP |

***Insert new subclause 11.13.27:***

### 11.13.27 Time Base

This parameter specifies time base for rate measurement as defined in 6.3.20.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].31 | 2 | Time base in milliseconds | DSA-REQ, DSA-RSP<br>DSC-REQ, DSC-RSP<br>REG-REQ, REG-RSP |

***Insert new subclause 11.13.28:***

### 11.13.28 Traffic Indication Preference

This parameter specifies whether traffic on a service flow should generate MOB_TRF-IND messages to an MS in sleep mode.

| Type | Length | Value | DSX |
|---|---|---|---|
| [145/146].34 | 1 | 0: No traffic indication<br>1: Traffic indication | DSx-REQ<br>DSx-RSP<br>DSx-ACK |

*Insert new subclause 11.13.29:*

### 11.13.29 MBS zone identifier assignment

The DSA-RSP message may contain the value of this parameter to specify a MBS Zone identifier. This parameter indicates a MBS zone through which the connection or virtual connection for the associated service flow is valid.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].33 | 8 | MBS zone identifier | DSA-REQ/RSP<br>DCD |

*Insert new subclause 11.13.30:*

### 11.13.30 Paging preference

This parameter specifies whether a service flow may generate paging.

| Type | Length | Value | DSX |
|---|---|---|---|
| [145/146].32 | 1 | 0: No paging generation<br>1: Paging generation | DSx-REQ<br>DSx-RSP<br>DSx-ACK |

*Insert new subclause 11.13.31:*

### 11.13.31 SN Feedback Enabled

The ‘SN Feedback Enabled’ field indicates whether or not SN feedback is enabled for the given connection. A value of 0 indicates that SN feedback is not enabled. A value of 1 indicates that SN feedback is enabled.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].37 | 1 | 0 - SN feedback is disabled (default)<br>1 - SN feedback is enabled | DSA-REQ, DSA-RSP,<br>DSC-REQ, DSC-REP |

***Insert new subclause 11.13.32:***

### 11.13.32 HARQ Service Flows

The ‘HARQ Service Flows’ field specifies whether the connection uses HARQ or not.

The relevance connections of this parameter when appears in REG-REQ/RSP messages are Basic, Primary, and Secondary CIDs.

Transport CIDs that have HARQ Connection enabled indication must only be transmitted inside HARQ PHY burst type. Basic, Primary, and secondary CIDs that have HARQ Connection enabled indication can be either transmitted inside HARQ or non-HARQ PHY burst type.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].44 | 1 | 0 = Non HARQ (default)<br>1 = HARQ Connection | DSA-REQ, DSA-RSP,<br>REG-REQ, REG-RSP |

***Insert new subclause 11.13.33:***

### 11.13.33 CID allocation for Active BSs

The value of this field specifies a list of CIDs assigned by active BSs in the diversity set except for the anchor BS for the service flow with non-null admittedQoSParamSet or ActiveQoSParamSet. There is one CID per active BS and the CID is used when the active BS becomes the anchor BS. If CID assignment is sent for each active BS in MOB_BSHO-RSP and MOB_BSHO-REQ messages, the DSx messages shall contain CID allocation for Active BSs. The CID for anchor BS is defined by 11.13.2. The value of (Num of active BS) is used to calculate length is the number of BSs in the diversity set.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].39 | *variable*<br>Length is defined as:<br>(Num of active BS -1) * 2 | List of CIDs for the active BSs. Starting from the first byte, every 2 bytes contains one CID value per active BS. CIDs are listed based on the TEMP_BS_ID of the active BS. The BS. The TEMP_BS_IDs are sorted in an ascending order | DSA-REQ/RSP<br>DSC-REQ/RSP |

***Insert new subclause 11.13.34:***

### 11.13.34 Authorization Token

The value of this field specifies an authorization token that may be used when MS creates or modifies a service flow by sending DSA-REQ or DSC-REQ message. An authorization token identifies a session and its QoS parameters, and is used for authorizing the QoS for one or more IP flows generated by higher-level service creation/modification procedures. The token is provided to the MS by the higher-level service through some mechanism that is outside the scope of this specification. The MS must include the token in this TLV exactly as received from the higher-level service and must treat the token as an opaque octet string whose meaning is of significance only to those higher-level services. The field should not be included in the DSA-REQ or DSC-REQ messages that are sent by BS.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].45 | *variable* | Authorization token that is used for authorizing the QoS for one or service flows generated by MS-initiated higher-level service flow creation or modification procedures | DSA-REQ<br>DSC-REQ |

***Insert new subclause 11.13.35:***

### 11.13.35 HARQ Channel mapping

This TLV is valid only in HARQ enabled connection. It specifies a HARQ channel number that may be used to carry data from this connection. This TLV may specify more then one channel per connection. HARQ channels may share more then one connection. An absent of this TLV means all HARQ channels can be used by this connection.

The absence of this TLV in any of the REQ or RSP messages of the connection creation means all HARQ channels can be used by this connection.

The relevance connections of this parameter when appears in REG-REQ/RSP messages are Basic, Primary, and Secondary CIDs.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].46 | *variable* | HARQ channel Index (1 byte each) | DSA-REQ, DSA-RSP, REG-REQ, REG-RSP |

***Insert new subclause 11.13.36:***

### 11.13.36 PDU SN extended subheader for HARQ reordering

This TLV is valid only in HARQ enabled connection. It specifies whether PDU SN extended subheader should be applied by the transmitter on every PDU on this connection. This SN may be used by the receiver to ensure PDU ordering.

This counter should start at 0 and should be reset after HHO/FBSS operations

The relevance connections of this parameter when appears in REG-REQ/RSP messages are Basic, Primary, and Secondary CIDs (each should have its own PDU numbering)

Value of 0 in either of the messages means the endpoint does not support the PDU SN number for the specific connection. If both end points support PDU SN for the connection, the larger SN number should be chosen.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].42 | 1 | 0–No support for PDU SN in this connection (default)<br>1–PDU SN (short) extended SH<br>2–PDU SN (long) extended SH<br>3-256–*Reserved*. | DSA-REQ, DSA-RSP, REG-REQ, REG-RSP |

***Insert new subclause 11.13.37:***

### 11.13.37 MBS contents IDs

If MS sends DSA-REQ message which requests a MBS service as described in 11.13.20, BS may respond to it with DSA-RSP message including MBS Contents Identifier TLV in order to establish an MBS connection with multiple MBS contents.

TLV values shall be composed of 2 byte-long MBS Contents IDs to distinguish the logical MBS connection for each MBS contents. Since MBS Contents ID is vendor-specific and dependent on application-level implementation, it is unnecessary to specify in this standard.

A 1 byte-long Logical Channel ID, which pairs with Multicast CID in MBS_DATA_IE, is allocated to each 2 byte-long MBS Contents IDs in order that it is included in TLV value. For example, Logical Channel ID ‘0’ is allocated to MBS Contents ID(0), Logical Channel ID ‘1’ is allocated to MBS Contents ID(1) and so on. Logical Channel ID is used for MS to discriminate the MBS message in MBS data burst.

According to the Dynamic Service Addition (DSA) procedure described in 6.3.13.1, a BS may send MS a DSA-REQ message to establish connection. Therefore, BS may also send MS a DSA-REQ message including MBS Contents Identifier TLV in order to make an establishment of MBS connection with multiple MBS contents.

| Type | Length | Value | Scope |
|---|---|---|---|
| [145/146].43 | *variable* (2*$n$) | MBS Contents ID(0),<br>MBS Contents ID(1), ...<br>MBS Contents ID($n$-1) | DSA-REQ<br>DSA-RSP<br>DSA-ACK |

***Insert a new subclause 11.14:***

## 11.14 DREG-CMD/REQ message encodings

| Name | Type | Length | Value |
|---|---|---|---|
| Paging Information | 1 | 5 | Bits 15:0 – PAGING_CYCLE—Cycle in which the paging message is transmitted within the paging group<br>Bits 23:16 – PAGING OFFSET—Determines the frame within the cycle in which the paging message is transmitted. Must be smaller than PAGING CYCLE value<br>Bits 39:24– Paging-group-ID—ID of the paging group the MS is assigned to |
| REQ-duration | 2 | 1 | Waiting value for the DREG-REQ message re-transmission (measured in frames) |
| Paging Controller ID | 3 | 6 | This is a logical network identifier for the serving BS or other network entity retaining MS service and operational information and/ or administering paging activity for the MS while in IDLE Mode |
| MAC Hash Skip Threshold | 5 | 2 | Maximum number of successive MOB_PAG-ADV messages that may be sent from a BS without individual notification for an MS for which BS is allowed to skip MS MAC Address Hash when the Action Code for the MS is 0b00, 'No Action Required'. If the value is set to 0xFF, a BS shall omit MAC Address hash of the MS with 'No Action Required' for every MOB_PAG-ADV message.On the contrary, if the value is set to zero, a BS shall include the MS MAC Address hash in every MOB_PAG-ADV message. |

| Name | Type | Length | Value |
|---|---|---|---|
| Idle Mode Retain Information | 4 | 1 | Idle Mode Retain Information is provided as part of this message is indicative only. Network Re-entry from Idle Mode process requirements may change at time of actual reentry. For each Bit location, a value of 0 indicates the information for the associated reentry management messages shall not be retained and managed, a value of 1 indicates the information for the associated re-entry management message shall be retained and managed<br>Bit #0: Retain MS service and operational information associated with SBC-REQ/RSP messages<br>Bit #1: Retain MS service and operational information associated with PKM-REQ/RSP messages<br>Bit #2: Retain MS service and operational information associated with REG-REQ/RSP messages<br>Bit #3: Retain MS service and operational information associated with Network Address<br>Bit #4: Retain MS service and operational information associated with Time of Day<br>Bit #5: Retain MS service and operational information associated with TFTP messages<br>Bit #6: Retain MS service and operational information associated with Full service (MAC state machines, CS classifier information, etc.). The information retained by setting Bit #6 does not include those information associated with SBC-REQ/RSP messages, PKM-REQ/RSP messages, REG-REQ/RSP messages, Network Address, Time of Day, and TFTP messages unless otherwise specified by setting one or more Bits #0-#5.<br>Bit #7: Consider Paging Preference of each Service Flow in resource retention. Bit #7 is meaningful when Bit #2 and Bit #6 have a value of 1. If Bit #2, Bit #6 and Bit #7 is 1, MS service and operational information associated with Full service (MAC state machines, CS classifier information, etc.) are retained for Service Flows with positive Paging Preference. If Bit #2 and Bit #6 are 1 and Bit #7 is 0, MS service and operational information associated with Full service (MAC state machines, CS classifier information, etc.) are retained for all Service Flows. |
| Paging cycle request | 52 | 2 | Requested Cycle in which the paging message is transmitted within the paging group. |

***Insert new subclause 11.15:***

## 11.15 Handover management encodings

***Insert new subclause 11.15.1:***

### 11.15.1 Resource_Retain_Time

The Resource_Retain_Time is Time duration for MS's connection information that will be retained in serving BS. This value is measured in 100 milliseconds. If this value is set to 0, the serving BS will retain the MS's connection information during Resource Retain Time negotiated at early registration stage. If this value is set to non-zero, it is the proposed Resource Retain Time by serving BS and the serving BS will retain the MS's connection information during that time after reception of MOB_HO-IND message.(HO_IND_type=0b00)

| Type | Length | Value | Scope |
|---|---|---|---|
| 1 | 2 | 0: The serving BS will retain the MS's connection information during Resource Retain Time negotiated at registration stage.<br>1-255: Resource Retain Time (100 milliseconds unit) | MOB_BSHO-REQ<br>MOB_BSHO-RSP |

*Insert new subclause 11.16:*

## 11.16 Sleep mode management encodings

*Insert new subclause 11.16.1:*

### 11.16.1 SLPID_Update

The SLPID_Update TLV specifies a new SLPID that replaces an old SLPID. This TLV may include multiple Old_New_SLPID values for the MSs negatively indicated in MOB_TRF-IND message.

| Type | Length | Value | Scope |
|---|---|---|---|
| 1 | *variable* | See following table | RNG-RSP<br>MOB_TRF-IND |

| Field | Length (bits) | Note |
|---|---|---|
| Old New SLPID | 20 | First 10 bits indicates old SLPID and the second 10 bits indicates new SLPID |

*Insert new subclause 11.16.2:*

### 11.16.2 Next Periodic Ranging

This value indicates offset of the frame in which the periodic ranging will be performed with respect to the frame where MOB_SLP-RSP is transmitted. If MS receives MOB_SLP-RSP message with 'Next Periodic Ranging' = 0, it shall deactivate all active Power Saving Classes and return to Normal Operation.

| Type | Length | Value | Scope |
|---|---|---|---|
| 2 | 2 | Offset in frames | MOB_SLP-RSP |

***Insert new subclause 11.17:***

## 11.17 MOB_PAG-ADV management message encodings

The encoding described in this subclause is specific to the MOB_PAG-ADV message (6.3.2.3.59).

***Insert new subclause 11.17.1:***

### 11.17.1 CDMA code and transmission opportunity assignment

The 'CDMA code and transmission opportunity assignment' field indicates the assigned code and transmission opportunity for an MS that is paged to use over dedicated CDMA ranging region.

| Type | Length (bits) | Value | Scope |
|---|---|---|---|
| 150 | variable;<br>8+ N_assign x 16) | Bit #0 - #7: N_assign<br>Subsequent (N_assign x 16) bits:<br>for (i = 0, i < N_assign, i++) {<br>8-bits code index assigned to an MS who is paged<br>8-bits transmission opportunity offset assigned to an MS who is paged<br>} | OFDMA |

***Insert new subclause 11.17.2:***

### 11.17.2 Page-Response Window

The 'Page-Response Window' TLV indicates the Page-Response window for an MS who is paged to transmit the assigned code for CDMA ranging channel.

| Type | Length | Value | PHY Scope |
|---|---|---|---|
| 152 | 1 | Page-Response window, in frames | OFDMA |

***Insert new subclause:]***

### 11.17.3 Enabled-Action-Triggered

This value indicates the enabled action that MS performs upon reaching trigger condition in sleep mode. MS may include this TLV item in MOB_SLP-REQ message to request an activation of type of Power Saving Class. BS shall include this TLV in MOB_SLP-RSP message transmitted in response to the MOB_SLP-REQ message.

| Type | Length | Value | Scope |
|---|---|---|---|
| 3 | 1 | Indicates action performed upon reaching trigger condition in sleep mode<br>If bit#0 is set to 1, respond on trigger with MOB_SCN-REPORT<br>If bit#1 is set to 1, respond on trigger with MOB_MSHO-REQ<br>If bit#2 is set to 1, on trigger, MS starts neighboring BS scanning process by sending MOB_SCN-REQ<br>Bit#3–bit#7: *Reserved*. Shall be set to 0. | MOB_SLP-REQ/RSP |

***Insert new subclause 11.18:***

## 11.18 MOB_NBR-ADV management message encodings

The encodings described in this subclause are specific to the MOB_NBR-ADV message (6.3.2.3.47).

***Insert new subclause 11.18.1:***

### 11.18.1 PHY Mode ID

***Insert the following tables into 11.18.1:***

| Name | Type | Length | Value | PHY scope |
|---|---|---|---|---|
| PHY Mode ID | 22 | 2 | Set to 0 for SCa | SCa, OFDM, OFDMA |

**Table 384a—Phy Mode ID fields description for OFDM PHY**

| Item | Size | Notes |
|---|---|---|
| **Bandwidth** | 7 bits | Channel BW in units of 125 kHz. |
| **FFT Size** | 3 bits | 0b011: 256<br>0b000-0b010, 0b100-0b111: *Reserved* |
| **Cyclic Prefix (CP)** | 2 bits | 0b00 = 1/4<br>0b01 = 1/8<br>0b10 = 1/16<br>0b11 = 1/32 |
| **Frame duration code** | 4 bits | 0b0000 = 2.0 ms<br>0b0001 = 2.5 ms<br>0b0010 = 4 ms<br>0b0011 = 5 ms<br>0b0100 = 8 ms<br>0b0101 = 10 ms<br>0b0110 = 12.5 ms<br>0b0111 = 20 ms<br>0b1000-0b1111 = *Reserved* |

### Table 384b—Phy Mode ID fields description for OFDMA PHY

| Item | Size | Notes |
|---|---|---|
| Bandwidth | 7 bits | Channel BW in units of 125Khz. |
| FFT Size | 3 bits | 0b000: 2048<br>0b001: 1024<br>0b010: 512<br>0b011: Reserved<br>0b100: 128<br>0b101–0b111: Reserved for future FFT size use |
| Cycle prefix (CP) | 2 bits | 0b00 = 1/4<br>0b01 = 1/8<br>0b10 = 1/16<br>0b11 = 1/32 |
| Frame duration code | 4 bits | 0b0000 = 2.0 ms<br>0b0001 = 2.5 ms<br>0b0010 = 4 ms<br>0b0011 = 5 ms<br>0b0100 = 8 ms<br>0b0101 = 10 ms<br>0b0110 = 12.5 ms<br>0b0111 = 20 ms<br>0b1000 - 0b1111= *Reserved* |

| Name | Type | Length | Value | PHY scope |
|---|---|---|---|---|
| FA Index | 21 | 1 | To be determined by a service provider or a governmental body like FCC after the licensed band is determined. If this TLV is present in the DCD message, the DL center frequency can be omitted in the message. | SCa, OFDM, OFDMA |

| Name | Type | Length | Value | PHY scope |
|---|---|---|---|---|
| PHY Mode ID | 22 | 2 | Set to 0 for SCa<br>Refer to Table 106f and Table 106g for the Phy Mode ID fields description of the other PHYs. | SCa, OFDM, OFDMA |

*Insert new subclause 11.19:*

## 11.19 MOB_SCN-REP message encodings

| Name | Type | Length | Value |
|---|---|---|---|
| Ranging_Parameters_Validity_Time | — | 1 | Estimated number of frames starting from the frame following the reception of the MOB_SCN-REP message, in which channel parameters learned by the MS during Association of specific BS stay valid and can be reused during future Network Reentry to the BS without additional CDMA-based Initial Ranging. A value of zero in this parameter signifies that this parameter should be ignored |

# 12. System profiles

## 12.1 WirelessMAN-SC (10–66 GHz) system profiles

### 12.1.1 WirelessMAN-SC MAC system profiles

***Change the title of 12.1.1.3 as indicated:***

### 12.1.1.3 Conventions for MAC ~~M~~management messages for profiles profM1 and profM2

***Change the second bullet of the first paragraph as indicated:***

- No TLVs besides ~~Error Encodings and~~ HMAC Tuples shall be reported back in DSA-RSP and DSC-RSP messages.

***Change the title of 12.1.1.4 as indicated:***

### 12.1.1.4 MAC Management message ~~P~~parameter ~~T~~transmission ~~O~~order

### 12.1.1.4.3 UCD

***Change the subclause as indicated:***

The parameters of the ~~D~~UCD message are PHY profile specific.

***Change 12.1.1.4.7 as follows:***

### 12.1.1.4.7 REG-REQ

- Vendor ID Encoding (optional)
- ~~Uplink~~ CID Support
- PKM Flow Control (default = no limit)
- DSx Flow Control (default = no limit)
- MCA Flow Control (default = no limit)
- IP version (default = IPv4)
- MAC CRC support (default = support)
- Multicast Polling Group CID support (default = 4)
- Convergence Sublayer Support (1 instance for each CS supported)
- Maximum number of classifiers (default = 0, no limit)
- PHS support (default = 0, no PHS support)
- HMAC Tuple

***Change the title of 12.1.1.4.20 as indicated:***

### 12.1.1.4.20 DSA-RSP—BS Initiated ~~S~~service ~~A~~addition

***Change the subclause as indicated:***

- Uplink Service Parameters
- ~~Service Flow Error Parameter Set(s) (one per errored parameter)~~
  ~~Errored Parameter~~
  ~~Error Code~~
  ~~Error Message (optional)~~

- Downlink Service Parameter(s)
- ~~Service Flow Error Parameter Set(s) (one per errored parameter)~~
    - ~~Errored Parameter~~
    - ~~Error Code~~
    - ~~Error Message (optional)~~
- HMAC Tuple

***Change the title of 12.1.1.4.23 as indicated:***

### 12.1.1.4.23 DSC-RSP—BS Initiated ~~S~~service ~~C~~change

***Change the subclause as indicated:***

- Uplink Service Parameters
- ~~Service Flow Error Parameter Set(s) (one per errored parameter)~~
    - ~~Errored Parameter~~
    - ~~Error Code~~
    - ~~Error Message (optional)~~
- Downlink Service Parameter(s)
- ~~Service Flow Error Parameter Set(s) (one per errored parameter)~~
    - ~~Errored Parameter~~
    - ~~Error Code~~
    - ~~Error Message (optional)~~
- HMAC Tuple

### 12.1.1.6 Message parameters specific to profM2

***Change the title of 12.1.1.6.1 as indicated:***

### 12.1.1.6.1 Packet CS ~~P~~parameters for DSA-REQ—BS ~~I~~initiated

***Change the subclause as indicated:***

- Packet Classification Rule(s) (uplink service flows only, default is no classification)
- Classifier Rule ~~ID~~ Index
- Classifier Rule Priority (default to 0)
- IP Type of Service/DSCP (only for IP CSs, default = do not classify on this)
- Protocol (only for IP CSs, default = do not classify on this)
- IP Masked Source Address (only for IP CSs, default = do not classify on this)
- IP Destination Address (only for IP CSs, default = do not classify on this)
- Protocol Source Port Range (only for IP CSs, default = do not classify on this)
- Protocol Destination Port Range (only for IP CSs, default = do not classify on this)
- Ethernet Destination MAC Address (only for Ethernet CSs, default = do not classify on this)
- Ethernet Source MAC Address (only for Ethernet CSs, default = do not classify on this)
- Ethertype/IEEE 802.2 SAP (only for Ethernet CSs, default = do not classify on this)
- IEEE 802.1D User Priority (only for VLAN CSs, default = do not classify on this)
- IEEE 802.1Q VLAN_ID (only for VLAN CSs, default = do not classify on this)
- Associated PHSI (default is no PHS for this classifier match)
- Vendor-specific Classifier Parameters
- PHS Rule(s)
- PHSI
- PHSS
- PHSF
- PHSM (default is suppress all bytes of the suppression field)

- PHSV (default is verify)
- Vendor-specific PHS Parameters

***Change the title of 12.1.1.6.2 as indicated:***

#### 12.1.1.6.2 Packet CS ~~P~~parameters for DSA-RSP—BS ~~I~~initiated

***Change the subclause as indicated:***

- Packet Classification Rule(s) (uplink service flows only, default is no classification)
- ~~Classifier Error Parameter Set(s) (one per errored parameter)~~
  - ~~Classifier Rule ID~~
  - ~~Errored Parameter~~
  - ~~Error Code~~
  - ~~Error Message (optional)~~
- PHS Rule(s)
- ~~PHS Error Parameter Set(s) (one per errored parameter)~~
- ~~PHSI~~
  - ~~Errored Parameter~~
  - ~~Error Code~~
  - ~~Error Message (optional)~~

#### 12.1.1.6.3 Packet CS Parameters for DSC-REQ—BS Initiated

***Change the subclause as indicated:***

- Classifier Dynamic Service Change Action(s)
- Packet Classification Rule(s) (uplink service flows only, 1 per Action)
- Classifier Rule ~~ID~~ Index
- Classifier Rule Priority (default to 0)
- IP Type of Service/DSCP (only for IP CSs, default = do not classify on this)
- Protocol (only for IP CSs, default = do not classify on this)
- IP Masked Source Address (only for IP CSs, default = do not classify on this)
- IP Destination Address (only for IP CSs, default = do not classify on this)
- Protocol Source Port Range (only for IP CSs, default = do not classify on this)
- Protocol Destination Port Range (only for IP CSs, default = do not classify on this)
- Ethernet Destination MAC Address (only for Ethernet CSs, default = do not classify on this)
- Ethernet Source MAC Address (only for Ethernet CSs, default = do not classify on this)
- Ethertype/IEEE 802.2 SAP (only for Ethernet CSs, default = do not classify on this)
- IEEE 802.1D User Priority (only for VLAN CSs, default = do not classify on this)
- IEEE 802.1Q VLAN_ID (only for VLAN CSs, default = do not classify on this)
- Associated PHSI (default is no PHS for this classifier match)
- Vendor-specific Classifier Parameters
- PHS Dynamic Service Change Action
- PHS Rule(s) (1 per Action)
- PHSI
- PHSS
- PHSF
- PHSM (default is suppress all bytes of the suppression field)
- PHSV (default is verify)
- Vendor-specific PHS Parameters

#### 12.1.1.6.4 Packet CS Parameters for DSC-RSP—BS Initiated

***Change the subclause as indicated:***

- Uplink Service Parameters
- ~~Service Flow Error Parameter Set(s) (one per errored parameter)~~
  ~~Errored Parameter~~
  ~~Error Code~~
  ~~Error Message (optional)~~
- Downlink Service Parameter(s)
- ~~Service Flow Error Parameter Set(s) (one per errored parameter)~~
  ~~Errored Parameter~~
  ~~Error Code~~
  ~~Error Message (optional)~~

## 12.2 WirelessMAN-SCa and WirelessHUMAN(-SCa) system profiles

### 12.2.3 WirelessMAN-SCa Physical Layer (PHY) Profiles

### 12.2.3.2 Specific PHY profiles

#### 12.2.3.2.3 WirelessHUMAN-specific PHY profile features

***Change the fifth bullet of the subclause as indicated:***

- DFS capability (if mandated by regulation)
  Detection of ~~primary~~specific spectrum users ~~with received signal strength in excess of –64 dBm~~ as defined by regulatory requirements
  Channel switching ~~within 300 µs~~as defined by regulatory requirements

### 12.2.4 WirelessMAN-SCa RF profiles

### 12.2.4.3 RF profiles for 10 MHz channelization

***Change all the references for 8.6.2 to 8.5.2.***

## 12.3 WirelessMAN-OFDM and WirelessHUMAN(-OFDM) system profiles

### 12.3.1 WirelessMAN-OFDM and WirelessHUMAN(-OFDM) MAC profiles

### 12.3.1.1 ProfM3_PMP: Basic Packet PMP MAC System Profile

***In the Table 401, change text in column "Conditions/Notes" for row "DFS" as indicated:***

Required when ~~intended~~if mandated by regulation for license exempt ~~bands~~usage. Not required when intended for licensed ~~bands~~usage.

#### 12.3.1.1.2 MAC Management Message Parameter Transmission Order

***Change the third sentence of the first paragraph as indicated:***

Both mandatory and optional TLVs shall subsequently be sequenced in order of increasing Type value except for the HMAC TLV, which shall be the final attribute in the messages' TLV attribute list.

### 12.3.1.2 ProfM3_Mesh: Basic Packet Mesh MAC system profile

***In the Table 402, change text in column "Conditions/Notes" for row "DFS" as indicated:***

Required when ~~intended~~if mandated by regulation for license exempt ~~bands~~usage. Not required when intended for licensed ~~bands~~usage.

***Insert a new row into Table 402:***

**Table 402a—Optional feature requirements profM3_mesh**

| | | |
|---|---|---|
| TEK encryption algorithms:<br>3-DES EDE with 128-bit key (type I)<br>RSA with 1024-bit key (type II)<br>ECB mode AES with 128-bit key (type III) | <br>Yes[1]<br>Yes[2]<br>No | <br>1: Mandatory for PMP mode<br>2: Mandatory for mesh mode |

### 12.3.2 WirelessMAN-OFDM and WirelessHUMAN(-OFDM) Physical Layer Profiles

***Change the relevant entry in Table 404 as indicated:***.

**Table 404—Minimum Performance basic requirements**

| Capability | Minimum performance | |
|---|---|---|
| Tx relative constellation error: | SS, | BS, |
| BPSK-1/2 | ≤ –13.0 dB | ≤ –13.0 dB |
| QPSK-1/2 | ≤ –16.0 dB | ≤ –16.0 dB |
| QPSK-3/4 | ≤ –18.5 dB | ≤ –18.5 dB |
| 16-QAM-1/2 | ≤ –21.5 dB | ≤ –21.5 dB |
| 16-QAM-3/4 | ≤ –25.0 dB | ≤ –25.0 dB |
| 64-QAM-2/3 | ≤ ~~–28.5~~29.0 dB | ≤ –29.0 dB |
| 64-QAM-3/4 | ≤ ~~–31.0~~30.0 dB | ≤ –31.0 dB |

### 12.3.2.4 ProfP3_3: WirelessMAN-OFDM PHY profile for 3 MHz channelization

***Change the relevant entries in Table 408 as indicated:***

**Table 408—Minimum Performance requirements for profP3_3**

| Capability | Minimum performance |
|---|---|
| $T_b$ | $= \cancel{73\frac{99}{437}\mu s}\ 74\frac{18}{43}\mu s$ |
| Reference frequency tolerance<br>SS to BS synchronization tolerance<br>Mesh to Mesh synchronization tolerance | <br>≤ ~~273.13~~268.75 Hz<br>≤ ~~409.67~~403.13 Hz |

### 12.3.2.5 ProfP3_5.5: WirelessMAN-OFDM PHY profile for 5.5 MHz channelization

***Change the relevant entries in Table 409 as indicated:***

**Table 409—Minimum Performance requirements for profP3_5.5**

| Capability | Minimum performance |
|---|---|
| $T_b$ | = ~~$40\frac{120}{157}$ µs~~ $40\frac{40}{79}$ µs |
| Reference frequency tolerance<br>SS to BS synchronization tolerance<br>Mesh to Mesh synchronization tolerance | <br>≤ ~~490.63~~493.75 Hz<br>≤ ~~735.94~~740.63 Hz |

### 12.3.2.6 profP3_10: WirelessHUMAN(-OFDM) PHY profile for 10 MHz channelization

***Change the last bullet in the first paragraph as indicated:***

— DFS capability (if mandated by regulation)
  — Ability to detect ~~primary~~specific spectrum users with ~~received signal strength in excess of 67 dBm~~ as defined by regulatory requirements
  — Ability to switch channel within ~~300 µs~~as defined by regulatory requirements.

***Change the relevant entries in Table 410 as indicated:***

**Table 410—Minimum Performance requirements for profP3_10**

| Capability | Minimum performance |
|---|---|
| $T_b$ | = ~~$22\frac{146}{357}$ µs~~ $22\frac{2}{9}$ µs |
| Reference frequency tolerance<br>SS to BS synchronization tolerance<br>Mesh to Mesh synchronization tolerance | <br>≤ ~~892.5~~900 Hz<br>≤ ~~1339~~1350 Hz |
| Reference time tolerance | ± $(T_b/32)/2$ |

### 12.3.3 WirelessMAN-OFDM RF profiles

***Change the subclause as indicated:***

For licensed bands, no explicit RF profiles are defined. A compliant system shall adhere to the requirements of 8.3.10.~~2~~4 for the specified supported bands.

## 12.4 WirelessMAN-OFDMA and WirelessHUMAN(-OFDMA) system profiles

*Change Table 411 as indicated:*

**Table 411—Profile definitions**

| Identifier | Description |
|---|---|
| OFDMA_profM1 | WirelessMAN-OFDMA basic packet PMP MAC Profile |
| OFDMA_profP1 | WirelessMAN-OFDMA 1.25 MHz channel basic PHY Profile |
| OFDMA_profP2 | WirelessMAN-OFDMA 3.5 MHz channel basic PHY Profile |
| OFDMA_profP3 | WirelessMAN-OFDMA 7 MHz channel basic PHY Profile |
| OFDMA_profP4 | WirelessMAN-OFDMA 8.75 MHz channel basic PHY Profile |
| OFDMA_profP~~4~~5 | WirelessMAN-OFDMA 14 MHz channel basic PHY Profile |
| OFDMA_profP6 | WirelessMAN-OFDMA 17.5 MHz channel basic PHY Profile |
| OFDMA_profP~~5~~7 | WirelessMAN-OFDMA 28 MHz channel basic PHY Profile |
| OFDMA_profP~~6~~8 | WirelessHUMAN(-OFDMA) 10 MHz channel basic PHY Profile |
| OFDMA_profP~~7~~9 | WirelessHUMAN(-OFDMA) 20 MHz channel basic PHY Profile |

*Change the title of 12.4.2 as indicated:*

### 12.4.2 WirelessMAN-OFDMA and WirelessHUMAN(-OFDMA) MAC ~~P~~profiles

*Change the title of 12.4.2.1 as indicated:*

### 12.4.2.1 Basic ~~P~~packet PMP MAC ~~P~~profile

*Change the last bullet of the second paragraph as indicated:*

— DFS shall be required for the license exempt bands ~~only~~if mandated by regulation.

*Change the title of 12.4.2.1.1 as indicated:*

### 12.4.2.1.1 Conventions for MAC ~~M~~management ~~M~~messages

*Change the second bullet of the first paragraph as indicated:*

— No TLVs besides ~~Error Encodings and~~ HMAC Tuples shall be reported back in DSA-RSP and DSC-RSP messages.

*Change the title of 12.4.2.1.2 as indicated:*

### 12.4.2.1.2 MAC ~~M~~management ~~M~~message ~~P~~parameter ~~T~~transmission ~~O~~order

***Change the fourth sentence of the first paragraph as indicated:***

For the required features, the relevant parameters shall be transmitted in order of increasing Type value of the parameter's TLV key except for the HMAC TLV which shall be the final attribute in the messages' TLV attribute list.

***Change the title of 12.4.3 as indicated:***

### 12.4.3 WirelessMAN-OFDMA and WirelessHUMAN(-OFDMA) System PHY ~~P~~profiles

***Change the title of 12.4.3.1 as indicated:***

#### 12.4.3.1 Common ~~F~~features of PHY ~~P~~profiles

***Change the title of 12.4.3.1.4 as indicated:***

#### 12.4.3.1.4 WirelessHUMAN PHY ~~P~~profiles ~~F~~features

***Change the second and last bullet in the first paragraph as indicated:***

- Where mandated by regulation, ~~A~~ability to detect ~~primary~~specific spectrum users ~~with received signal strength in excess of –61 dBm~~ as defined by regulatory requirements
- Ability to switch channel within ~~300 μs~~as defined by regulatory requirements

#### 12.4.3.1.5 Minimum performance requirements

***Change Table 413 as indicated:***

**Table 413—Minimum performance requirements for all profiles**

| Capability | Minimum performance |
|---|---|
| Tx Dynamic range<br>SS<br>BS | <br>≥ 30 dB<br>≥ 10 dB |
| Tx Power Level minimum adjustment step | ≤ 1 dB |
| Tx Power Level minimum relative step accuracy | ≤ ± 0.5 dB |
| BS Spectral flatness, when using all subchannels.<br>Absolute difference between adjacent subcarriers: (2.5dB should be added for Pilot carriers within the symbol due to their boosting). | ≤ 0.1 dB |
| Deviation of average energy in each carrier from the measured energy averaged over all ~~1702~~ active tones:<br>~~Carriers –425 to –1 and +1 to +425:~~Carriers -floor(($N_{used}$-1)/4) to -1 and +1 to +floor(($N_{used}$-1)/4): | ≤ ±2dB |
| ~~Carriers –851 to –425 and +425 to +851~~ Carriers -floor(($N_{used}$-1)/2) to -floor(($N_{used}$-1)/4) and floor(($N_{used}$-1)/4) to floor(($N_{used}$-1)/2): | ≤ +2/–4dB |

### Table 413—Minimum performance requirements for all profiles *(continued)*

| Capability | Minimum performance | |
|---|---|---|
| SS Spectral flatness, when using all subchannels.<br>Absolute difference between adjacent subcarriers: (2.5 dB should be added for Pilot carriers within the symbol due to their boosting). | ≤ 0.1 dB | |
| Deviation of average energy in each carrier from the measured energy averaged over all ~~1696~~ active tones:<br>~~Carriers -424 to -1 and +1 to +424~~ Carriers -floor(($N_{used}$-1)/4) to -1 and +1 to +floor(($N_{used}$-1)/4): | ≤ ± 2dB | |
| ~~Carriers -848 to -424 and +424 to +848~~ Carriers -floor(($N_{used}$-1)/2) to -floor(($N_{used}$-1)/4) and floor(($N_{used}$-1)/4) to floor(($N_{used}$-1)/2): | ≤ +2/–4dB | |
| Spectral mask (OOB) | Local regulation | |
| Tx relative constellation error: | SS, | BS, |
| QPSK-1/2 | ≤ ~~–19.4~~ –15 dB | ≤ –15 dB |
| QPSK-3/4 | ≤ ~~–21.2~~ –18 dB | ≤ ~~–16 dB~~ –18 dB |
| 16-QAM-1/2 | ≤ ~~–26.4~~ –20.5 dB | ≤ –20.5 dB |
| 16-QAM-3/4 | ≤ ~~–28.2~~ –24 dB | ≤ –24 dB |
| 64-QAM-1/2 | ≤ –26 dB | ≤ –26 dB |
| 64-QAM-2/3 (if 64-QAM supported) | ≤ ~~–32.7~~ –28 dB | ≤ –28 dB |
| 64-QAM-3/4 (if 64-QAM supported) | ≤ ~~–34.4~~ –30 dB | ≤ –30 dB |
| Rx max. input level on-channel reception tolerance | ≥ –30 dBm | |
| Rx max. input level on-channel damage tolerance | ≥ 0 dBm | |
| Number Of Subchannels Supported when receiving/ transmitting<br>SS<br>BS | <br><br>1-32<br>1-32 | |
| First adjacent channel rejection at BER=$10^{-6}$ for 3 dB degradation C/I<br>16-QAM-3/4<br>64-QAM-3/4 (if 64-QAM supported) | <br><br>≥ 11 dB<br>≥ 4 dB | |
| Second adjacent channel rejection at BER=$10^{-6}$ for 3 dB degradation C/I<br>16-QAM-3/4<br>64-QAM-3/4 (if 64-QAM supported) | <br><br>≥ 30 dB<br>≥ 23 dB | |
| SSTTG and SSRTG:<br>TDD<br>H-FDD | <br>≤ 50 μ s<br>≤ 100 μ s | |
| Reference time tolerance | ± ($T_b$/32)/~~10~~4 | |

***Change the title of 12.4.3.2 as indicated:***

### 12.4.3.2 WirelessMAN-OFDMA 1.25 MHz channel basic PHY ~~P~~profile

***Change Table 414 as indicated:***

**Table 414—Minimum performance requirements for OFDMA_ProfP1**

| Capability | Minimum performance |
|---|---|
| Channel bandwidth | 1.25 MHz |
| Operation mode | Licensed bands only |
| Tx Dynamic range<br>SS<br>BS | <br>≥ 40 dB<br>≥ 10 dB |
| ~~Tx relative constellation error:~~<br>~~QPSK-1/2~~<br>~~16-QAM-3/4~~ | <br>~~≤ –22.4 dB~~<br>~~≤ –28.2 dB~~ |
| ~~1st adjacent channel rejection at BER=$10^{-6}$ for 3 dB degradation C/I~~<br>~~16-QAM-3/4~~ | <br>~~≥ 30dB~~ |
| ~~2nd adjacent channel rejection at BER=$10^{-6}$ for 3 dB degradation C/I~~<br>~~16-QAM-3/4~~ | <br>~~≥ 80 dB~~ |
| BER performance threshold, BER=$10^{-6}$ (using all subchannels BS/SS)<br>QPSK-1/2<br>16-QAM-3/4<br>[Add to sensitivity 10*log10(NumberOfSubChannelsUsed/32) when using less subchannels in the BS Rx] | <br>≤ –90 dBm<br>≤ –80 dBm |
| Reference frequency tolerance<br>BS<br>SS to BS synchronization tolerance | <br>≤ ± $1*10^{-6}$<br>≤ 2 Hz |
| TTG (TDD only) | ≥ 200 µs |
| RTG (TDD only) | ≥ 5 µs |
| Frame duration code set | {4,7} |

*Change the title of 12.4.3.3 as indicated:*

#### 12.4.3.3 WirelessMAN-OFDMA 3.5 MHz channel basic PHY ~~P~~profile

*Change the Table 415 as indicated:*

**Table 415—Minimum performance requirements for OFDMA_ProfP2**

| Capability | Minimum performance |
|---|---|
| Channel bandwidth | 3.5 MHz |
| Operation mode | Licensed bands only |
| BER performance threshold, BER=$10^{-6}$ (using all subchannels BS/SS)<br>QPSK-1/2<br>QPSK-3/4<br>16QAM-1/2<br>16QAM-3/4<br>64QAM-2/3 (if 64-QAM supported)<br>64QAM-3/4 (if 64-QAM supported)<br>[Add to sensitivity 10*log10(NumberOfSubChannelsUsed/32) when using less subchannels in the BS Rx] | <br>≤ –87 dBm<br>≤ –85 ~~84~~ dBm<br>≤ –80 dBm<br>≤ –78 ~~77~~ dBm<br>≤ –74 ~~73~~ dBm<br>≤ –72 ~~71~~ dBm |
| Reference frequency tolerance<br>BS<br>SS to BS synchronization tolerance | <br>≤ ± ~~4~~ 2*$10^{-6}$<br>≤ 20 Hz |
| Frame duration code set | {4,7} |

*Change the title of 12.4.3.4 as indicated:*

#### 12.4.3.4 WirelessMAN-OFDMA 7 MHz channel basic PHY ~~P~~profile

*Change the Table 416 as indicated:*

**Table 416—Minimum performance requirements for OFDMA_ProfP3**

| Capability | Minimum performance |
|---|---|
| Channel bandwidth | 7 MHz |
| Operation mode | Licensed bands only |
| BER performance threshold, BER=$10^{-6}$ (using all subchannels BS/SS)<br>QPSK-1/2<br>QPSK-3/4<br>16QAM-1/2<br>16QAM-3/4<br>64QAM-2/3 (if 64-QAM supported)<br>64QAM-3/4 (if 64-QAM supported)<br>[Add to sensitivity 10*log10(NumberOfSubChannelsUsed/32) when using less subchannels in the BS Rx] | <br>≤ –84 dBm<br>≤ –82 ~~81~~ dBm<br>≤ –77 dBm<br>≤ –75 ~~74~~ dBm<br>≤ –71 dBm<br>≤ –69 ~~68~~ dBm |

**Table 416—Minimum performance requirements for OFDMA_ProfP3 *(continued)***

| Capability | Minimum performance |
|---|---|
| Reference frequency tolerance<br>BS<br>SS to BS synchronization tolerance | <br>≤ ± ~~4~~ 2*$10^{-6}$<br>≤ 40 Hz |
| Frame duration code set | {2,3,5} |

***Change the title of 12.4.3.5 as indicated:***

### 12.4.3.5 WirelessMAN-OFDMA 8.75 MHz channel basic PHY ~~P~~profile

***Change the text under 'Minimum performance' of 'BS Reference frequency tolerance' field in Table 417 to '≤ ± 2*$10^{-6}$'.***

***Change the note below Table 417 as indicated:***

NOTE—When using this profile, the sampling frequency (see 8.4.2.4) shall be: $F_s$ = floor(n×*BW/*~~2~~8000)×~~2~~8000

***Change the title of 12.4.3.6 as indicated:***

### 12.4.3.6 WirelessMAN-OFDMA 14 MHz channel basic PHY ~~P~~profile

***Change the Table 418 as indicated:***

**Table 418—Minimum performance requirements for OFDMA_ProfP5**

| Capability | Minimum performance |
|---|---|
| Channel bandwidth | 14 MHz |
| Operation mode | Licensed bands only |
| BER performance threshold, BER=$10^{-6}$ (using all subchannels BS/SS)<br>QPSK-1/2<br>QPSK-3/4<br>16-QAM-1/2<br>16-QAM-3/4<br>64-QAM-2/3 (if 64-QAM supported)<br>64-QAM-3/4 (if 64-QAM supported)<br><br>[Add to sensitivity 10*log10(NumberOfSubChannelsUsed/32) when using less subchannels in the BS Rx] | <br><br>≤ –81 dBm<br>≤ –79 ~~78~~ dBm<br>≤ –74 dBm<br>≤ –72 ~~71~~ dBm<br>≤ –68 ~~67~~ dBm<br>≤ –66 ~~65~~ dBm |
| Reference frequency tolerance<br>BS<br>SS to BS synchronization tolerance | <br>≤ ±~~4~~ 2*$10^{-6}$<br>≤ 80 Hz |
| Frame duration code set | {2,3,5} |

***Change the title of 12.4.3.7 as indicated:***

### 12.4.3.7 WirelessMAN-OFDMA 17.5 MHz channel basic PHY ~~P~~profile

***Change the text under ‘Minimum performance’ of ‘BS Reference frequency tolerance’ field in Table 419 to ‘$\leq \pm 2*10^{-6}$’.***

***Change the note below Table 419 as indicated:***

NOTE—When using this profile, the sampling frequency (see 8.4.2.4) shall be: $F_s$ = floor(n×*BW/*~~2~~8000)×~~2~~8000

***Change the title of 12.4.3.8 as indicated:***

### 12.4.3.8 WirelessMAN-OFDMA 28 MHz channel basic PHY ~~P~~profile

***Change the text under ‘Minimum performance’ of ‘BS Reference frequency tolerance’ field in Table 420 to ‘$\leq \pm 2*10^{-6}$’.***

***Change the title of 12.4.3.9 as indicated:***

### 12.4.3.9 WirelessHUMAN(-OFDMA) 10 MHz channel basic PHY ~~P~~profile

***Change the text under ‘Minimum performance’ of ‘BS Reference frequency tolerance’ field in Table 421 to ‘$\leq \pm 2*10^{-6}$’.***

***Change the title of 12.4.3.10 as indicated:***

### 12.4.3.10 WirelessHUMAN(-OFDMA) 20 MHz channel basic PHY ~~P~~profile

***Change the text under ‘Minimum performance’ of ‘BS Reference frequency tolerance’ field in Table 422 to ‘$\leq \pm 2*10^{-6}$’.***

### 12.4.4 WirelessMAN-OFDMA RF profiles

***Change the second paragraph as indicated:***

Table 423 defines the RF channels for the license bands, for informative purpose. ~~t~~The channels shall be calculated using the following formula

$$F_{start} + n \cdot \Delta F_c, \forall n \in N_{range}$$

***Insert to the ‘Channel Bandwidth’, ‘Center Frequency Step $\Delta F_c$’, ‘Uplink $F_{start}$’ and ‘Downlink $F_{start}$’ columns titles in Table 423 the text:***

(MHz)

# Annex A

(informative)

# Bibliography

***Change reference [B10] as indicated:***

~~[B10] ERC/DEC/(99)23, *ERC Decision on the harmonised frequency bands to be designated for the introduction of HIPERLANS, 29-11-1999,* http://www.ero.dk/doc98/official/pdf/DEC9923E.PDF.~~

[B10] (ECC/DEC/(04)08) ECC Decision of 09 July 2004 on the harmonized use of the 5 GHz frequency bands for the implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLANs), 9th July 2004 revised November 2004,
http://www.ero.dk/documentation/docs/doccategory.asp?catid=1&catname=ECC/ERC/ECTRA%20Decisions.

***Insert new reference [B11] and renumber the following references as needed:***

[B11] Recommendation ITU-R M.1652, Dynamic frequency selection (DFS) in wireless access systems including radio local area networks for the purpose of protecting the radio determination service in the 5 GHz band, 2003, http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=R-REC-M.1652 .

# Annex B

(informative)

# Supporting material for frequencies below 11 GHz

## B.1 Targeted frequency bands

***Delete the section and renumber subsequent sections as needed.***

## B.2 License-exempt co-existence and interference analyses

***Delete the section and renumber subsequent sections as needed.***

## B.3 Performance characteristics

### B.3.2 WirelessMAN-OFDM/OFDMA PHY symbol and performance parameters

***In Table B.26, change the 'n' value for 'WCS' from '144/145' to '144/125'.***

# Annex C

(informative)

# Example MAC common part sublayer service definition

## C.1 MAC service definition

### C.1.1 MAC service definition for PMP

#### C.1.1.1 Primitives

#### C.1.1.1.1 MAC_CREATE_SERVICE FLOW.request

#### C.1.1.1.1.2 Semantics of the service primitive

***Change the fourth paragraph as indicated:***

The convergence sublayer parameter indicates which CS handles data received on this connection. ~~If the value is zero, then no CS is used; other v~~Values for specific CSs are given in 11.13.19.

***Insert the following annex:***

# Annex D

(informative)

# Messages sequence charts (MSCs)

This annex provides example MSCs for the procedures of handover and sleep mode operations.

## D.1 Handover MSCs

### D.1.1 Neighbor BS advertisement and scanning

The following figures describe the example message flows for neighbor BS advertisements and scanning of neighbors by the MS request, BS request and periodic scanning of neighbors during handover.

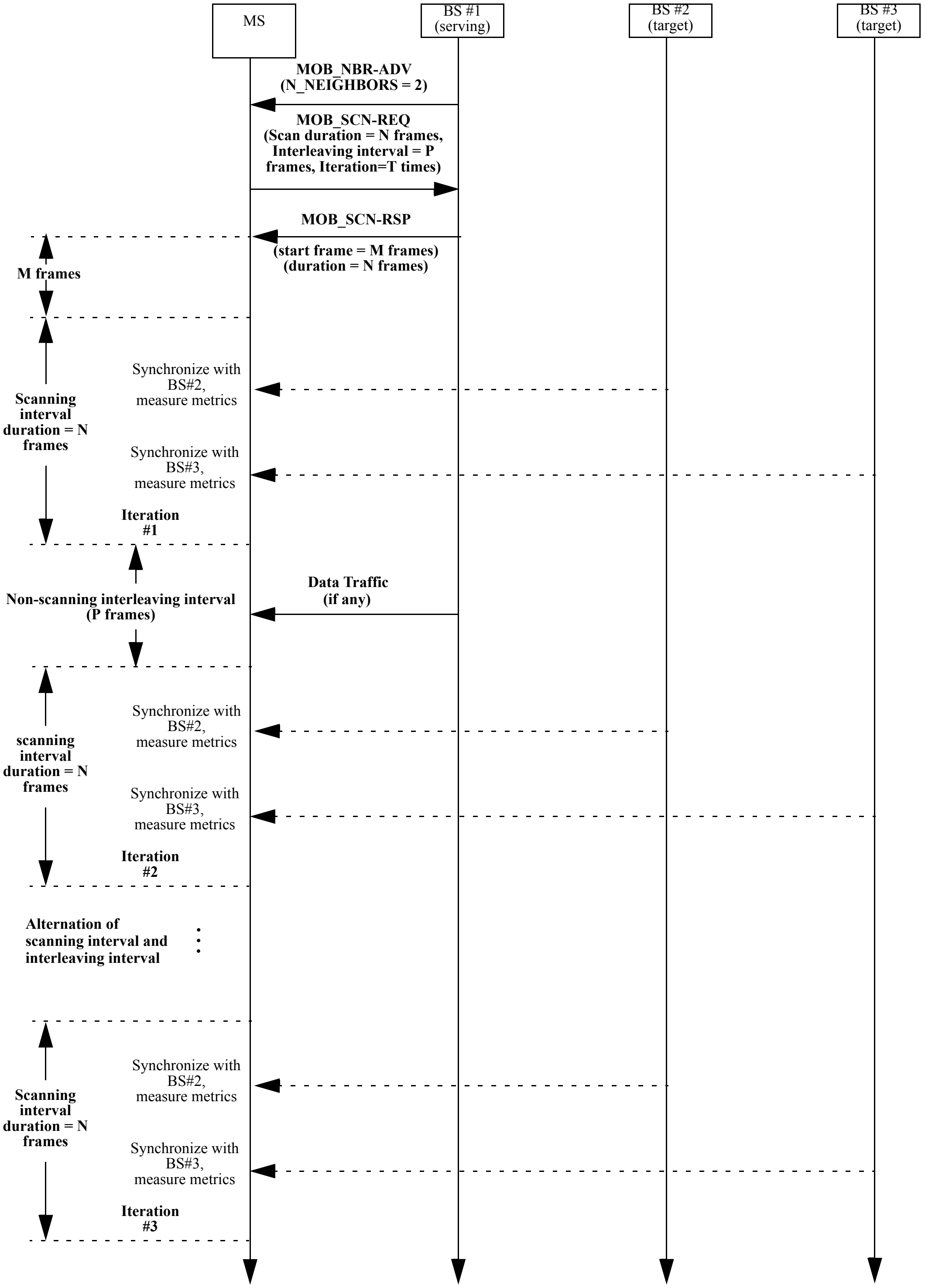

MS
BS #1 (serving)
BS #2 (target)
BS #3 (target)
MOB_NBR-ADV (N_NEIGHBORS = 2)
MOB_SCN-REQ (Scan duration = N frames, Interleaving interval = P frames, Iteration=T times)
MOB_SCN-RSP
(start frame = M frames) (duration = N frames)
M frames
Synchronize with BS#2, measure metrics
Scanning interval duration = N frames
Synchronize with BS#3, measure metrics
Iteration #1
Data Traffic (if any)
Non-scanning interleaving interval (P frames)
Synchronize with BS#2, measure metrics
scanning interval duration = N frames
Synchronize with BS#3, measure metrics
Iteration #2
Alternation of scanning interval and interleaving interval
Synchronize with BS#2, measure metrics
Scanning interval duration = N frames
Synchronize with BS#3, measure metrics
Iteration #3

Figure D.1—Example Neighbor BS advertisement and scanning (without association) by MS request

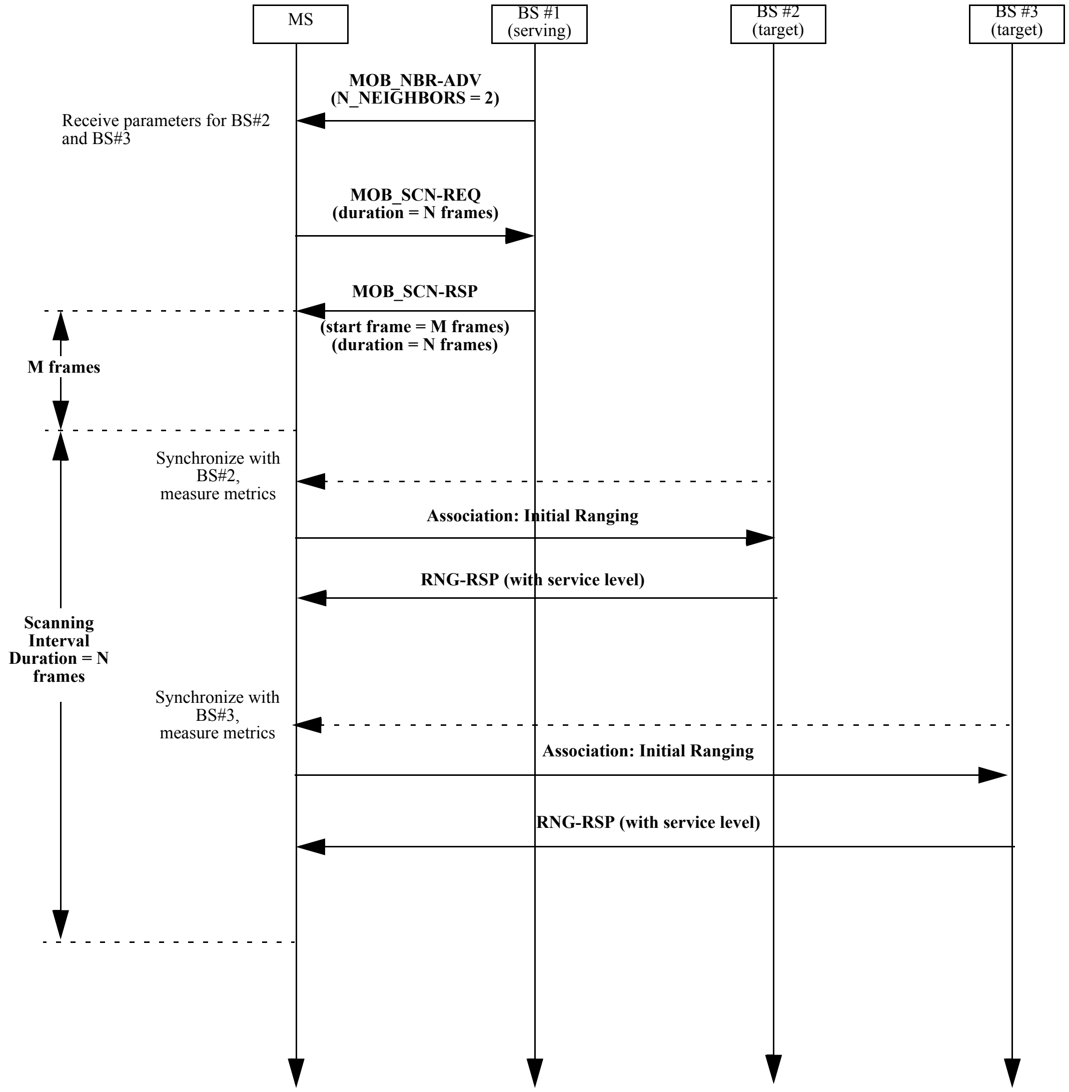

MS
BS #1 (serving)
BS #2 (target)
BS #3 (target)
MOB_NBR-ADV (N_NEIGHBORS = 2)
Receive parameters for BS#2 and BS#3
MOB_SCN-REQ (duration = N frames)
MOB_SCN-RSP
(start frame = M frames) (duration = N frames)
M frames
Synchronize with BS#2, measure metrics
Association: Initial Ranging
RNG-RSP (with service level)
Scanning Interval Duration = N frames
Synchronize with BS#3, measure metrics
Association: Initial Ranging
RNG-RSP (with service level)

Figure D.2—Example Neighbor BS advertisement and scanning (with non-coordinated association) by MS request

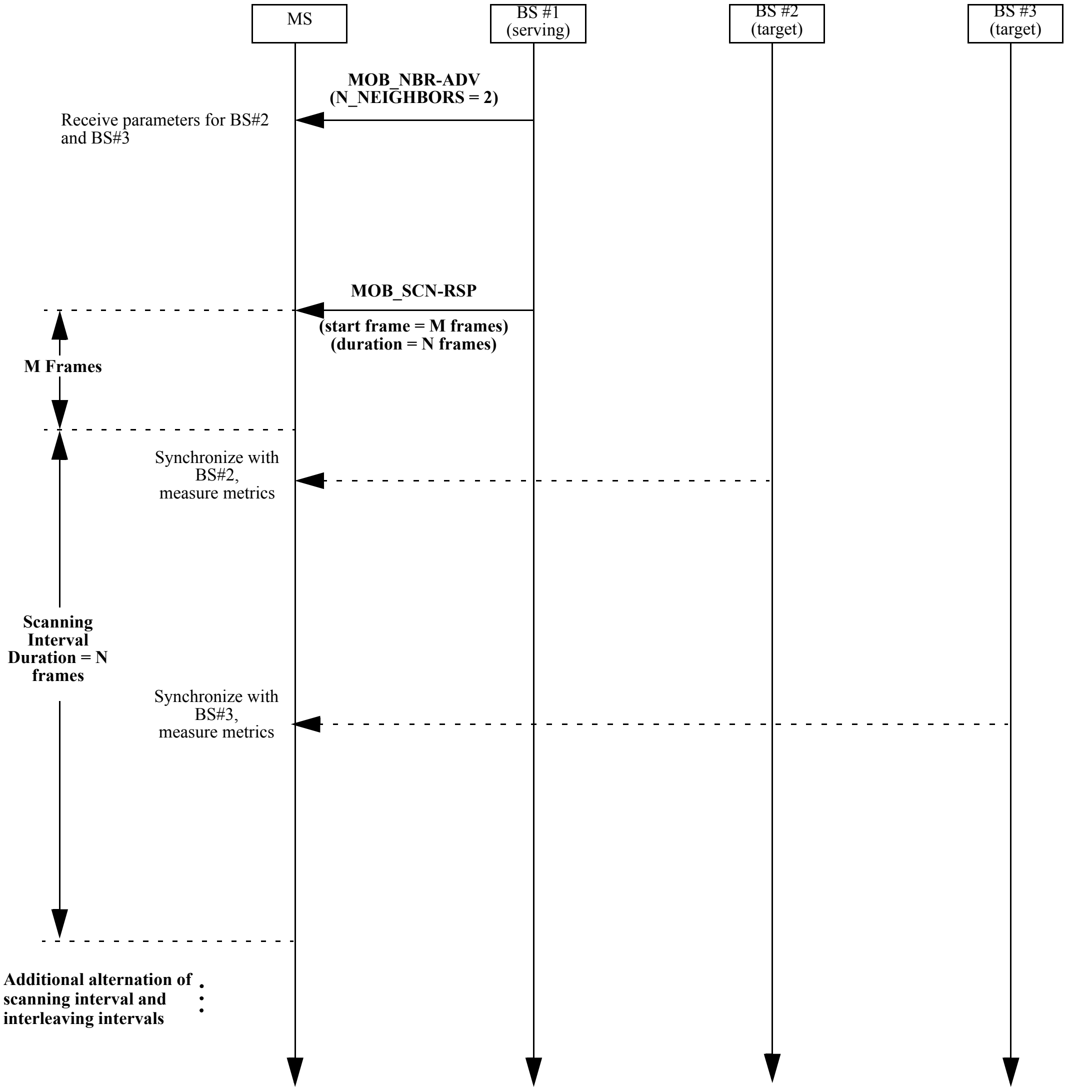

MS
BS #1
(serving)
BS #2
(target)
BS #3
(target)
MOB_NBR-ADV
(N_NEIGHBORS = 2)
Receive parameters for BS#2
and BS#3
MOB_SCN-RSP
(start frame = M frames)
(duration = N frames)
M Frames
Synchronize with
BS#2,
measure metrics
Scanning
Interval
Duration = N
frames
Synchronize with
BS#3,
measure metrics
Additional alternation of
scanning interval and
interleaving intervals

Figure D.3—Example Neighbor BS advertisement and scanning (without association) by BS request

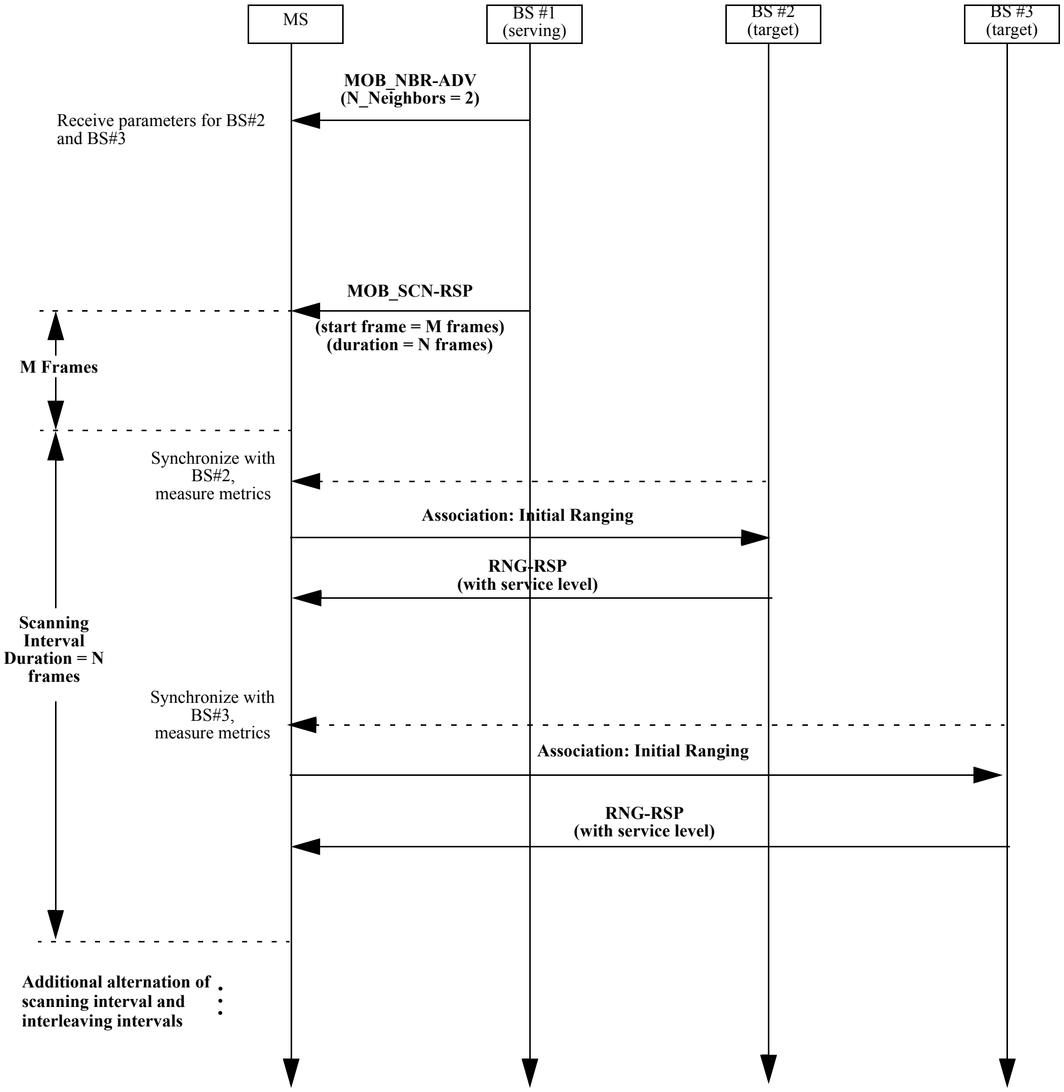

MS
BS #1
(serving)
BS #2
(target)
BS #3
(target)
MOB_NBR-ADV
(N_Neighbors = 2)
Receive parameters for BS#2
and BS#3
MOB_SCN-RSP
(start frame = M frames)
(duration = N frames)
M Frames
Synchronize with
BS#2,
measure metrics
Association: Initial Ranging
RNG-RSP
(with service level)
Scanning
Interval
Duration = N
frames
Synchronize with
BS#3,
measure metrics
Association: Initial Ranging
RNG-RSP
(with service level)
Additional alternation of
scanning interval and
interleaving intervals

Figure D.4—Example Neighbor BS advertisement and scanning (with association) by BS request

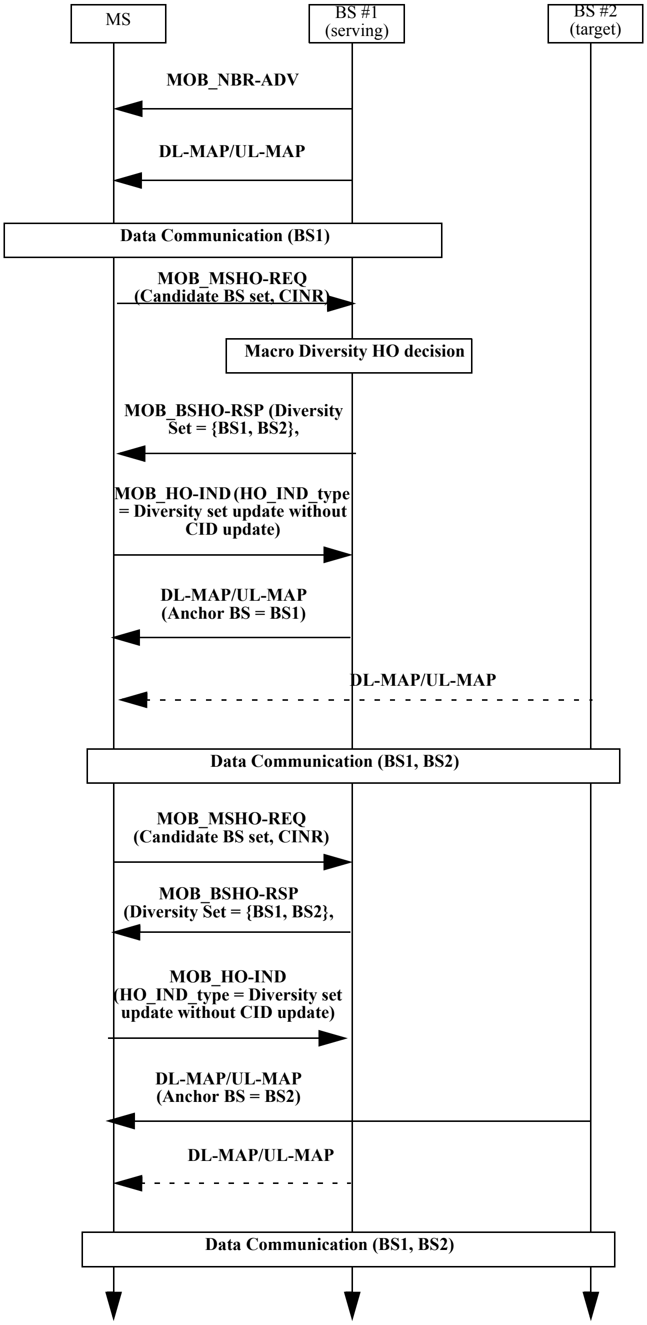

MS
BS #1 (serving)
BS #2 (target)
MOB_NBR-ADV
DL-MAP/UL-MAP
Data Communication (BS1)
MOB_MSHO-REQ (Candidate BS set, CINR)
Macro Diversity HO decision
MOB_BSHO-RSP (Diversity Set = {BS1, BS2},
MOB_HO-IND (HO_IND_type = Diversity set update without CID update)
DL-MAP/UL-MAP (Anchor BS = BS1)
DL-MAP/UL-MAP
Data Communication (BS1, BS2)
MOB_MSHO-REQ (Candidate BS set, CINR)
MOB_BSHO-RSP (Diversity Set = {BS1, BS2},
MOB_HO-IND (HO_IND_type = Diversity set update without CID update)
DL-MAP/UL-MAP (Anchor BS = BS2)
DL-MAP/UL-MAP
Data Communication (BS1, BS2)

**Figure D.5—Example Macro Diversity HO (Diversity Set Update: Add)**

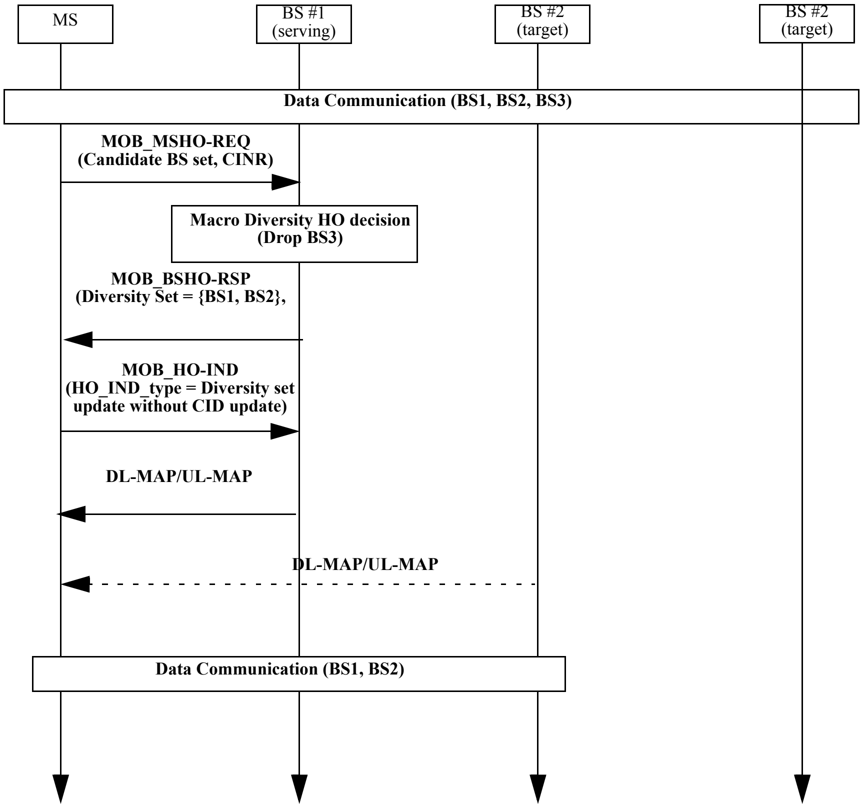

MS
BS #1 (serving)
BS #2 (target)
BS #2 (target)
Data Communication (BS1, BS2, BS3)
MOB_MSHO-REQ (Candidate BS set, CINR)
Macro Diversity HO decision (Drop BS3)
MOB_BSHO-RSP (Diversity Set = {BS1, BS2},
MOB_HO-IND (HO_IND_type = Diversity set update without CID update)
DL-MAP/UL-MAP
DL-MAP/UL-MAP
Data Communication (BS1, BS2)

Figure D.6—Example Macro Diversity HO (Diversity Set Update: Drop)

## D.2 Sleep mode MSCs

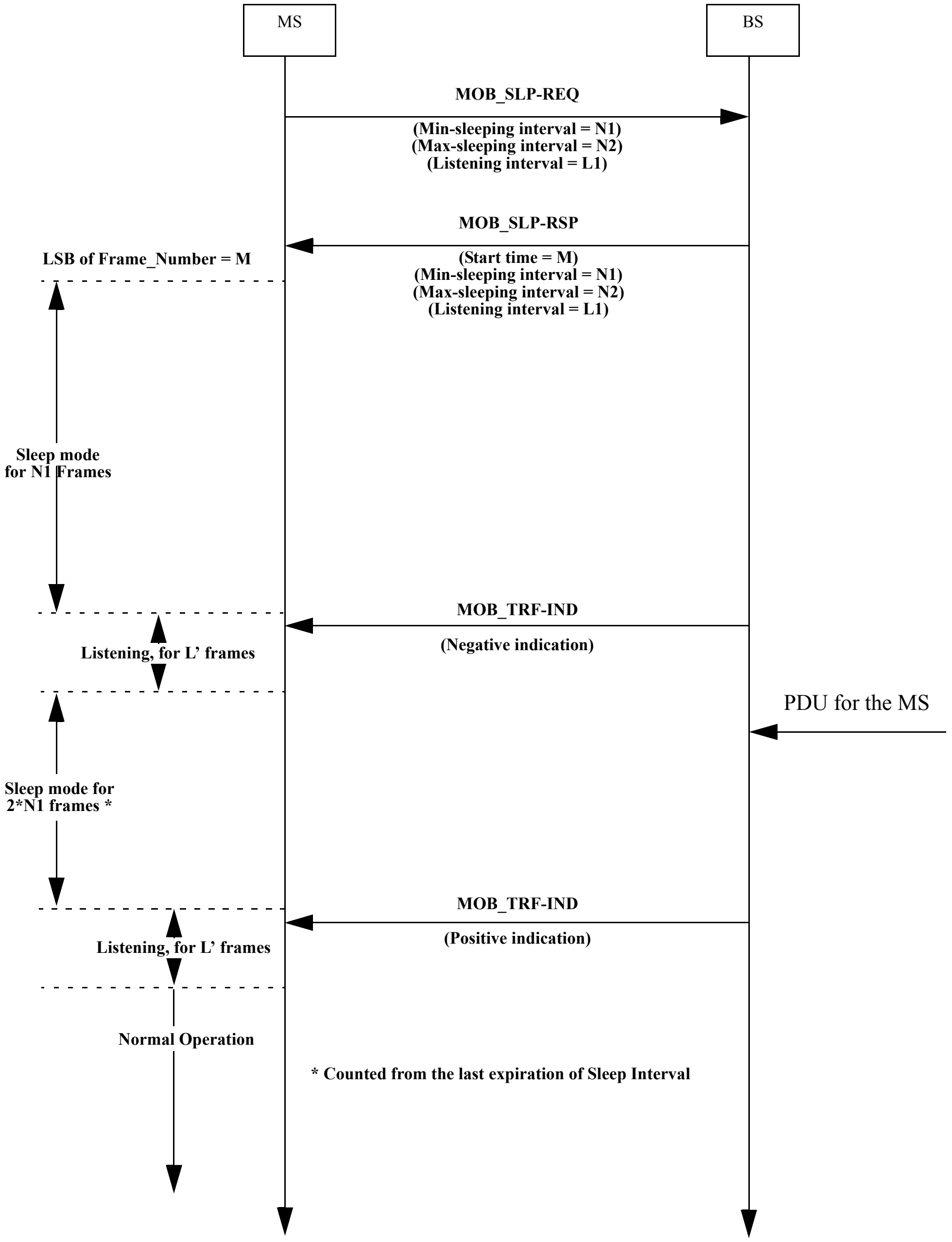

MS
BS
MOB_SLP-REQ
(Min-sleeping interval = N1)
(Max-sleeping interval = N2)
(Listening interval = L1)
MOB_SLP-RSP
LSB of Frame_Number = M
(Start time = M)
(Min-sleeping interval = N1)
(Max-sleeping interval = N2)
(Listening interval = L1)
Sleep mode
for N1 Frames
MOB_TRF-IND
(Negative indication)
Listening, for L' frames
PDU for the MS
Sleep mode for
2*N1 frames *
MOB_TRF-IND
(Positive indication)
Listening, for L' frames
Normal Operation
* Counted from the last expiration of Sleep Interval

Figure D.7—Example sleep mode — MS initiated

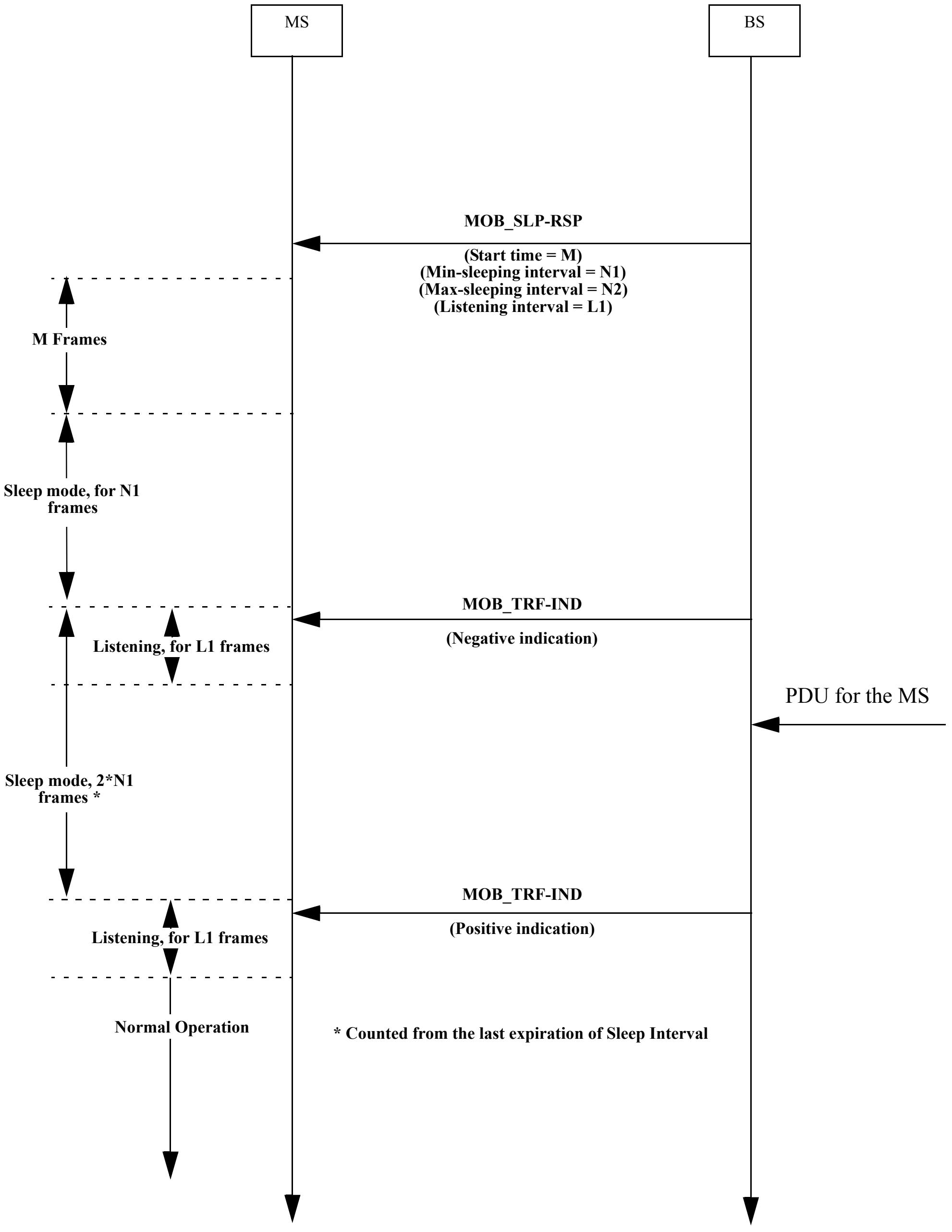

MS
BS
MOB_SLP-RSP
(Start time = M)
(Min-sleeping interval = N1)
(Max-sleeping interval = N2)
(Listening interval = L1)
M Frames
Sleep mode, for N1 frames
MOB_TRF-IND
(Negative indication)
Listening, for L1 frames
PDU for the MS
Sleep mode, 2*N1 frames *
MOB_TRF-IND
(Positive indication)
Listening, for L1 frames
Normal Operation
* Counted from the last expiration of Sleep Interval

Figure D.8—Example sleep mode — BS initiated

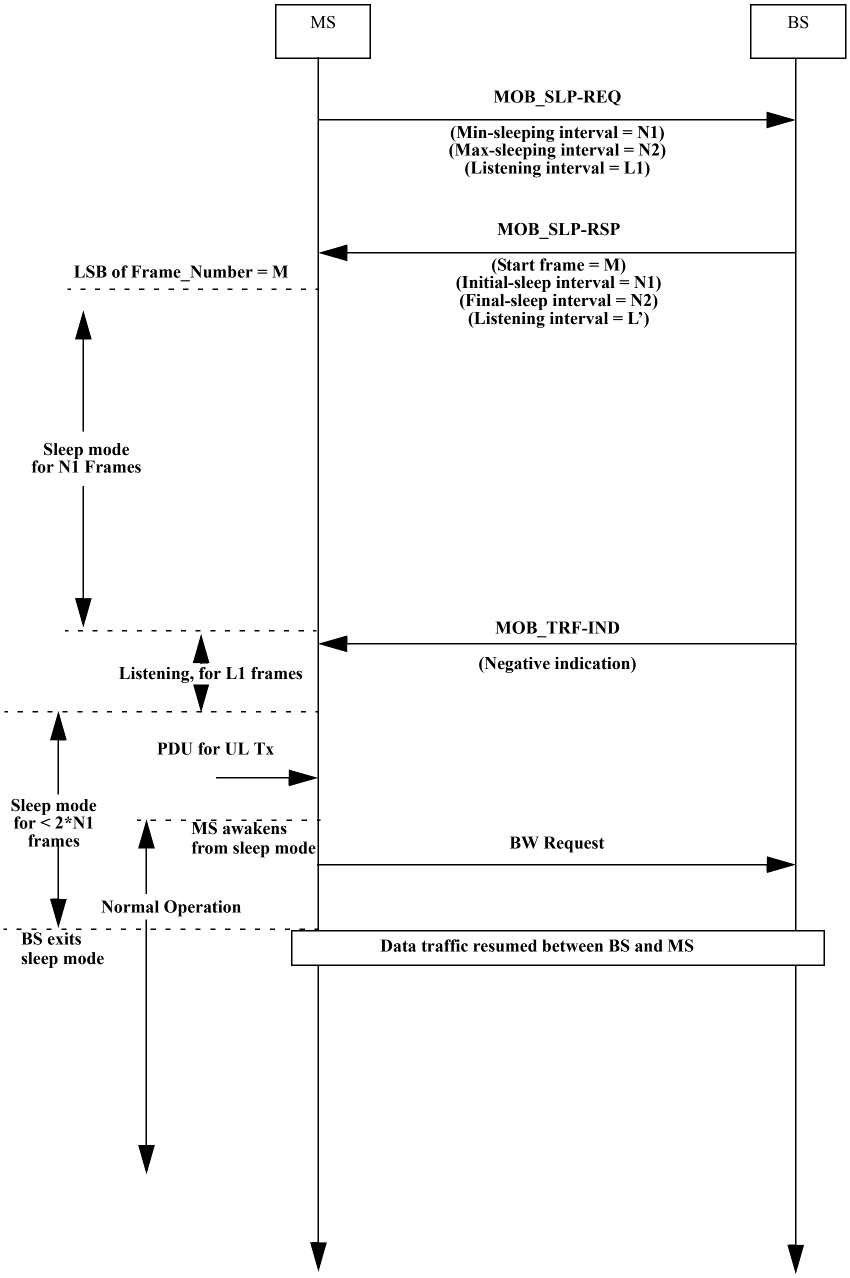

MS
BS
MOB_SLP-REQ
(Min-sleeping interval = N1)
(Max-sleeping interval = N2)
(Listening interval = L1)
MOB_SLP-RSP
(Start frame = M)
(Initial-sleep interval = N1)
(Final-sleep interval = N2)
(Listening interval = L')
LSB of Frame_Number = M
Sleep mode for N1 Frames
MOB_TRF-IND
(Negative indication)
Listening, for L1 frames
PDU for UL Tx
Sleep mode for < 2*N1 frames
MS awakens from sleep mode
BW Request
Normal Operation
BS exits sleep mode
Data traffic resumed between BS and MS

Figure D.9—Sleep mode—MS initiating awakening

*Insert the following annex:*

# Annex E

(informative)

# Block diagrams

This annex provides example block diagrams for the procedures of handover.

## E.1 Handover block diagrams

### E.1.1 Handover initiated by Mobile Station

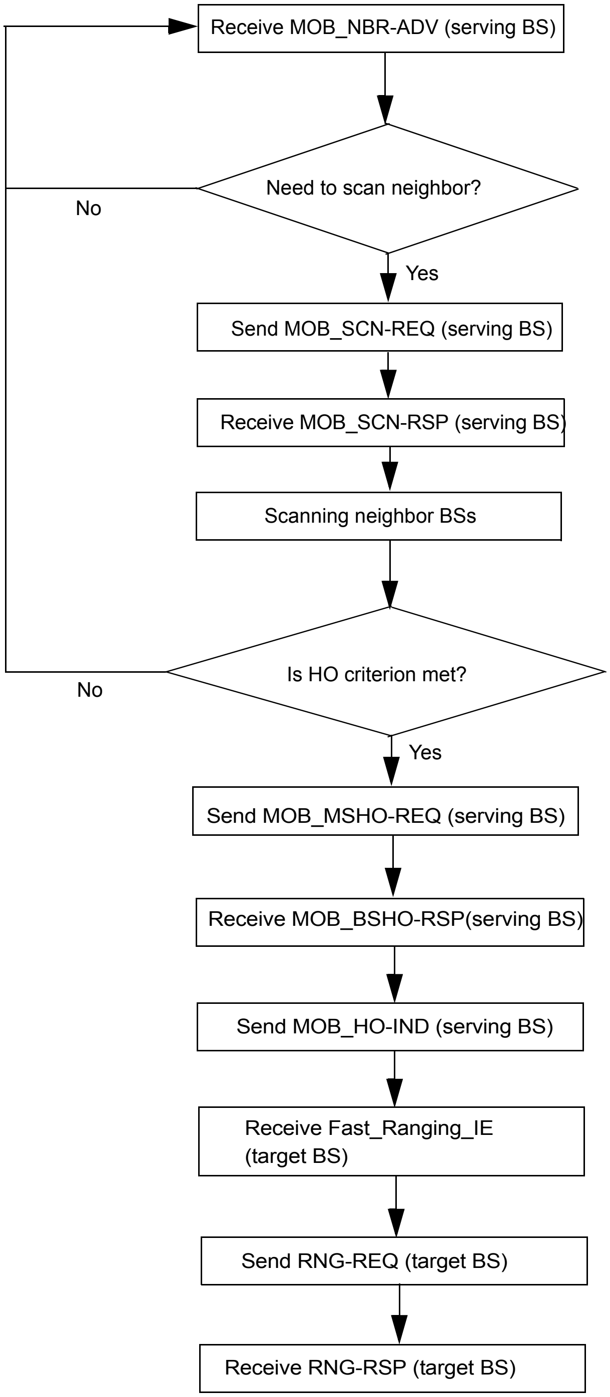

Receive MOB_NBR-ADV (serving BS)
Need to scan neighbor?
No
Yes
Send MOB_SCN-REQ (serving BS)
Receive MOB_SCN-RSP (serving BS)
Scanning neighbor BSs
Is HO criterion met?
No
Yes
Send MOB_MSHO-REQ (serving BS)
Receive MOB_BSHO-RSP(serving BS)
Send MOB_HO-IND (serving BS)
Receive Fast_Ranging_IE (target BS)
Send RNG-REQ (target BS)
Receive RNG-RSP (target BS)

**Figure E.1—MS initiated HO process block diagram as seen by MS**

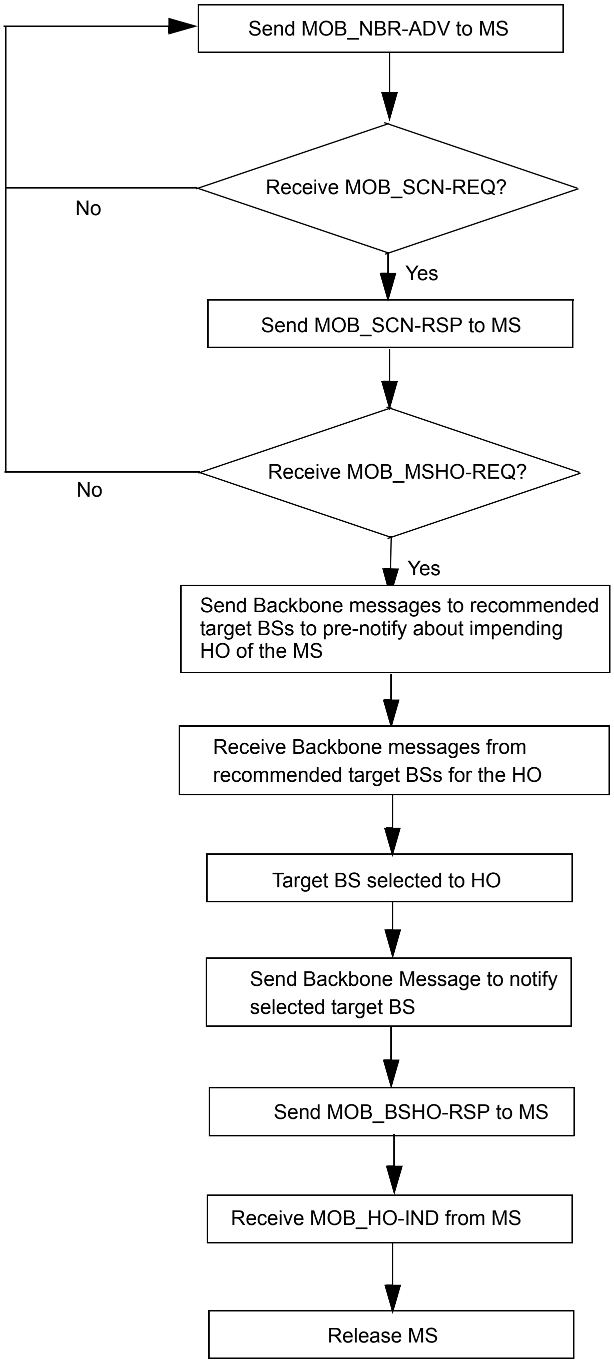

Send MOB_NBR-ADV to MS
Receive MOB_SCN-REQ?
No
Yes
Send MOB_SCN-RSP to MS
Receive MOB_MSHO-REQ?
No
Yes
Send Backbone messages to recommended target BSs to pre-notify about impending HO of the MS
Receive Backbone messages from recommended target BSs for the HO
Target BS selected to HO
Send Backbone Message to notify selected target BS
Send MOB_BSHO-RSP to MS
Receive MOB_HO-IND from MS
Release MS

**Figure E.2—MS initiated HO process block diagram as seen by serving BS where final target BS is selected by serving BS**

### E.1.2 Handover initiated by Base Station

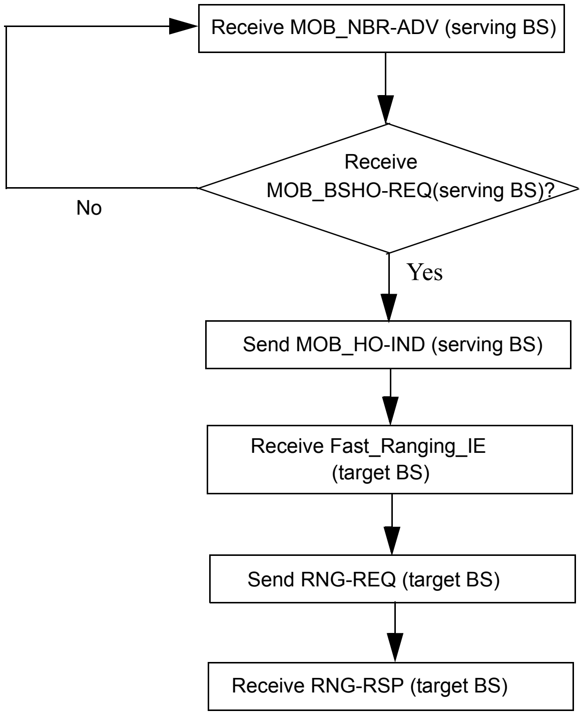

Receive MOB_NBR-ADV (serving BS)
Receive
MOB_BSHO-REQ(serving BS)?
No
Yes
Send MOB_HO-IND (serving BS)
Receive Fast_Ranging_IE
(target BS)
Send RNG-REQ (target BS)
Receive RNG-RSP (target BS)

Figure E.3—BS Initiated HO process block diagram as seen by MS

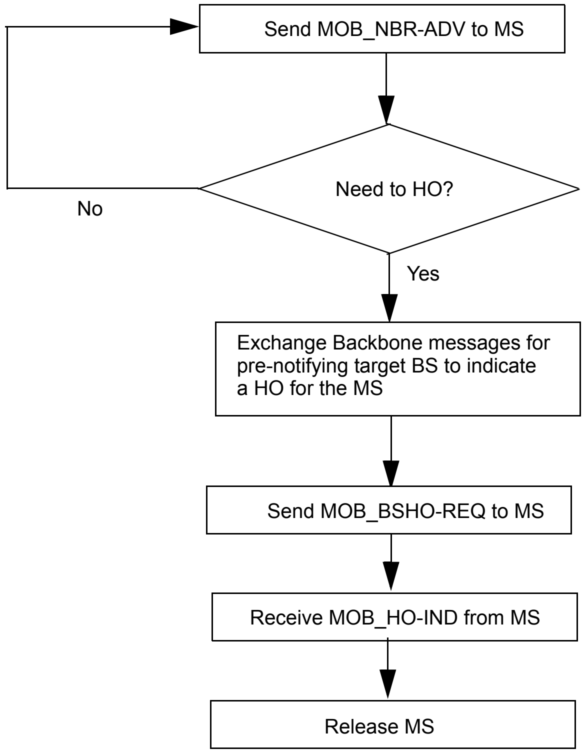

Send MOB_NBR-ADV to MS
Need to HO?
No
Yes
Exchange Backbone messages for pre-notifying target BS to indicate a HO for the MS
Send MOB_BSHO-REQ to MS
Receive MOB_HO-IND from MS
Release MS

**Figure E.4—BS Initiated HO process block diagram as seen by serving BS**

*Insert the following annex:*

# Annex F

(informative)

# Test vectors

## F.1 Cryptographic method test vectors

### F.1.1 AES CTR Mode Known Answer Test for Variable Text

### F.1.1.1 TEST vector

### F.1.1.1.1 Test 1

**PLAIN TEXT: 64 Bytes**

```
d8 65 c9 cd ea 33 56 c5 48 8e 7b a1 5e 84 f4 eb
a3 b8 25 9c 05 3f 24 ce 29 67 22 1c 00 38 84 d7
9d 4c a4 87 7f fa 4b c6 87 c6 67 e5 49 5b cf ec
12 f4 87 17 32 aa e4 5a 11 06 76 11 3d f9 e7 da
```

**Roll-over-counter: 1 Byte**

```
00
```

**PHY Synchronization: 3 Byte**

```
ffffff
```

**Counter: 16 Bytes**

```
00 ff ff ff 00 ff ff ff 00 ff ff ff 00 ff ff ff
```

**Key: 16Bytes**

```
00 00 00 00 00 00 00 00 ff ff ff ff ff ff ff ff
```

**CIPHER TEXT: 64 Byte + 1 Byte(Roll-over-counter)**

```
00 65 e1 16 74 b6 2e 38 bc ad 88 b4 d8 30 7e 44
2b cb 5d 66 ee 5c 1c 82 ca 3d cf 21 db 90 c9 13
b4 25 10 f4 d1 41 1e 04 8a 60 99 cf 02 32 d4 fe
24 db 28 78 f0 fb 1c b6 c8 b5 41 63 6d e9 a6 1b
15
```

**DECRYPT TEXT: 64 Byte**

```
d8 65 c9 cd ea 33 56 c5 48 8e 7b a1 5e 84 f4 eb
a3 b8 25 9c 05 3f 24 ce 29 67 22 1c 00 38 84 d7
9d 4c a4 87 7f fa 4b c6 87 c6 67 e5 49 5b cf ec
12 f4 87 17 32 aa e4 5a 11 06 76 11 3d f9 e7 da
```

#### F.1.1.1.2 Test 2

**PLAIN TEXT: 256 Bytes**

```
45 8b 61 c3 84 ab 89 0b 71 ef ef b9 49 be a4 5b
b1 2b 71 e2 d5 55 3b e5 5a b0 f5 97 a9 dc 71 ed
66 d1 b0 ea 7c 38 f4 ec 26 e2 a5 6f 9f 48 ca 4f
73 3a 31 47 8f 6b 2c e9 1b 21 7f c3 fd f0 b0 63
c0 5f 4c 3c 96 3f 28 bc 21 cc 2b bf 14 f4 0e 86
2e 3e cd bc a9 f8 a4 c3 18 23 86 15 12 35 77 d2
93 c2 0e 29 00 35 e4 21 00 0e df 13 02 ed 99 2f
2a 65 ea d2 5c 8e 95 74 b0 1a 88 c2 4e ff 94 e1
c0 a2 0a c0 d6 ed e0 d5 fb bf e8 fc ab 80 2a d5
e4 14 a7 40 a2 3b b4 52 55 3c 13 a3 3a a7 83 f9
48 8c b9 1d 79 98 f2 74 57 da 70 01 59 9a d6 3c
ad 7c 7c 4f b7 2f a0 0b 6a b3 ad a4 59 30 9c a1
bc 55 be 34 ec b0 a8 42 89 17 43 e1 b0 18 1d 5d
94 98 ab 4a c7 4a 55 31 fc 01 d4 55 31 70 f6 ec
c4 b3 20 b0 63 c7 f2 eb dd 35 cc 8d 4d e8 e9 e0
80 94 2a 47 de 7f 77 da 7f 4b 2f b0 bb 24 9b 7f
```

**Roll-over-counter: 1 Byte**

```
00
```

**PHY Synchronization: 3 Byte**

```
ffffff
```

**Counter: 16 Bytes**

```
00 ff ff ff 00 ff ff ff 00 ff ff ff 00 ff ff ff
```

**Key: 16Bytes**

```
00 00 00 00 00 00 00 00 ff ff ff ff ff ff ff ff
```

**CIPHER TEXT: 256 Byte + 1 Byte(Roll-over-counter)**

```
00 f8 0f be 7a d8 b6 e7 72 94 e9 20 c0 27 44 14
9b d9 ce 32 90 8c 76 9d e1 4e 18 f6 50 39 2d e6
8e de 8d e0 bc 42 dc bb a0 c1 bd 0d 88 e4 c7 fb
87 ba e6 ce a0 46 dd 7e 7b bf 66 6a bf 29 af 4c
ac ec 7b ca 8c 91 41 41 f5 18 98 be 04 ec 83 7b
b3 1e 08 65 93 d9 74 fb c2 58 c4 d1 e9 17 fa a8
08 09 a9 21 24 a5 f8 c1 90 89 8e b8 e1 18 28 aa
e8 da 8c c4 bd 0a 5c f8 36 bd 5c da 33 3b 72 d9
52 f7 ba 62 94 9b 2c 9a 27 34 b5 c9 6b 0a 69 9a
44 3f bf a7 a4 a2 cb 4b ab 95 2f e8 b8 94 19 e9
6f e1 d9 00 cd 60 e7 2b 38 db a6 86 4e f0 83 fe
13 1a c2 d2 33 2f 8d 30 fa bb bd 0e c6 26 e4 55
e4 37 a4 78 62 33 4d f4 07 53 f2 a6 26 8b 15 94
55 ca a5 da 0d 4a eb f6 6d e5 bf 10 b9 28 17 83
49 1f 80 3c 50 56 68 0a 40 08 86 b1 8e ec 48 01
38 33 9c c7 4c 68 aa c9 a3 8d 28 57 8e eb 62 39
c0
```

**DECRYPT TEXT: 256 Byte**

```
45 8b 61 c3 84 ab 89 0b 71 ef ef b9 49 be a4 5b
b1 2b 71 e2 d5 55 3b e5 5a b0 f5 97 a9 dc 71 ed
66 d1 b0 ea 7c 38 f4 ec 26 e2 a5 6f 9f 48 ca 4f
73 3a 31 47 8f 6b 2c e9 1b 21 7f c3 fd f0 b0 63
c0 5f 4c 3c 96 3f 28 bc 21 cc 2b bf 14 f4 0e 86
2e 3e cd bc a9 f8 a4 c3 18 23 86 15 12 35 77 d2
93 c2 0e 29 00 35 e4 21 00 0e df 13 02 ed 99 2f
2a 65 ea d2 5c 8e 95 74 b0 1a 88 c2 4e ff 94 e1
c0 a2 0a c0 d6 ed e0 d5 fb bf e8 fc ab 80 2a d5
e4 14 a7 40 a2 3b b4 52 55 3c 13 a3 3a a7 83 f9
48 8c b9 1d 79 98 f2 74 57 da 70 01 59 9a d6 3c
ad 7c 7c 4f b7 2f a0 0b 6a b3 ad a4 59 30 9c a1
bc 55 be 34 ec b0 a8 42 89 17 43 e1 b0 18 1d 5d
94 98 ab 4a c7 4a 55 31 fc 01 d4 55 31 70 f6 ec
c4 b3 20 b0 63 c7 f2 eb dd 35 cc 8d 4d e8 e9 e0
80 94 2a 47 de 7f 77 da 7f 4b 2f b0 bb 24 9b 7f
```

### F.1.1.1.3 Test 3

**PLAIN TEXT: 1500 Bytes**

```
d7 ba 2e 39 80 20 24 5d 54 ef e9 a0 d7 d2 7f 56
65 a9 9c 43 27 13 1c a6 5e 4a 55 18 6e f0 96 44
a9 c4 7d 29 e3 a1 85 36 8f 6e d5 65 3f 54 bb a4
fd 57 e6 23 6a 02 c9 c7 4c 1e de b9 0d 73 fd b6
36 7a de 19 1a 63 4e a9 d0 22 0e 0e 76 c8 b2 72
1f 97 95 88 99 5d 4e e4 7b 2c 9d 87 9f 99 3c d5
12 1a ed 2c 7c 3a d4 4b 5c e1 59 d1 a9 0a 42 c8
a1 d7 4f 39 33 9d 1d ad c9 b9 34 67 51 70 3c 63
89 28 8f 04 62 62 4f bd 43 a7 8e ec b0 d0 b3 50
a6 02 89 d9 9f a5 85 67 5d b9 ce ae 28 09 11 b0
31 9f b4 92 01 02 4f 43 a8 dc 2f 58 ab e2 a8 51
e3 30 29 81 d5 ad e8 31 65 b5 df 8d be ef 3c ee
8e ef 7f 8e f1 cd d1 99 a9 ff f0 54 e0 97 a4 c3
c7 cc 44 9b 79 2b cc de e0 ab 6a 9d 99 a6 8a 26
95 09 b4 85 d6 84 1d 7e 83 0d d1 63 a4 74 25 6a
40 69 05 b8 93 d1 96 73 7b ff 10 14 a5 99 39 39
a2 ed bd 77 71 da f4 f3 e7 c5 56 8a 39 7b f4 78
e3 f8 30 76 c8 c5 e8 42 c3 f7 55 68 90 8e a0 31
7b 5d a8 eb 36 9c de 1d 60 33 a6 98 ae 99 10 90
91 3f 05 59 03 ed 9a c6 e4 ef 2d 73 7d cc a4 f8
28 4b e2 5e e7 c0 7a 46 f3 20 de a0 b8 ed 30 49
2b 34 a1 2e 21 3b f3 04 2a 1f 77 a7 eb 1a 9e 13
65 80 70 4c 3f ea 91 31 09 6f d1 c1 5c 00 0a 87
34 aa b4 54 e4 a6 58 0d c5 ce b3 af e8 51 c1 4d
d0 31 98 0e 1a 29 3f 23 97 0f e4 f3 0f ed 79 42
97 2c 96 7a d1 ee 87 96 bb 3a 44 a3 8a 05 ef 59
35 86 67 4f af a6 72 45 b5 56 37 c3 43 af 05 d9
db 9a 53 ab 87 da 41 42 13 84 e4 9d 88 d3 f6 bd
59 5d 0c 07 02 7d 4b b6 d2 82 78 15 31 7c ed 0c
16 3f b7 9d 18 f7 df 2b 7a c2 c8 02 95 bd bf ed
19 ca f3 1a 47 3e d0 19 c0 47 2d f1 c3 19 fc d9
58 b2 75 70 a8 53 9a 22 15 61 24 a9 1e e2 96 36
ac 88 50 f2 c5 20 0a 84 67 37 74 2a 4f 70 02 a7
21 77 16 c8 ca b0 ea df 11 0d 87 2e ee 1d 64 99
a4 b4 8b 69 d3 94 ec 39 cb 60 62 19 cf 64 c0 f0
da d5 b7 a3 85 a0 81 95 ac 08 c2 9a 24 25 33 c8
d9 bd 30 ab 51 1c e4 1b 7b 46 34 4a a9 f3 39 82
c8 f0 25 4c 90 a5 e0 3c ad a2 d6 d1 c6 08 98 9f
c4 c7 49 14 e2 2d 2e 5d 72 61 a6 1a 54 df 9c 1b
cf c0 67 5e 65 46 9a 12 e7 6f e2 ad 76 79 4b 3a
3f 94 4e 21 c0 7b 7d 32 dc 23 4c 30 01 e7 4a d0
a7 b1 2d 0c f6 c7 1d dd 36 ff 8a ab 78 d5 e5 b7
68 32 d7 28 ad 53 59 89 76 a4 b8 76 8b 02 45 32
b2 72 3d a8 39 5a 84 6e 58 0d 19 d0 e2 fd 86 49
2f 5c 71 db af ca 63 24 6e 1b 9a f8 1c df 29 ce
51 66 75 89 bf f9 f6 17 06 0e e6 e7 0b 6c 30 39
c8 a0 13 77 69 76 9b d6 91 34 ce ad 13 f7 7a 63
5c ef eb 1b e7 e1 32 ec ee 17 d3 f8 83 02 31 4a
a1 44 c0 0a b9 5a e0 49 8e ad f6 a0 a4 6f 03 ff
5e ed 1a 44 ce 4b 30 bb 62 02 b3 e4 03 e3 2e a4
26 ed ad df 47 8d 28 d5 3a 1d 74 dd 8c 77 dc e9
63 f5 2d 31 40 5d eb a1 5e 9e 85 61 81 b2 05 a7
9f b2 86 e6 3e ad ba 77 ca 2e 54 56 a4 2f 3f 07
```

```
24 6b 37 63 c8 22 04 26 bf 88 87 40 3a 8b e6 d9
3d 6b be 7b 18 77 f1 e2 a4 45 37 48 73 76 4e 97
e1 84 f9 a8 a5 fd cd 64 84 53 a3 be de 89 96 1a
f4 53 94 0c ca 85 ed 6e c9 24 b5 3c 99 03 d2 7a
86 cb 21 2b c7 ed 8f 4b 40 32 09 1d bb 9e 37 ae
f1 ca b9 bb 4f a6 28 18 c9 dd 53 62 df 25 db 64
ef fc 8f b6 e9 1e 01 28 4f 09 45 09 a6 7b b7 97
45 70 51 93 15 78 aa de 54 fd 40 32 21 1a 96 10
16 25 c5 fe 42 c5 25 91 cd 6a 9a 73 e4 50 0a 29
c0 5a bc d4 d2 65 b2 26 62 f1 58 82 0b ed 92 20
12 57 1d 53 1c 42 e4 e9 ac 7d 5b 90 cd 65 b8 8d
be 73 60 8f d8 12 b5 39 02 0c bb 0c f9 4c 2c 0a
a3 49 5d be 8a 40 a6 35 bd 01 c4 8a 65 7c 16 23
ee 76 b2 c5 87 66 fe 89 71 b8 95 69 04 c0 72 a6
08 cf 64 92 0f 09 c7 cb 0a 8b 55 6e 06 6a 91 f3
e0 42 b8 67 a7 b5 ef 17 6d 84 80 71 44 f2 17 4b
c0 7a dd ce 83 a3 99 8c 2d ee fa 33 58 8a 25 37
cb dd 9d 72 92 8c 89 ff 10 08 6f 53 fa 85 9d b9
ff 7a 87 81 1c 20 0c 49 0d 06 7b 64 8f a0 9b 5a
7d 38 cc 0e c4 54 0d d3 5c 7b 25 55 00 c2 0e ff
3b 95 7f 57 b4 8b a0 c1 90 1b 25 1f ba c0 79 37
f7 44 45 ba 98 51 8d f3 cc b1 47 cc 73 54 ca ae
e9 48 05 9c d2 a4 5d 62 be 82 81 78 41 f9 ae 38
3d f2 f1 d4 43 7e c6 0e 2e 0d d9 a1 61 a2 4e 49
e9 52 e5 bb f5 42 1c b3 c3 9c 2b 04 95 d9 3b d1
ca 2b a5 0c a8 6a 1a d6 77 f2 76 d7 93 c4 20 7c
15 04 37 0a 45 53 bd 08 ef e7 0b 83 bf 45 54 89
70 f8 95 18 62 ae ee d9 a0 64 b0 33 27 cf af 3c
d3 e5 45 18 37 01 1f 26 e8 29 a9 a6 6e fc 2f dd
f4 c3 f5 56 71 e2 2e 10 45 dd 42 6b ac f0 a6 7e
d5 eb 95 0c ec b4 31 d3 dd da 79 4a d6 a7 27 c9
69 1b 1f da fd 4c e9 41 29 2b ac d4 1a 52 52 ef
3d e6 fa 28 99 2b fb 75 04 73 bf d9 19 e5 a2 82
00 c0 5c fc 0c 44 3d 35 6e e8 08 88 3a 59 76 76
3f 70 9d d8 9b 97 4c 9e 09 0a 77 22 ef 18 a4 ee
d8 ff e9 e3 43 25 17 b1 0d 1f 38 46 78 ae bb b7
1e 57 8e b8 ee d9 56 f7 e3 cc 19 d1 e4 bd bf bb
bc a8 9e fe cc b5 ae d9 d3 e6 1e 4b 93 d9 01 b0
30 8e 68 1d 67 bd 14 49 88 2c 1a 6b e8 d8 25 a4
7f c3 a1 4b 77 4f 24 4a 34 42 94 c6 1a 95 76 4a
23 de 67 89 9a 7a d2 22 a6 ec 8c 8e
```

**Roll-over-counter: 1 Byte**

```
00
```

**PHY Synchronization: 3 Byte**

```
ffffff
```

**Counter: 16 Bytes**

```
00 ff ff ff 00 ff ff ff 00 ff ff ff 00 ff ff ff
```

**Key: 16Bytes**

```
00 00 00 00 00 00 00 00 ff ff ff ff ff ff ff ff
```

**CIPHER TEXT: 1500 Byte + 1 Byte(Roll-over-counter)**

```
00 6a 3e f1 80 dc 3d 4a 24 b1 e9 26 d9 b9 28 cf
96 0d 4c df 31 7e 30 ba a2 4a e2 56 df fe 01 01
27 11 98 2d 7f dd 45 ca 7a 68 31 7d 82 44 db 8a
6c 34 8b 19 c4 a3 b4 9b 55 e8 59 cb c5 d9 2c 01
79 1a 5e 58 a9 1d 1d 27 e0 e9 76 9b b5 8e bf c7
47 2f a1 3d a7 e9 d1 11 e5 3b cb ca 7b 9a 56 e3
0f 88 71 c2 21 d9 f7 f1 fa d5 61 3e 23 b3 cf 71
0f 51 3e 61 56 65 4f 70 ef c4 ff 66 96 24 fd 71
d0 be 30 e7 50 2f a3 35 4f 8c ad af 7b 11 39 03
c1 7d a9 89 3d 9f 55 7a 9e 9d aa 35 b5 86 b7 7b
26 98 ca 0d 42 18 7d 96 0f 24 a0 d9 17 02 fb 80
7e 54 8e 87 fd 4d 0f 78 c0 b4 bb 7c ef c1 3b f5
ab 05 1e b9 d8 2e 30 8d dc 73 1a 15 93 db 9a 2d
cb 99 f1 35 dc f4 8a 6f 82 f9 15 ae 71 80 c1 ff
83 4e 3a a8 65 e3 2b e5 d5 56 be ac 60 05 d4 cd
b2 f3 61 e8 b3 25 04 28 0a 89 9c 68 2a f5 df 9b
86 fb 5d aa 90 d1 af 43 06 c0 9f d4 9d 1c 0d cb
c9 d2 ef 3e bc 9c 92 a4 61 36 b8 f6 4b d7 6d 8f
2e d3 ec 87 40 9d 19 a0 e4 10 f7 74 76 7d f1 60
4b 98 70 ce 5d aa 28 0e 42 dc 4e a3 86 0d 30 5f
f6 2f 6a b8 a0 c3 f7 85 56 58 53 d4 e0 16 a8 be
09 0a d9 d9 1f ab 02 b9 94 74 75 1c f4 ca 6d 75
93 4f 08 1c b6 46 46 ff 97 c2 c0 af 64 39 a3 4c
e1 90 74 6d d0 a8 2b 75 0f 21 a5 3b ad 95 6f 42
c2 9d 23 19 e4 f3 3f 45 c2 eb c5 bd 2c 75 5f 77
d9 01 0f ef e9 01 53 2e 34 17 21 ba 5a d8 bc 60
1a f2 32 e1 f2 88 fc a2 ac 55 7d 47 b2 1b cf cd
79 c1 9a ac 24 19 e0 5e 56 f8 db c3 3b c9 aa f4
fd 19 80 83 2a 59 4a c6 5e f8 40 13 00 d9 77 5c
4a ca b0 5b 53 de 4c a0 3d 96 04 60 d8 bf d5 a3
f9 da 41 ed 8e 0b e9 a8 52 40 46 c1 21 78 4e 04
5b 0b 20 ad 4b 23 32 51 8e e7 b2 ac a1 51 c8 4d
0f e0 cd e5 64 16 71 df 64 76 1d 51 71 02 a2 76
66 38 01 46 87 ec 44 6f 1d 44 f5 8b 7b 7e 63 14
4b 29 2b 8d fc a6 3e 14 75 b8 a8 27 23 b3 f2 1c
79 a8 2f 2b 3b 69 3e d9 0d 74 1a 32 c6 b0 98 86
18 3f 9f a2 c0 a5 bb b8 85 61 7b 0d 23 47 e4 39
0f 53 cf 9c 19 34 55 3c de 0e 24 ed 07 6c e9 d3
7d 91 aa 32 33 5a df 42 90 55 63 eb cf f7 b8 62
9b 40 2a 3c e8 06 ef 84 50 da 51 fc 82 26 63 fb
c2 58 44 d6 1b 56 db 52 d9 7f c0 36 63 8f 70 2a
6e be ee 72 23 40 3e db 47 96 d3 eb 4c 9e dc cf
db f5 70 dd 01 ec a6 93 95 f0 91 06 c4 6f 74 5e
c7 cd 74 e7 45 53 af 92 c3 96 f3 4d 10 85 b2 11
4f cc 19 b0 a6 11 f5 ac 5a 2b 2b 96 44 3d 35 b4
3a ad 66 32 d6 b5 66 4a 55 2f aa df a2 2d d9 0e
e3 90 90 dd 0b 09 5a 3a 27 24 98 ff 27 2b 45 0e
f4 22 42 1c f2 4a 2d 00 98 b5 ea 88 87 a9 fe 8d
58 8a 4e 64 85 82 13 d1 13 43 66 b4 91 85 20 8d
b7 e2 a5 20 17 02 78 f7 19 a0 b4 74 a2 80 ec 5f
8d 47 7c 23 7f df 35 df d4 ad c8 ac 9a e5 df 6e
e0 5c 81 ce 6a 6c 75 b1 07 09 b7 f0 97 73 82 56
93 e6 fe 5d b1 8e 85 08 f3 df 53 50 4d 3c 12 71
```

```
45 50 45 47 c1 64 f0 09 38 26 3d 56 e6 ed de 71
17 28 3b 51 08 c0 e9 d1 13 ae 7c ff 82 73 0b ee
ae 8d 3d a1 e2 47 a4 0c 66 67 83 61 6e 1a 49 7f
d6 9d d0 21 70 fc 99 f5 f0 0c 0f 1a 5e b6 94 ac
4a 7d f6 f1 89 dd 49 2d f9 0f 1c 21 ae 8c 5c c3
0c 38 3e 24 9d 32 9f 4a 0c a6 83 93 f1 e5 1c 4e
c3 a2 5d 77 95 51 60 7b e5 09 eb 4c b7 5b 1b 7f
09 89 e0 63 5c 36 1f 42 9b 18 66 39 28 18 ad ec
c7 56 d8 95 4f e8 b8 02 8f 0a 57 6b 7e d1 1c 61
e2 b8 40 54 12 d0 01 be f6 e4 e4 01 09 86 56 48
12 a5 85 62 d9 34 00 8e c5 b3 77 e2 e7 08 5e 9d
61 d8 dc b1 4c 3c 21 75 31 5d 75 ce 5d 15 27 fe
7f 85 21 10 d3 41 07 74 0b 35 af 1a 45 9c db 4e
a1 f4 f4 c0 28 d9 d4 54 ad ef e2 d6 1e 94 10 f8
3e ed ae ef 6d e9 d1 19 b5 2b ed d2 54 b8 b0 47
5b 8b c7 e6 2c 82 ed 7d d6 f4 f8 59 60 7c 15 12
fd 68 41 fe 46 77 f8 96 99 45 dd ed 47 68 4d 6d
e8 51 cc da 66 a0 56 4d e9 74 af f8 06 ff 92 7e
6d 12 ba 21 3c 86 04 cf a0 c0 bd 18 86 c2 11 bc
13 81 a2 54 60 a8 21 fd 50 b2 19 5c 8c 5a ee 00
fe 11 b8 71 ea 15 c3 15 28 1c 41 d5 a7 27 22 c2
42 e7 5f 1b aa ec f9 09 04 00 0d 0d 63 8b 84 aa
a0 d2 e7 f5 1b b6 d8 5f f7 5c 53 f0 9a 41 f2 27
96 33 c4 93 d9 11 5c 5b 1a a4 d4 f8 2c c0 fc 79
99 ad 8b cd 34 fb 7e e6 60 40 11 80 30 b2 0d 23
36 df d8 b5 0c d2 76 1a 1f 4d 7b d9 32 3e 97 09
f7 5f b1 6c 3c 6b 78 17 c0 4e 63 66 a7 8b 46 85
38 bd fa d1 e2 e9 3d c8 33 33 94 08 b2 c2 8b c8
ab 89 1f 78 d8 7c f7 0b 61 f2 f2 6c 81 38 72 f5
9d d3 32 43 7b 15 68 e3 d8 eb be 73 d1 1d 35 16
a1 17 dc 02 65 da 91 62 2a 9f 82 6d 75 f7 ab 0c
83 63 e2 7f d9 25 9b 44 9e 35 fd 0e 1a 1e b1 c7
e4 46 a6 03 2a 11 ba d1 2a aa 34 6b ee d1 ae 3b
c4 bc cb f9 35 03 e0 e6 03 55 1f bf b0 c0 b4 7d
99 ad 7d 5b 65 63 a7 9c a4 61 8b 5d 11 bf 40 43
bb 83 4d d8 fa ec 25 60 e2 a2 3c b0 6e 23 92 4b
ff 47 83 7f 06 4d 27 67 d8 50 80 07 69 ae e3 d0
7b 9e 18 7a 1f 46 52 b5 4e 6a bc 34 f7 91 60 ee
5b f9 2c a7 ce 8f 90 d0 e5 6f d1 44 f0 2f 98 d3
26 79 80 7a 7c 76 bf 86 25 e6 d1 c6 0a 24 7b 61
63 ff 6a f3 f5 d5 8b ce 4f c5 2c d6 0c
```

**DECRYPT TEXT: 1500 Byte**

```
d7 ba 2e 39 80 20 24 5d 54 ef e9 a0 d7 d2 7f 56
65 a9 9c 43 27 13 1c a6 5e 4a 55 18 6e f0 96 44
a9 c4 7d 29 e3 a1 85 36 8f 6e d5 65 3f 54 bb a4
fd 57 e6 23 6a 02 c9 c7 4c 1e de b9 0d 73 fd b6
36 7a de 19 1a 63 4e a9 d0 22 0e 0e 76 c8 b2 72
1f 97 95 88 99 5d 4e e4 7b 2c 9d 87 9f 99 3c d5
12 1a ed 2c 7c 3a d4 4b 5c e1 59 d1 a9 0a 42 c8
a1 d7 4f 39 33 9d 1d ad c9 b9 34 67 51 70 3c 63
89 28 8f 04 62 62 4f bd 43 a7 8e ec b0 d0 b3 50
a6 02 89 d9 9f a5 85 67 5d b9 ce ae 28 09 11 b0
31 9f b4 92 01 02 4f 43 a8 dc 2f 58 ab e2 a8 51
e3 30 29 81 d5 ad e8 31 65 b5 df 8d be ef 3c ee
8e ef 7f 8e f1 cd d1 99 a9 ff f0 54 e0 97 a4 c3
c7 cc 44 9b 79 2b cc de e0 ab 6a 9d 99 a6 8a 26
95 09 b4 85 d6 84 1d 7e 83 0d d1 63 a4 74 25 6a
40 69 05 b8 93 d1 96 73 7b ff 10 14 a5 99 39 39
a2 ed bd 77 71 da f4 f3 e7 c5 56 8a 39 7b f4 78
e3 f8 30 76 c8 c5 e8 42 c3 f7 55 68 90 8e a0 31
7b 5d a8 eb 36 9c de 1d 60 33 a6 98 ae 99 10 90
91 3f 05 59 03 ed 9a c6 e4 ef 2d 73 7d cc a4 f8
28 4b e2 5e e7 c0 7a 46 f3 20 de a0 b8 ed 30 49
2b 34 a1 2e 21 3b f3 04 2a 1f 77 a7 eb 1a 9e 13
65 80 70 4c 3f ea 91 31 09 6f d1 c1 5c 00 0a 87
34 aa b4 54 e4 a6 58 0d c5 ce b3 af e8 51 c1 4d
d0 31 98 0e 1a 29 3f 23 97 0f e4 f3 0f ed 79 42
97 2c 96 7a d1 ee 87 96 bb 3a 44 a3 8a 05 ef 59
35 86 67 4f af a6 72 45 b5 56 37 c3 43 af 05 d9
db 9a 53 ab 87 da 41 42 13 84 e4 9d 88 d3 f6 bd
59 5d 0c 07 02 7d 4b b6 d2 82 78 15 31 7c ed 0c
16 3f b7 9d 18 f7 df 2b 7a c2 c8 02 95 bd bf ed
19 ca f3 1a 47 3e d0 19 c0 47 2d f1 c3 19 fc d9
58 b2 75 70 a8 53 9a 22 15 61 24 a9 1e e2 96 36
ac 88 50 f2 c5 20 0a 84 67 37 74 2a 4f 70 02 a7
21 77 16 c8 ca b0 ea df 11 0d 87 2e ee 1d 64 99
a4 b4 8b 69 d3 94 ec 39 cb 60 62 19 cf 64 c0 f0
da d5 b7 a3 85 a0 81 95 ac 08 c2 9a 24 25 33 c8
d9 bd 30 ab 51 1c e4 1b 7b 46 34 4a a9 f3 39 82
c8 f0 25 4c 90 a5 e0 3c ad a2 d6 d1 c6 08 98 9f
c4 c7 49 14 e2 2d 2e 5d 72 61 a6 1a 54 df 9c 1b
cf c0 67 5e 65 46 9a 12 e7 6f e2 ad 76 79 4b 3a
3f 94 4e 21 c0 7b 7d 32 dc 23 4c 30 01 e7 4a d0
a7 b1 2d 0c f6 c7 1d dd 36 ff 8a ab 78 d5 e5 b7
68 32 d7 28 ad 53 59 89 76 a4 b8 76 8b 02 45 32
b2 72 3d a8 39 5a 84 6e 58 0d 19 d0 e2 fd 86 49
2f 5c 71 db af ca 63 24 6e 1b 9a f8 1c df 29 ce
51 66 75 89 bf f9 f6 17 06 0e e6 e7 0b 6c 30 39
c8 a0 13 77 69 76 9b d6 91 34 ce ad 13 f7 7a 63
5c ef eb 1b e7 e1 32 ec ee 17 d3 f8 83 02 31 4a
a1 44 c0 0a b9 5a e0 49 8e ad f6 a0 a4 6f 03 ff
5e ed 1a 44 ce 4b 30 bb 62 02 b3 e4 03 e3 2e a4
26 ed ad df 47 8d 28 d5 3a 1d 74 dd 8c 77 dc e9
63 f5 2d 31 40 5d eb a1 5e 9e 85 61 81 b2 05 a7
9f b2 86 e6 3e ad ba 77 ca 2e 54 56 a4 2f 3f 07
```

```
24 6b 37 63 c8 22 04 26 bf 88 87 40 3a 8b e6 d9
3d 6b be 7b 18 77 f1 e2 a4 45 37 48 73 76 4e 97
e1 84 f9 a8 a5 fd cd 64 84 53 a3 be de 89 96 1a
f4 53 94 0c ca 85 ed 6e c9 24 b5 3c 99 03 d2 7a
86 cb 21 2b c7 ed 8f 4b 40 32 09 1d bb 9e 37 ae
f1 ca b9 bb 4f a6 28 18 c9 dd 53 62 df 25 db 64
ef fc 8f b6 e9 1e 01 28 4f 09 45 09 a6 7b b7 97
45 70 51 93 15 78 aa de 54 fd 40 32 21 1a 96 10
16 25 c5 fe 42 c5 25 91 cd 6a 9a 73 e4 50 0a 29
c0 5a bc d4 d2 65 b2 26 62 f1 58 82 0b ed 92 20
12 57 1d 53 1c 42 e4 e9 ac 7d 5b 90 cd 65 b8 8d
be 73 60 8f d8 12 b5 39 02 0c bb 0c f9 4c 2c 0a
a3 49 5d be 8a 40 a6 35 bd 01 c4 8a 65 7c 16 23
ee 76 b2 c5 87 66 fe 89 71 b8 95 69 04 c0 72 a6
08 cf 64 92 0f 09 c7 cb 0a 8b 55 6e 06 6a 91 f3
e0 42 b8 67 a7 b5 ef 17 6d 84 80 71 44 f2 17 4b
c0 7a dd ce 83 a3 99 8c 2d ee fa 33 58 8a 25 37
cb dd 9d 72 92 8c 89 ff 10 08 6f 53 fa 85 9d b9
ff 7a 87 81 1c 20 0c 49 0d 06 7b 64 8f a0 9b 5a
7d 38 cc 0e c4 54 0d d3 5c 7b 25 55 00 c2 0e ff
3b 95 7f 57 b4 8b a0 c1 90 1b 25 1f ba c0 79 37
f7 44 45 ba 98 51 8d f3 cc b1 47 cc 73 54 ca ae
e9 48 05 9c d2 a4 5d 62 be 82 81 78 41 f9 ae 38
3d f2 f1 d4 43 7e c6 0e 2e 0d d9 a1 61 a2 4e 49
e9 52 e5 bb f5 42 1c b3 c3 9c 2b 04 95 d9 3b d1
ca 2b a5 0c a8 6a 1a d6 77 f2 76 d7 93 c4 20 7c
15 04 37 0a 45 53 bd 08 ef e7 0b 83 bf 45 54 89
70 f8 95 18 62 ae ee d9 a0 64 b0 33 27 cf af 3c
d3 e5 45 18 37 01 1f 26 e8 29 a9 a6 6e fc 2f dd
f4 c3 f5 56 71 e2 2e 10 45 dd 42 6b ac f0 a6 7e
d5 eb 95 0c ec b4 31 d3 dd da 79 4a d6 a7 27 c9
69 1b 1f da fd 4c e9 41 29 2b ac d4 1a 52 52 ef
3d e6 fa 28 99 2b fb 75 04 73 bf d9 19 e5 a2 82
00 c0 5c fc 0c 44 3d 35 6e e8 08 88 3a 59 76 76
3f 70 9d d8 9b 97 4c 9e 09 0a 77 22 ef 18 a4 ee
d8 ff e9 e3 43 25 17 b1 0d 1f 38 46 78 ae bb b7
1e 57 8e b8 ee d9 56 f7 e3 cc 19 d1 e4 bd bf bb
bc a8 9e fe cc b5 ae d9 d3 e6 1e 4b 93 d9 01 b0
30 8e 68 1d 67 bd 14 49 88 2c 1a 6b e8 d8 25 a4
7f c3 a1 4b 77 4f 24 4a 34 42 94 c6 1a 95 76 4a
23 de 67 89 9a 7a d2 22 a6 ec 8c 8e
```

### F.1.1.1.4 Test Program

```
/*******************************************************************/
/* 802.16e MBS (Multimedia Broadcast Service) AES-CTR mode example */
/* program for KAT (Known Answer Test). KAT help implementors to   */
/* verify AES algorithm and CTR mode correctly for MBS defined     */
/* in PKMv2                                                        */
/* Version Number: 0.2                                             */
/* Name: JunHyuk Song, Jicheol Lee                                 */
/*******************************************************************/

#include <stdlib.h>
#include <stdio.h>

#define MAX_BUF10000

/*****************************/
/*** AES 16X16 SBOX Table ****/
/*****************************/

unsigned char sbox_table[256] =
{
   0x63, 0x7c, 0x77, 0x7b, 0xf2, 0x6b, 0x6f, 0xc5,
   0x30, 0x01, 0x67, 0x2b, 0xfe, 0xd7, 0xab, 0x76,
   0xca, 0x82, 0xc9, 0x7d, 0xfa, 0x59, 0x47, 0xf0,
   0xad, 0xd4, 0xa2, 0xaf, 0x9c, 0xa4, 0x72, 0xc0,
   0xb7, 0xfd, 0x93, 0x26, 0x36, 0x3f, 0xf7, 0xcc,
   0x34, 0xa5, 0xe5, 0xf1, 0x71, 0xd8, 0x31, 0x15,
   0x04, 0xc7, 0x23, 0xc3, 0x18, 0x96, 0x05, 0x9a,
   0x07, 0x12, 0x80, 0xe2, 0xeb, 0x27, 0xb2, 0x75,
   0x09, 0x83, 0x2c, 0x1a, 0x1b, 0x6e, 0x5a, 0xa0,
   0x52, 0x3b, 0xd6, 0xb3, 0x29, 0xe3, 0x2f, 0x84,
   0x53, 0xd1, 0x00, 0xed, 0x20, 0xfc, 0xb1, 0x5b,
   0x6a, 0xcb, 0xbe, 0x39, 0x4a, 0x4c, 0x58, 0xcf,
   0xd0, 0xef, 0xaa, 0xfb, 0x43, 0x4d, 0x33, 0x85,
   0x45, 0xf9, 0x02, 0x7f, 0x50, 0x3c, 0x9f, 0xa8,
   0x51, 0xa3, 0x40, 0x8f, 0x92, 0x9d, 0x38, 0xf5,
   0xbc, 0xb6, 0xda, 0x21, 0x10, 0xff, 0xf3, 0xd2,
   0xcd, 0x0c, 0x13, 0xec, 0x5f, 0x97, 0x44, 0x17,
   0xc4, 0xa7, 0x7e, 0x3d, 0x64, 0x5d, 0x19, 0x73,
   0x60, 0x81, 0x4f, 0xdc, 0x22, 0x2a, 0x90, 0x88,
   0x46, 0xee, 0xb8, 0x14, 0xde, 0x5e, 0x0b, 0xdb,
   0xe0, 0x32, 0x3a, 0x0a, 0x49, 0x06, 0x24, 0x5c,
   0xc2, 0xd3, 0xac, 0x62, 0x91, 0x95, 0xe4, 0x79,
   0xe7, 0xc8, 0x37, 0x6d, 0x8d, 0xd5, 0x4e, 0xa9,
   0x6c, 0x56, 0xf4, 0xea, 0x65, 0x7a, 0xae, 0x08,
   0xba, 0x78, 0x25, 0x2e, 0x1c, 0xa6, 0xb4, 0xc6,
   0xe8, 0xdd, 0x74, 0x1f, 0x4b, 0xbd, 0x8b, 0x8a,
   0x70, 0x3e, 0xb5, 0x66, 0x48, 0x03, 0xf6, 0x0e,
   0x61, 0x35, 0x57, 0xb9, 0x86, 0xc1, 0x1d, 0x9e,
   0xe1, 0xf8, 0x98, 0x11, 0x69, 0xd9, 0x8e, 0x94,
   0x9b, 0x1e, 0x87, 0xe9, 0xce, 0x55, 0x28, 0xdf,
   0x8c, 0xa1, 0x89, 0x0d, 0xbf, 0xe6, 0x42, 0x68,
   0x41, 0x99, 0x2d, 0x0f, 0xb0, 0x54, 0xbb, 0x16
};

/*****************************/
/**** Function Prototypes ****/
/*****************************/

void bitwise_xor(unsigned char *ina, unsigned char *inb, unsigned char *out);
void print_hex(unsigned char *buf, int len) ;

/********************************************************************/
/*************** AES algorithm operation functions ******************/
/********************************************************************/

void xor_128(unsigned char *a, unsigned char *b, unsigned char *out);
void xor_32(unsigned char *a, unsigned char *b, unsigned char *out);

unsigned char sbox(unsigned char a);
void next_key(unsigned char *key, int round);
void byte_sub(unsigned char *in, unsigned char *out);
void shift_row(unsigned char *in, unsigned char *out);
void mix_column(unsigned char *in, unsigned char *out);
void add_round_key( unsigned char *shiftrow_in,
                       unsigned char *mcol_in,
                       unsigned char *block_in,
                       int round,
                       unsigned char *out);
void aes128k128d(unsigned char *key, unsigned char *data, unsigned char *ciphertext);
```

```
/*******************************************/
/* This function is to generate 32bit nonce */
/* based on GCC rand()                      */
/*******************************************/

unsigned long random_32bit(void)
{
        return (unsigned long) rand();
}
/***********************************************/
/* This function is to generate random plain text */
/***********************************************/

unsigned char random_8bit(void)
{
        unsigned char ret;

        ret = (unsigned char) 1 + (int) (256.0*rand()/(RAND_MAX+1.0));
        return ret;
}

void generate_plain(unsigned char *plain, int len)
{
        int     i;

        for ( i=0; i<len; i++ ) {
                plain[i] = random_8bit();
        }
}




/**************************************************************************/
/* AES Encryption functions are defined here.                             */
/* Performs a 128 bit AES encryption with 128 bit key and data blocks based */
/* based on NIST Special Publication 800-38A, FIPS 197                    */
/**************************************************************************/

/************************/
/* 128 bits XOR function */
/************************/


void xor_128(unsigned char *a, unsigned char *b, unsigned char *out)
{
    int i;
    for (i=0;i<16; i++)
    {
        out[i] = a[i] ^ b[i];
    }
}


/************************/
/* 32 bits XOR function */
/************************/

void xor_32(unsigned char *a, unsigned char *b, unsigned char *out)
{
    int i;
    for (i=0;i<4; i++)
    {
        out[i] = a[i] ^ b[i];
    }
}


/**********************************/
/* AES SBOX Table Setup   **********/
/**********************************/

unsigned char sbox(unsigned char a)
{
    return sbox_table[(int)a];
}


/*****************************************/
/* AES next_key operation *****************/
```

```
/*******************************************/

void next_key(unsigned char *key, int round)
{
    unsigned char rcon;
    unsigned char sbox_key[4];
    unsigned char rcon_table[12] =
    {
        0x01, 0x02, 0x04, 0x08, 0x10, 0x20, 0x40, 0x80,
        0x1b, 0x36, 0x36, 0x36
    };

    sbox_key[0] = sbox(key[13]);
    sbox_key[1] = sbox(key[14]);
    sbox_key[2] = sbox(key[15]);
    sbox_key[3] = sbox(key[12]);

    rcon = rcon_table[round];

    xor_32(&key[0], sbox_key, &key[0]);
    key[0] = key[0] ^ rcon;

    xor_32(&key[4], &key[0], &key[4]);
    xor_32(&key[8], &key[4], &key[8]);
    xor_32(&key[12], &key[8], &key[12]);
}


/************************************/
/* AES Byte Substituition **********/
/************************************/

void byte_sub(unsigned char *in, unsigned char *out)
{
    int i;
    for (i=0; i< 16; i++)
    {
        out[i] = sbox(in[i]);
    }
}



/************************************/
/* AES Shift Row Operation *********/
/************************************/

void shift_row(unsigned char *in, unsigned char *out)
{
    out[0] =  in[0];
    out[1] =  in[5];
    out[2] =  in[10];
    out[3] =  in[15];
    out[4] =  in[4];
    out[5] =  in[9];
    out[6] =  in[14];
    out[7] =  in[3];
    out[8] =  in[8];
    out[9] =  in[13];
    out[10] = in[2];
    out[11] = in[7];
    out[12] = in[12];
    out[13] = in[1];
    out[14] = in[6];
    out[15] = in[11];
}


/************************************/
/****** AES mix_column operation ***/
/************************************/

void mix_column(unsigned char *in, unsigned char *out)
{
    int i;
    unsigned char add1b[4];
    unsigned char add1bf7[4];
    unsigned char rotl[4];
    unsigned char swap_halfs[4];
    unsigned char andf7[4];
    unsigned char rotr[4];
    unsigned char temp[4];
    unsigned char tempb[4];

    for (i=0 ; i<4; i++)
    {
        if ((in[i] & 0x80)== 0x80)
            add1b[i] = 0x1b;
        else
            add1b[i] = 0x00;
    }

    swap_halfs[0] = in[2];    /* Swap halfs */
    swap_halfs[1] = in[3];
    swap_halfs[2] = in[0];
    swap_halfs[3] = in[1];

    rotl[0] = in[3];        /* Rotate left 8 bits */
    rotl[1] = in[0];
    rotl[2] = in[1];
    rotl[3] = in[2];

    andf7[0] = in[0] & 0x7f;
    andf7[1] = in[1] & 0x7f;
    andf7[2] = in[2] & 0x7f;
    andf7[3] = in[3] & 0x7f;

    for (i = 3; i>0; i--)    /* logical shift left 1 bit */
    {
        andf7[i] = andf7[i] << 1;
        if ((andf7[i-1] & 0x80) == 0x80)
        {
            andf7[i] = (andf7[i] | 0x01);
        }
    }
    andf7[0] = andf7[0] << 1;
    andf7[0] = andf7[0] & 0xfe;

    xor_32(add1b, andf7, add1bf7);

    xor_32(in, add1bf7, rotr);

    temp[0] = rotr[0];         /* Rotate right 8 bits */
    rotr[0] = rotr[1];
    rotr[1] = rotr[2];
    rotr[2] = rotr[3];
    rotr[3] = temp[0];

    xor_32(add1bf7, rotr, temp);
    xor_32(swap_halfs, rotl,tempb);
    xor_32(temp, tempb, out);
}

/* AES Encryption function that will do multiple round of AddRoundKey, SubBytes,
   ShiftRows, and MixColumns operations */

void aes128k128d(unsigned char *key, unsigned char *data, unsigned char *ciphertext)
{
    int round;
    int i;
    unsigned char intermediatea[16];
    unsigned char intermediateb[16];
    unsigned char round_key[16];

    for(i=0; i<16; i++) round_key[i] = key[i];

    for (round = 0; round < 11; round++)
    {
        if (round == 0) /* First AddRound Key Operation */
        {
            xor_128(round_key, data, ciphertext);
            next_key(round_key, round);
        }
        else if (round == 10) /* Final Round operations */
        {
            byte_sub(ciphertext, intermediatea);
            shift_row(intermediatea, intermediateb);
            xor_128(intermediateb, round_key, ciphertext);
        }
        else    /* 1 - 9 */
        {
            byte_sub(ciphertext, intermediatea);
            shift_row(intermediatea, intermediateb);
            mix_column(&intermediateb[0], &intermediatea[0]);
            mix_column(&intermediateb[4], &intermediatea[4]);
            mix_column(&intermediateb[8], &intermediatea[8]);
            mix_column(&intermediateb[12], &intermediatea[12]);
            xor_128(intermediatea, round_key, ciphertext);
            next_key(round_key, round);
        }
    }

}

/************************************/
/* bitwise_xor()                    */
/* A 128 bit, bitwise exclusive or  */
/************************************/

void bitwise_xor(unsigned char *ina, unsigned char *inb, unsigned char *out)
{
    int i;
    for (i=0; i<16; i++)
    {
        out[i] = ina[i] ^ inb[i];
    }
}


/***************************************************/
/* It generate 128bit key as                       */
/* 00 00 00 00 00 00 00 00 ff ff ff ff ff ff ff ff */
/* for Variable Key Known Answer Test              */
/****************************************************/

void generate_key(unsigned char *key)
{
        int                       i;

        for (i=0; i<8; i++ ) {
                key[i] = 0x00;
        }
        for (i=8; i<16; i++ ) {
                key[i] = 0xff;
        }
}

/***************************************************/
/* Initialization of Counter
/* first, construct 32 bit value by concatenate 8bit-rollovercounter
 *              and 24bit-phy_sync
 * seconds, concatnate the above results 4 times
/***************************************************/

void init_counter(unsigned char rollcnt, unsigned long phy_sync, unsigned char *ctr)
{
        int             i, j;

        for ( i=0; i<4; i++ ) {
                ctr[i*4+0] = rollcnt;
                ctr[i*4+1] = (phy_sync >> 16 ) & 0xff;
                ctr[i*4+2] = (phy_sync >> 8 ) & 0xff;
                ctr[i*4+3] = phy_sync & 0xff;
        }
}

/*************************************************************/
/* It increment counter by one upon encryption of each block */
/*************************************************************/

void add_counter(char *ctr)
{
        int             value, i;
        int             overflow;

        overflow = 1;
        for ( i=15; i>=0 ; i-- ) {
                if ( overflow == 0 ) break;
                value = ctr[i] & 0xff;
                value ++;
                if ( value >= 256 )
                        overflow = 1;
                else overflow = 0;
                ctr[i] = value & 0xff;
        }
}
/* Return Roll over Counter */
unsigned char get_rollcnt(void)
{
        return 0x00;
}
unsigned long get_phy_sync(void)
{
        /* Suppose that phy sync 24bits are all one in this example. */
        return 0x00ffffff;
}

/********************************************************/
/* int encrypt_pdu()                                    */
/* Encrypts a plaintext pdu in accordance with          */
/* the proposed 802.16e AES CTR specification.          */
/* Roll-over-counter takes place.                       */
/* Returns the resulting cipher text                    */
/********************************************************/
int encrypt_pdu(unsigned char *key, unsigned char *plain, int len, unsigned char *cipher)
{
        int                                i, n_blocks, n_remain, out_len = 0;
        unsigned charctr[16], rollcnt;
        unsigned char aes_out[16], remain[16], temp[16];
        unsigned longphy_sync_value;

        rollcnt = get_rollcnt();
        phy_sync_value = get_phy_sync();
#ifdef DEBUG
        printf("Roll-over-counter: 1 Byte\n\n");
        printf("%02x\n\n",rollcnt);
        printf("PHY Syncronization: 3 Byte\n\n");
        printf("%06x\n\n", phy_sync_value);
#endif

        cipher[0] = rollcnt;

        out_len += 1;

        n_blocks = len / 16;
        n_remain  = len % 16;

        init_counter(rollcnt,phy_sync_value,ctr);
#ifdef DEBUG
        printf("Counter: 16 Bytes\n\n");
        print_hex(ctr,16);
        printf("\n");
    printf("Key: 16Bytes\n\n");
    print_hex(key,16);
        printf("\n");
#endif
        for ( i=0; i< n_blocks; i++ ) {
                aes128k128d(key, ctr, aes_out);
        bitwise_xor(aes_out, &plain[i*16], &cipher[i*16+1]);
                add_counter(ctr);

                out_len += 16;
        }

        for ( i=0; i<16; i++ ) {
                remain[i] = 0;
        }
        for ( i=0; i<n_remain; i++ ) {
                remain[i] = plain[n_blocks*16+i];
        }
        aes128k128d(key,ctr,aes_out);
        bitwise_xor(aes_out,&remain[0], &temp[0]);

        for ( i=0; i<n_remain; i++ ) {
                cipher[n_blocks*16+1+i] = temp[i];
        }
        out_len += n_remain;
        return out_len;
}
/********************************************************/
/* int decrypt_pdu()                                    */
/* decrypts a cipher pdu in accordance with             */
/* the proposed 802.16e AES CTR specification.          */
/* Decode roll-over-counter field                       */
/* Returns the resulting decrypted text                 */
/********************************************************/

int decrypt_pdu(unsigned char *key, unsigned char *cipher, int len, unsigned char *plain)
{
        int                                i, n_blocks, n_remain, out_len = 0;
        unsigned charctr[16],rollcnt;
        unsigned char aes_out[16], remain[16], temp[16];
        unsigned longphy_sync_value;

        phy_sync_value = get_phy_sync();
        rollcnt = cipher[0];

        len -= 1;

        n_blocks = len / 16;
        n_remain  = len % 16;

        init_counter(rollcnt, phy_sync_value, ctr);
        for ( i=0; i< n_blocks; i++ ) {
             aes128k128d(key, ctr, aes_out);
             bitwise_xor(aes_out, &cipher[i*16+1], &plain[i*16]);
                  add_counter(ctr);
                  out_len += 16;
        }

        for ( i=0; i<16; i++ ) {
                remain[i] = 0;
        }
        for ( i=0; i<n_remain; i++ ) {
                remain[i] = cipher[n_blocks*16+1+i];
        }
        aes128k128d(key,ctr,aes_out);
        bitwise_xor(aes_out,&remain[0], &temp[0]);

        for ( i=0; i<n_remain; i++ ) {
                plain[n_blocks*16+i] = temp[i];
        }
        out_len += n_remain;
        return out_len;
}

/* HEX value print out function           */
void print_hex(unsigned char *buf, int len)
{
        int              i;

        for ( i=0; i<len; i++ ) {
                printf("%02x ", buf[i]);
                if ( (i % 16) == 15 ) printf("\n");
        }
        if ( (i % 16) != 0 ) printf("\n");
}

int compare(unsigned char *x, unsigned char *y, int len)
{
        int              i;

        for ( i=0; i<len; i++ ) {
                if ( x[i] == y[i] ) continue;
                return (x[i] - y[i]);
        }
        return 0;
}


int test_case(int length)
{
        unsigned charkey[16];
        unsigned charplain[MAX_BUF];
        unsigned charcipher[MAX_BUF+4];
        unsigned chardecrypt[MAX_BUF];

        /* 0. Get a 128bits key */
        generate_key(key);

        /* 1. Generate Plain Text with length */

        generate_plain(plain,length);

#ifdef DEBUG
```

```
        printf("PLAIN TEXT: %d Bytes\n\n",length);
        print_hex(plain,length);
        printf("\n\n");
#endif

        /* 2. Encrypt Plain Text to Cipher Text */

        encrypt_pdu(key,plain,length,cipher);

#ifdef DEBUG
        printf("CIPHER TEXT: %d Byte + 1 Byte(Roll-over-counter)\n\n",length);
        print_hex(cipher,length+1);
        printf("\n\n");
#endif

        /* 3. Decrypt Cipher Text to decrypt text */

        decrypt_pdu(key,cipher,length+1,decrypt);

#ifdef DEBUG
        printf("DECRYPT TEXT: %d Byte\n\n",length);
        print_hex(decrypt,length);
        printf("\n\n");
#endif

        /* 4. Compare decrypt text and original plain text */

        if ( compare(decrypt,plain,length) == 0 ) {
                return 1; /* Test Success */
        } else {
                return 0; /* Test Failure */
        }
}


/****************************************************/
/* AES CTR main()                                   */
/* Test vectors                                     */
/****************************************************/

int main()
{
        int             i, len[] = { 64, 256, 1500 };

        for ( i=0; i<sizeof(len)/sizeof(len[0]); i++ ) {
                printf("Test                                                        %d
*************************************************\n\n",i+1);
                if ( !test_case(len[i]) ) {
                        printf(" ==> Failure\n");
                }
        }
        return 0;
}
```

## F.2 Test vectors for CRC16 CCITT X.25

```
unsigned char crc16vector1[] = {
0x01, 0x02, 0x03, 0x04, 0x05, 0x06, 0x07, 0x08, 0x09, 0x0a,
/*CRC*/
0xd3,0x8d};/* last two bytes are CRC in big endian format */



unsigned char crc16vector2[] = {
0x01, 0x02, 0x03, 0x04, 0x05, 0x06, 0x07, 0x08, 0x09, 0x0a,
0x0b, 0x0c, 0x0d, 0x0e, 0x0f, 0x10, 0x11, 0x12, 0x13, 0x14,
/*CRC*/
0xe3, 0x94};}; /* last two bytes are CRC in big endian format */


unsigned char crc16[] = {
0xC0, 0xFC, 0xDA, 0x37}; /* last two bytes are CRC in big endian format */

unsigned char crc16A[] = {
0x80, 0xCE, 0xC1, 0xEA};  /* last two bytes are CRC in big endian format */

unsigned char crc16B[] = {
0x80, 0xFC, 0xD7, 0xFB}; /* last two bytes are CRC in big endian format */

unsigned char crc16C[] = {
0xC0, 0xCE, 0xCC, 0x26}; /* last two bytes are CRC in big endian format */
```

*Insert the following annex:*

# Annex G

(informative)

## Network model for mobile communications

## G.1 Network reference model

### G.1.1 Entities

The network reference model includes groups of BS units providing network service (not necessarily contiguous) to authorized MS in a geographic region. A group of BS units that share administrative affiliation, and are connected by a backbone (wired or unwired) are referred to as a provider network. Multiple provider networks of varying design, performance, and ownership/administration may coexist in the same region.

Provider networks may employ specialized servers for AAA (Authorization, Authentication and Accounting), management, provisioning, and other functions. These servers responsible are collectively termed Authentication and Service Authorization Servers (ASA-servers) in this specification. A provider may deploy single or multiple ASA-servers, and may do so in a centralized or distributed manner.

The mobility related entities are described in Table G.1.

Operations between BSs and ASA servers are not specified.

**Table G.1—Mobility related entities**

| Entity | Description |
|---|---|
| MS | Mobile Station, contains MAC (CS), and PHY layers |
| BS | Base Station: as defined in 3.5 |
| ASA Server(s) | Authentication and Service Authorization Server servicing the whole operator’s network. These servers are optional, and may be implemented as a distributed entity. |

Depending on a provider network’s configuration and administrative policies, an MS may perform a handover from one BS to another. A provider network’s scheme for managing handovers might be localized in the relevant BSs, or it might be distributed and/or involve ASA servers.

Figure G.1 shows an example where two BS are connected to an operator backbone. BS #1 is the serving BS for an MS. BS #2 is the neighbor BS. If the MS moves closer to BS #2, as depicted by the shaded arrow, BS #2 might become a target BS for a handover.

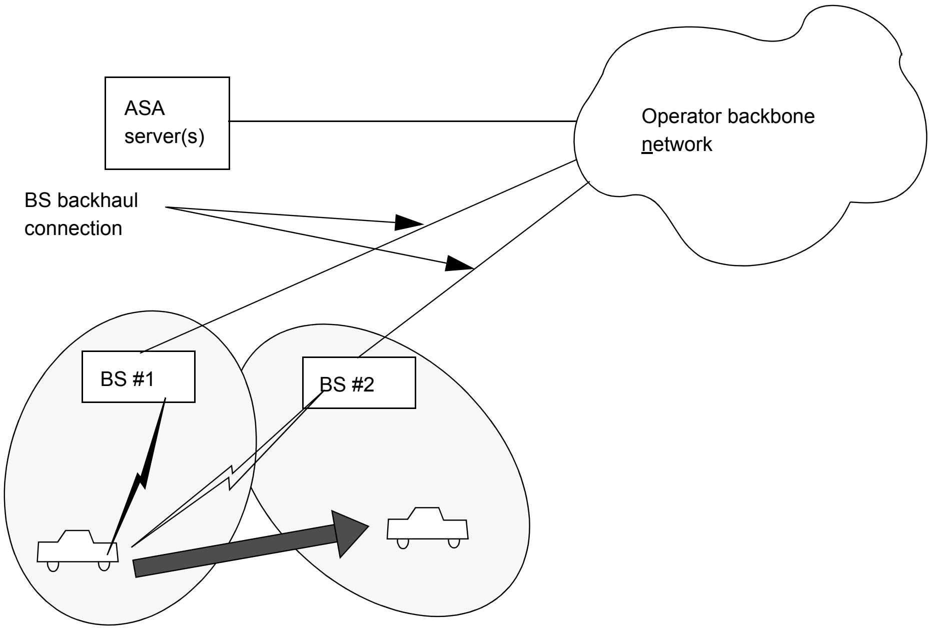

ASA
server(s)
Operator backbone
network
BS backhaul
connection
BS #1
BS #2

Figure G.1—Network model example

Figure G.2 shows the network reference model in the control plane.

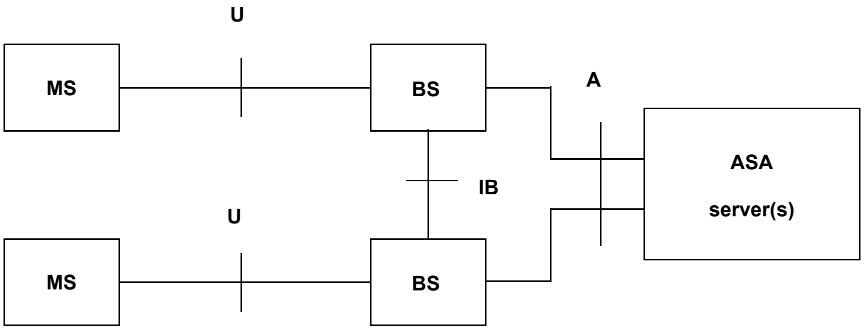

U
MS
BS
A
ASA
server(s)
IB
U
MS
BS

Figure G.2—Logical network reference model, control plane

The following reference points (Table G.2) are present at the control plane network model

### Table G.2—Reference points at the control plane

| Reference point | Elements to be specified by IEEE 802.16e | Comments |
|---|---|---|
| U | PHY, MAC (including CS) operations, including message exchanges for mobility support | — |
| IB | BS-to-BS messages | Transport protocol is not specified |
| A | Messages serving MS authentication and service authorization functions | Transport protocol is not specified |

***Insert the following annex:***

# Annex H

(informative)

## LDPC direct encoding

The LPDC code is flexible in that it can accommodate various code rates as well as packet sizes.

The encoding of a packet at the transmitter generates parity-check bits **p**=($p_0$, …, $p_{m-1}$) based on an information block **s**=($s_0$, …, $s_{k-1}$), and transmits the parity-check bits along with the information block. Because the current symbol set to be encoded and transmitted is contained in the transmitted codeword, the information block is also known as systematic bits. The encoder receives the information block **s**=($s_0$, …, $s_{k-1}$) and uses the matrix $\mathbf{H}_{\mathrm{bm}}$ to determine the parity-check bits. The expanded matrix **H** is determined from the model matrix $\mathbf{H}_{\mathrm{bm}}$. Since the expanded matrix **H** is a binary matrix, encoding of a packet can be performed with vector or matrix operations conducted over GF(2).

One method of encoding is to determine a generator matrix **G** from **H** such that $\mathbf{G}\ \mathbf{H}^{\mathrm{T}} = \mathbf{0}$. A $k$-bit information block $\mathbf{s}_{1\times k}$ can be encoded by the code generator matrix $\mathbf{G}_{k\times n}$ via the operation $\mathbf{x} = \mathbf{s}\ \mathbf{G}$ to become an $n$-bit codeword $\mathbf{x}_{1\times n}$, with codeword $\mathbf{x}$=[$\mathbf{s}\ \mathbf{p}$]=[$s_0, s_1, \ldots, s_{k-1}, p_0, p_1, \ldots, p_{m-1}$], where $p_0, \ldots p_{m-1}$ are the parity-check bits; and $s_0, \ldots s_{k-1}$ are the systematic bits.

Encoding an LDPC code from **G** can be quite complex. The LDPC codes are defined such that very low complexity encoding directly from **H** is possible.

The following informative subsection shows two such methods.

## H.1 Method 1a

Encoding is the process of determining the parity sequence **p** given an information sequence **s.** To encode, the information block **s** is divided into $k_b = n_b - m_b$ groups of z bits. Let this grouped **s** be denoted **u**,

$$u = \left[u(0)\ u(1)\ \ldots\ u(k_b - 1)\right],$$

where each element of **u** is a column vector as follows

$$u(i) = \left[S_{iz}\ S_{iz+1}\ \ldots\ S_{(i+1)z-1}\right]^T$$

Using the model matrix $\mathbf{H}_{\mathrm{bm}}$, the parity sequence **p** is determined in groups of z. Let the grouped parity sequence **p** be denoted **v**,

$$v = \left[v(0)\ v(1)\ \ldots\ v(m_b - 1)\right],$$

where each element of **v** is a column vector as follows

$$v(i) = \left[p_{iz}\; p_{iz+1}\; \cdots\; p_{(i+1)z-1}\right]^T$$

Encoding proceeds in two steps, (1) initialization, which determines **v**(0), and (b) recursion, which determines **v**(*i*+1) from **v**(i), $0 \le i \le m_b - 2$.

An expression for **v**(0) can be derived by summing over the rows of $\mathbf{H}_{\mathrm{bm}}$ to obtain

$$P_{p(x,\,k_b)}v(0) = \sum_{j=0}^{k_b-1}\sum_{i=0}^{m_b-1} P_{p(i,j)}u(j) \tag{H.1}$$

where *x*, $1 \le x \le m_b - 2$, is the row index of $\mathbf{h}_{\mathrm{bm}}$ where the entry is nonnegative and unpaired, and $\mathbf{P}_{\mathrm{i}}$ represents the *z*x*z* identity matrix circularly right shifted by size *i*.

Equation (H.2) is solved for ***v***(0) by multiplying by $P^{-1}{}_{p(x,\,k_b)}$, and $P^{-1}{}_{p(x,\,k_b)} = P_{z-p(x,k_b)}$ since $p(x,k_b)$ represents a circular shift.

Considering the structure of $\mathbf{H'}_{\mathrm{b2}}$ ,the recursion can be derived as follows,

$$v(1) = \sum_{j=0}^{k_b-1} P_{p(i,j)}u(j) + P_{p(i,\,k_b)})v(0),\; i = 0, \tag{H.2}$$

$$v(i+1) = v(i) + \sum_{j=0}^{k_b-1} P_{p(i,j)}u(j) + P_{p(i,\,k_b)}v(0),\; i = 1, \ldots, m_b - 2 \tag{H.3}$$

where

$$P_{-1} \equiv 0_{z \times z}$$

Thus all parity bits not in v(0) are determined by evaluation Equation (H.3) for $0 \le i \le m_b - 2$. Equation (H.1), Equation (H.2), and Equation (H.3) completely describe the encoding algorithm. These equations also have a straightforward interpretation in terms of standard digital logic architectures. Since the non-zero elements *p*(*i*,*j*) of $\mathbf{H}_{\mathrm{bm}}$ represent circular shift sizes of a vector, all products of the form $\mathbf{P}_{p(i,j)}\boldsymbol{u(j)}$ can be implemented by a size-z barrel shifter.

## H.2 Method 1b

Equivalently, Method 1 can be implemented in a parallel fashion where almost all parity check parity bits are generated simultaneously. The initialization and the recursion steps of Method 1 become

1) Initialization. The parity check bit vector *v*(0) are computed by

$$P_{p(x,\,k_b)}v(0) = \sum_{j=0}^{k_b-1}\left(\sum_{q=0}^{m_b-1} P_{p(q,j)}\right)u(j) \tag{H.4}$$

2) Parallel computation. The parity check bit vectors $v(1) \sim v(m_b - 1)$ are concurrently computed by

$$v(i) = \sum_{j=0}^{k_b-1}\left(\sum_{q=i}^{m_b-1} P_{p(q,j)}\right)u(j) + \sum_{q=i}^{m_b-1} P_{p(q,k_b)}v(0)\ i\ = 1, \ldots, m_b - 1 \tag{H.5}$$

The parallel encoding method may significantly reduced the latency at the expense of extra storage for the sum:

$$\left(\sum_{q=i}^{m_b-1} P_{p(q,j)}\right)$$

## H.3 Method 2

For efficient encoding of LDPC, **H** are divided into the form

$$H = \begin{bmatrix} A & B & T \\ C & D & E \end{bmatrix} \tag{H.6}$$

where $A$ is $(m-z)\times k\alpha$, $B$ is $(m-z)\times z$, T is $(m-z)\times(m-z)$, C is $z\times k$, D is $z\times z$, and finally $E$ is $z\times(m-z)$. $\begin{pmatrix} B \\ D \end{pmatrix}$ and **D** correspond to the expanded $\mathbf{h}_b$ and $\mathbf{h}_b(m_b\text{-}1)$, respectively.

Let $v = (u, p_1, p_2)$ where u denotes the systematic part, $\boldsymbol{p_1}$ and $\boldsymbol{p_2}$ combined denote the parity part, $\boldsymbol{p_1}$ has length **z**, and $\boldsymbol{p_2}$ has length $(m-z)$. The definition equation $(H \cdot v^t) = 0$ splits into two equations, as in Equation (H.8) and Equation (H.9).

$$Au^T + Bp_1^T + Tp_2^T = 0 \tag{H.7}$$

and

$$(ET^{-1}A + C)u^T + (ET^{-1}B + D)p_1^T = 0 \tag{H.8}$$

Define $\phi := (ET^{-1}B + D)$ and with the parity check matrix as indicated $\phi = I$. Then from Equation (H.8), it can be concluded that

$$P_1^T = (ET^{-1}A + C)u^T \tag{H.9}$$

and

$$P_2^T = T^{-1}(Au^T + Bp_1^T) \tag{H.10}$$

As a result, the encoding procedures and the corresponding operations can be summarized below and illustrated in Figure H.1.

## H.4 Encoding procedure

**Step 1)** Compute $Au^T$ and $Cu^T$.

**Step 2)** Compute $ET^{-1}(Au^T)$.

**Step 3)** Compute $p_1^T$ by $p_1^T = ET^{-1}(Au^T) + Cu^T$

**Step 4)** Compute $p_2^T$ by $Tp_2^T = Au^T + Bp_1^T$

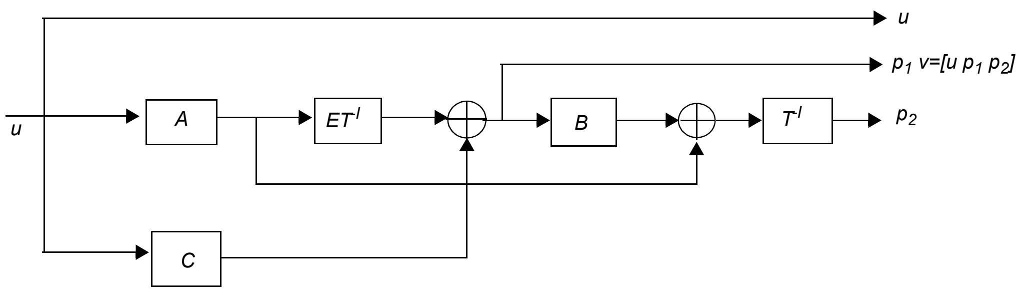


Figure H.1—Block diagram of the encoder architecture for the block LDPC code