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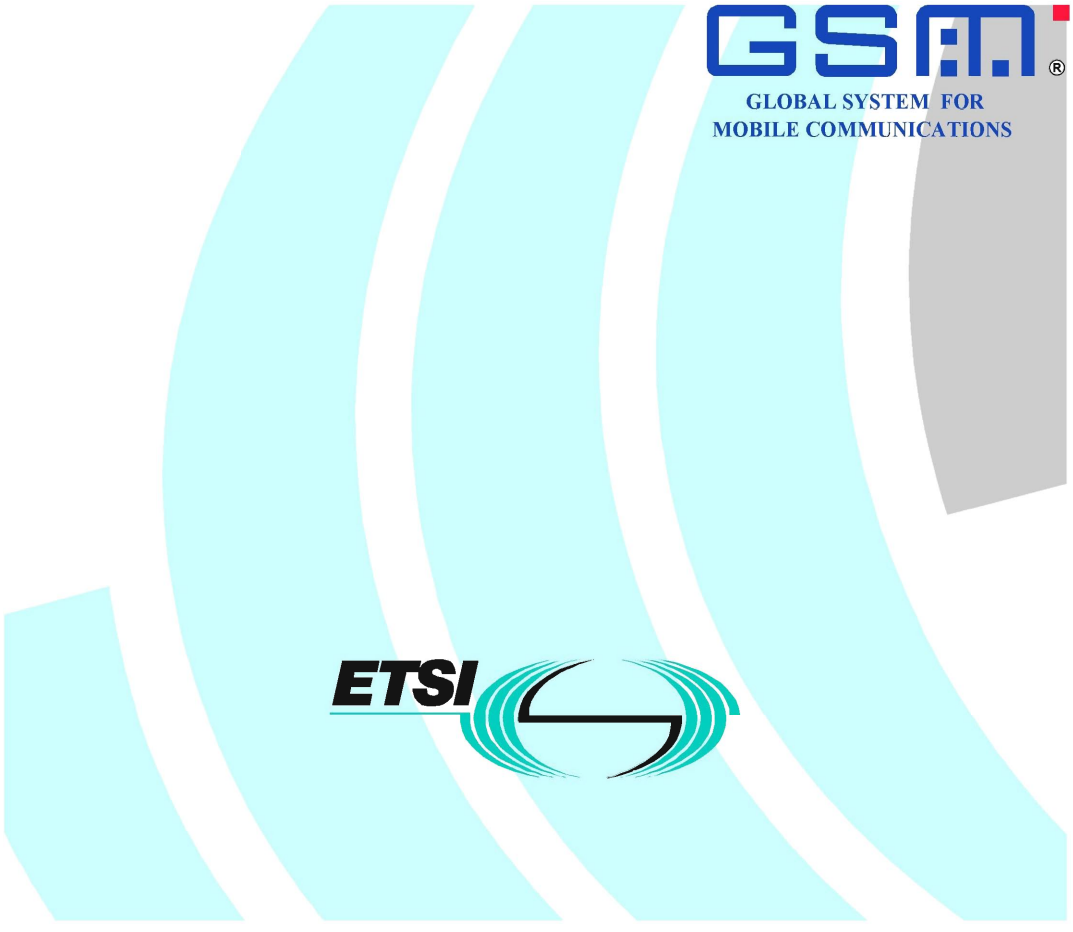
Technical Specification

Digital cellular telecommunications system (Phase 2+);
Mobile radio interface layer 3 specification
(GSM 04.08 version 6.1.1 Release 1997)



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Contents

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Foreword

This ETSI Technical Specification has been produced by Special Mobile Group (SMG) of the European Telecommunications Standards Institute (ETSI).

This TS specifies the procedures used at the radio interface (Reference Point Um, see GSM 04.02) for Call Control (CC), Mobility Management (MM) and Radio Resource (RR) management within the European digital cellular telecommunications system.

The contents of this TS are subject to continuing work within SMG and may change following formal SMG approval. Should SMG modify the contents of this TS it will then be republished by ETSI with an identifying change of release date and an increase in version number as follows:

Version 6.x.y

where:

6 GSM Phase 2+ Release 1997

y the third digit is incremented when editorial only changes have been incorporated in the specification;

x the second digit is incremented for all other types of changes, i.e. technical enhancements, corrections, updates, etc.

The specification from which this TS has been derived was originally based on CEPT documentation, hence the presentation of this TS is not in accordance with the ETSI drafting rules.

Introduction

The present document includes references to features which are not part of the Phase 2+ Release 96 of the GSM Technical specifications. All subclauses which were changed as a result of these features contain a marker (see table below) relevant to the particular feature.

The following table lists all features that were introduced after Release 96.

Feature	Designator
BA Range IE handling	$(impr-BA-range-handling)$
Advanced Speech Call Item	$(ASCI)$
Call Completion Busy Subscriber	$(CCBS)$
Mobile Assisted Frequency Allocation	$(MAFA)$
Network Indication of Alerting in MS	(NIA)

0 Scope

This Technical Specification specifies the procedures used at the radio interface (Reference Point Um, see GSM 04.02) for Call Control (CC), Mobility Management (MM), Radio Resource (RR) management and Session Management (SM).

When the notations for "further study" or "FS" or "FFS" are present in this ETS they mean that the indicated text is not a normative portion of this standard.

These procedures are defined in terms of messages exchanged over the control channels of the radio interface. The control channels are described in GSM 04.03.

The structured functions and procedures of this protocol and the relationship with other layers and entities are described in general terms in GSM 04.07.

0.1 Scope of the Technical Specification

The procedures currently described in this TS are for the call control of circuit-switched connections, session management for GPRS services, mobility management and radio resource management for circuit-switched and GPRS services.

GSM 04.10 contains functional procedures for support of supplementary services.

GSM 04.11 contains functional procedures for support of point-to-point short message services.

GSM 04.12 contains functional description of short message - cell broadcast.

GSM 04.60 contains procedures for radio link control and medium access control (RLC/MAC) of packet data physical channels.

NOTE: "layer 3" includes the functions and protocols described in this Technical Specification. The terms "data link layer" and "layer 2" are used interchangeably to refer to the layer immediately below layer 3.

0.2 Application to the interface structures

The layer 3 procedures apply to the interface structures defined in GSM 04.03. They use the functions and services provided by layer 2 defined in GSM 04.05 and GSM 04.06. GSM 04.07 gives the general description of layer 3 including procedures, messages format and error handling.

0.3 Structure of layer 3 procedures

A building block method is used to describe the layer 3 procedures.

The basic building blocks are "elementary procedures" provided by the protocol control entities of the three sublayers, i.e. radio resource management, mobility management and connection management sublayer.

Complete layer 3 transactions consist of specific sequences of elementary procedures. The term "structured procedure" is used for these sequences.

0.4 Test procedures

Test procedures of the GSM radio interface signalling are described in GSM 11.10 and GSM 11.2x series.

0.5 Use of logical channels

The logical control channels are defined in GSM 05.02. In the following those control channels are considered which carry signalling information or specific types of user packet information:

i) Broadcast Control CHannel (BCCH): downlink only, used to broadcast Cell specific information;

ii) Synchronization CHannel (SCH): downlink only, used to broadcast synchronization and BSS identification information;

iii) Paging CHannel (PCH): downlink only, used to send page requests to Mobile Stations (MSs);

iv) Random Access CHannel (RACH): uplink only, used to request a Dedicated Control CHannel;

v) Access Grant CHannel (AGCH): downlink only, used to allocate a Dedicated Control CHannel;

vi) Standalone Dedicated Control CHannel (SDCCH): bi-directional;

vii)Fast Associated Control CHannel (FACCH): bi-directional, associated with a Traffic CHannel;

viii) Slow Associated Control CHannel (SACCH): bi-directional, associated with a SDCCH or a Traffic CHannel;

ix) Cell Broadcast CHannel (CBCH): downlink only used for general (not point to point) short message information.

x) Notification CHannel (NCH): downlink only, used to notify mobile stations of VBS (Voice Broadcast Service) calls or VGCS (Voice Group Call Service) calls.

Two service access points are defined on signalling layer 2 which are discriminated by their Service Access Point Identifiers (SAPI) (see GSM 04.06):

i) SAPI 0: supports the transfer of signalling information including user-user information;

ii) SAPI 3: supports the transfer of user short messages.

Layer 3 selects the service access point, the logical control channel and the mode of operation of layer 2 (acknowledged, unacknowledged or random access, see GSM 04.05 and GSM 04.06) as required for each individual message.

0.6 Overview of control procedures

0.6.1 List of procedures

The following procedures are specified in this Technical Specification:

a) Clause 3 specifies elementary procedures for Radio Resource management:

- system information broadcasting (subclause 3.2.2)
- RR connection establishment (subclause 3.3)
  - entering the dedicated mode : immediate assignment procedure (subclause 3.3.1.1)
  - paging procedure for RR connection establishment (subclause 3.3.2)
  - notification procedure (subclause 3.3.3)
- Procedures in dedicated mode and in group transmit mode (subclause 3.4)
  - measurement report procedure (subclause 3.4.1.2)
  - intracell change of channels (subclause 3.4.3)
  - intercell change of channels (subclause 3.4.4)
  - frequency redefinition procedure (subclause 3.4.5)
  - channel mode change procedure (subclause 3.4.6)
  - ciphering mode setting procedure (subclause 3.4.7)

    - additional channel assignment procedure (subclause 3.4.8)
    - partial channel release procedure (subclause 3.4.9)
  - radio resources connection release (subclause 3.4.13)
  - specific RR procedures for voice broadcast channels and voice group call channels (subclause 3.4.15)
  - RR procedures on CCCH related to temporary block flow establishment (subclause 3.5)
    - packet paging procedure using CCCH (subclause 3.5.1)
    - packet access procedure using CCCH (subclause 3.5.2)
  - packet downlink assignment procedure using CCCH (subclause 3.5.3)
  - RR procedures on DCCH related to temporary block flow establishment
    - Assignment to Packet Data Channel procedure (subclause 3.4.19)
    - Network commanded cell reselection (subclause 3.4.20)

b) Clause 4 specifies elementary procedures for Mobility Management

  - mobility management common procedures (subclause 4.3)
    - TMSI reallocation procedure (subclause 4.3.1)
    - authentication procedure (subclause 4.3.2)
    - identification procedure (subclause 4.3.3)
    - IMSI detach procedure (subclause 4.3.4)
    - abort procedure (subclause 4.3.5)
    - MM information procedure (subclause 4.3.6)
  - mobility management specific procedures (subclause 4.4)
    - location updating procedure (subclause 4.4.1)
    - periodic updating (subclause 4.4.2)
    - IMSI attach procedure (subclause 4.4.3)
    - generic location updating procedure (subclause 4.4)
  - connection management sublayer service provision
    - mobility management connection establishment (subclause 4.5.1)
    - mobility management connection information transfer phase (subclause 4.5.2)
    - mobility management connection release (subclause 4.5.3)
  - GPRS specific mobility management procedures (subclause 4.7)
    - GPRS attach procedure (subclause 4.7.3)
    - GPRS detach procedure (subclause 4.7.4)
    - GPRS routing area updating procedure (subclause 4.7.5)
  - GPRS common mobility management procedures (subclause 4.7)
    - GPRS P-TMSI reallocation procedure (subclause 4.7.6)

- GPRS authentication and ciphering procedure (subclause 4.7.7)
- GPRS identification procedure (subclause 4.7.8)
- GPRS information procedure (subclause 4.7.12)

c) Clause 5 specifies elementary procedures for circuit switched Call Control comprising the following elementary procedures:

- mobile originating call establishment (subclause 5.2.1)
- mobile terminating call establishment (subclause 5.2.2)
- signalling procedures during the active state (subclause 5.3)
  - user notification procedure (subclause 5.3.1)
  - call rearrangements (subclause 5.3.2)
  - DTMF protocol control procedure (subclause 5.5.7)
  - in-call modification (subclause 5.3.4)
- call clearing initiated by the mobile station (subclause 5.4.3)
- call clearing initiated by the network (subclause 5.4.4)
- miscellaneous procedures
  - in-band tones and announcements (subclause 5.5.1)
  - status enquiry procedure (subclause 5.5.3)
  - call re-establishment procedure (subclause 5.5.4)

d) Clause 6 specifies elementary procedures for session management

- GPRS session management procedures (subclause 6.1)
  - PDP context activation (subclause 6.1.1)
  - PDP context modification (subclause 6.1.2)
  - PDP context deactivation (subclause 6.1.3)
  - anonymous PDP context activation (subclause 6.1.4)
  - anonymous PDP context deactivation (subclause 6.1.5)

The elementary procedures can be combined to form structured procedures. Examples of such structured procedures are given in clause 7. This part of the Technical Specification is only provided for guidance to assist implementations.

Clause 8 specifies actions to be taken on various error conditions and also provides rules to ensure compatibility with future enhancements of the protocol.

0.7 Applicability of implementations

The applicability of procedures of this technical specification for the mobile station is dependent on the services and functions which are to be supported by a mobile station.

0.7.1 Voice Group Call Service (VGCS) and Voice Broadcast Service (VBS)

For mobile stations supporting the Voice Group Call Service or the Voice Broadcast Service, it is explicitly mentioned throughout this technical specification if a certain procedure is applicable only for such a service and, if necessary, how mobile stations not supporting such a service shall behave.

For VGCS and VBS, the following possible mobile station implementations exist:

- support of listening to voice broadcast calls (VBS listening)
- support of originating a voice broadcast call (VBS originating)
- support of listening to voice group calls (VGCS listening)
- support of talking in voice group calls (VGCS talking. This always includes the implementation for VGCS listening)
- support of originating a voice group call (VGCS originating. This always includes the implementation for VGCS talking)

Apart from the explicitly mentioned combinations, all possible combinations are optional and supported by this technical specification.

The related terms are used in this technical specification, if information on these implementation options is required.

0.7.2 General Packet Radio Service (GPRS)

For mobile stations supporting the General Packet Radio Service (GPRS), it is explicitly mentioned throughout the technical specification if a certain procedure is applicable only for such a service and, if necessary, how mobile stations not supporting such a service shall behave.

A GPRS MS may operate in one of the following MS operation modes, see 03.60 [74]:

- MS operation mode A;
- MS operation mode B; or
- MS operation mode C.

The MS operation mode depends on the services that the MS is attached to, i.e., only GPRS or both GPRS and non-GPRS services, and upon the MS's capabilities to operate GPRS and other GSM services simultaneously. Mobile stations that are capable to operate GPRS services are referred to as GPRS MSs.

NOTE: Other GSM technical specifications may refer to the MS operation modes A, B, and C as GPRS class-A MS, GPRS class-B MS, and GPRS class-C MS.

It should be noted that it is possible that for a GPRS MS, the GMM procedures currently described in the ETS do not support combinations of VGCS, VBS and GPRS. The possible interactions are not studied yet.

1 Normative references

References may be made to:

a) specific versions of publications (identified by date of publication, edition number, version number, etc.), in which case, subsequent revisions to the referenced document do not apply; or

b) all versions up to and including the identified version (identified by "up to and including" before the version identity); or

c) all versions subsequent to and including the identified version (identified by "onwards" following the version identity); or

d) publications without mention of a specific version, in which case the latest version applies.

A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

[1] GSM 01.02: "Digital cellular telecommunications system (Phase 2+); General description of a GSM Public Land Mobile Network (PLMN)".

[2] GSM 01.04: "Digital cellular telecommunications system (Phase 2+); Abbreviations and acronyms".

[3] GSM 02.02: "Digital cellular telecommunications system (Phase 2+); Bearer Services (BS) supported by a GSM Public Land Mobile Network (PLMN)".

[4] GSM 02.03: "Digital cellular telecommunications system (Phase 2+); Teleservices supported by a GSM Public Land Mobile Network (PLMN)".

[5] GSM 02.09: "Digital cellular telecommunications system (Phase 2+); Security aspects".

[6] GSM 02.11: "Digital cellular telecommunications system (Phase 2+); Service accessibility".

[7] GSM 02.17: "Digital cellular telecommunications system (Phase 2+); Subscriber identity modules Functional characteristics".

[8] GSM 02.40: "Digital cellular telecommunications system (Phase 2+); Procedures for call progress indications".

[9] GSM 03.01: "Digital cellular telecommunications system (Phase 2+); Network functions".

[10] GSM 03.03: "Digital cellular telecommunications system (Phase 2+); Numbering, addressing and identification".

[11] GSM 03.13: "Digital cellular telecommunications system (Phase 2+); Discontinuous Reception (DRX) in the GSM system".

[12] GSM 03.14: "Digital cellular telecommunications system (Phase 2+); Support of Dual Tone Multi-Frequency signalling (DTMF) via the GSM system".

[13] GSM 03.20: "Digital cellular telecommunications system (Phase 2+); Security related network functions".

[14] GSM 03.22: "Digital cellular telecommunications system (Phase 2+); Functions related to Mobile Station (MS) in idle mode".

[15] GSM 04.02: "Digital cellular telecommunications system (Phase 2+); GSM Public Land Mobile Network (PLMN) access reference configuration".

[16] GSM 04.03: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface Channel structures and access capabilities".

[17] GSM 04.04: "Digital cellular telecommunications system (Phase 2+); layer 1 General requirements".

[18] GSM 04.05: "Digital cellular telecommunications system (Phase 2+); Data Link (DL) layer General aspects".

[19] GSM 04.06: "Digital cellular telecommunications system (Phase 2+); Mobile Station - Base Station System (MS - BSS) interface Data Link (DL) layer specification".

[20] GSM 04.07: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface signalling layer 3 General aspects".

[21] GSM 04.10: "Digital cellular telecommunications system ; Mobile radio interface layer 3 Supplementary services specification General aspects".

[22] GSM 04.11: "Digital cellular telecommunications system (Phase 2); Point-to-Point (PP) Short Message Service (SMS) support on mobile radio interface".

[23] GSM 04.12: "Digital cellular telecommunications system (Phase 2+); Short Message Service Cell Broadcast (SMSCB) support on the mobile radio interface".

[24] GSM 04.80: "Digital cellular telecommunications system (Phase 2+); Mobile radio interface layer 3 supplementary services specification Formats and coding".

[25] GSM 04.81: "Digital cellular telecommunications system (Phase 2+); Line identification supplementary services - Stage 3".

[26] GSM 04.82: "Digital cellular telecommunications system (Phase 2+); Call Forwarding (CF) supplementary services - Stage 3".

[27] GSM 04.83: "Digital cellular telecommunications system (Phase 2+); Call Waiting (CW) and Call Hold (HOLD) supplementary services - Stage 3".

[28] GSM 04.84: "Digital cellular telecommunications system (Phase 2+); MultiParty (MPTY) supplementary services - Stage 3".

[29] GSM 04.85: "Digital cellular telecommunications system (Phase 2+); Closed User Group (CUG) supplementary services - Stage 3".

[30] GSM 04.86: "Digital cellular telecommunications system (Phase 2+); Advice of Charge (AoC) supplementary services - Stage 3".

[31] GSM 04.88: "Digital cellular telecommunications system (Phase 2+); Call Barring (CB) supplementary services - Stage 3".

[32] GSM 05.02: "Digital cellular telecommunications system (Phase 2+); Multiplexing and multiple access on the radio path".

[33] GSM 05.05: "Digital cellular telecommunications system (Phase 2+); Radio transmission and reception".

[34] GSM 05.08: "Digital cellular telecommunications system (Phase 2+); Radio subsystem link control".

[35] GSM 05.10: "Digital cellular telecommunications system (Phase 2+); Radio subsystem synchronization".

[36] GSM 07.01: "Digital cellular telecommunications system (Phase 2+); General on Terminal Adaptation Functions (TAF) for Mobile Stations (MS)".

[37] GSM 09.02: "Digital cellular telecommunications system (Phase 2+); Mobile Application Part (MAP) specification".

[38] GSM 09.07: "Digital cellular telecommunications system (Phase 2+); General requirements on interworking between the Public Land Mobile Network (PLMN) and the Integrated Services Digital Network (ISDN) or Public Switched Telephone Network (PSTN)".

[39] GSM 11.10: "Digital cellular telecommunications system (Phase 2+); Mobile Station (MS) conformity specification".

[40] GSM 11.21: "Digital cellular telecommunications system (Phase 2); The GSM Base Station System (BSS) equipment specification".

[41] ISO/IEC 646 (1991): "Information technology - ISO 7-bit coded character set for information interchange".

[42] ISO/IEC 6429: "Information technology - Control functions for coded character sets".

[43] ISO 8348 (1987): "Information processing systems - Data communications - Network service definition".

[44] CCITT Recommendation E.163: "Numbering plan for the international telephone service".

[45] CCITT Recommendation E.164: "Numbering plan for the ISDN era".

[46] CCITT Recommendation E.212: "Identification plan for land mobile stations".

[47] ITU-T Recommendation F.69 (1993): "Plan for telex destination codes".

[48] CCITT Recommendation I.330: "ISDN numbering and addressing principles".

[49] CCITT Recommendation I.440 (1989): "ISDN user-network interface data link layer - General aspects".

[50] CCITT Recommendation I.450 (1989): "ISDN user-network interface layer 3 General aspects".

[51] ITU-T Recommendation I.500 (1993): "General structure of the ISDN interworking recommendations".

[52] CCITT Recommendation T.50: "International Alphabet No. 5".

[53] CCITT Recommendation Q.931: ISDN user-network interface layer 3 specification for basic control".

[54] CCITT Recommendation V.21: "300 bits per second duplex modem standardized for use in the general switched telephone network".

[55] CCITT Recommendation V.22: "1200 bits per second duplex modem standardized for use in the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[56] CCITT Recommendation V.22bis: "2400 bits per second duplex modem using the frequency division technique standardized for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[57] CCITT Recommendation V.23: "600/1200-baud modem standardized for use in the general switched telephone network".

[58] CCITT Recommendation V.26ter: "2400 bits per second duplex modem using the echo cancellation technique standardized for use on the general switched telephone network and on point-to-point 2-wire leased telephone-type circuits".

[59] CCITT Recommendation V.32: "A family of 2-wire, duplex modems operating at data signalling rates of up to 9600 bit/s for use on the general switched telephone network and on leased telephone-type circuits".

[60] CCITT Recommendation V.110: "Support of data terminal equipments (DTEs) with V-Series interfaces by an integrated services digital network".

[61] CCITT Recommendation V.120: "Support by an ISDN of data terminal equipment with V-Series type interfaces with provision for statistical multiplexing".

[62] CCITT Recommendation X.21: "Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for synchronous operation on public data networks".

[63] CCITT 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".

[64] CCITT Recommendation X.28: "DTE/DCE interface for a start-stop mode data terminal equipment accessing the packet assembly/disassembly facility (PAD) in a public data network situated in the same country".

[65] CCITT Recommendation X.30: "Support of X.21, X.21 bis and X.20 bis based data terminal equipments (DTEs) by an integrated services digital network (ISDN)".

[66] CCITT Recommendation X.31: "Support of packet mode terminal equipment by an ISDN".

[67] CCITT Recommendation X.32: "Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and accessing a packet switched public data network through a public switched telephone network or an integrated services digital network or a circuit switched public data network".

[68] CCITT Recommendation X.75 (1988): "Packet-switched signalling system between public networks providing data transmission services".

[69] CCITT Recommendation X.121: "International numbering plan for public data networks".

[70] ETS 300 102-1: "Integrated Services Digital Network (ISDN); User-network interface layer 3 Specifications for basic call control".

[71] ETS 300 102-2: "Integrated Services Digital Network (ISDN); User-network interface layer 3 Specifications for basic call control".

[72] ISO/IEC10646: “Universal Multiple-Octet Coded Character Set (UCS)”; UCS2, 16 bit coding.

[73] GSM 02.60: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Service Description; Stage 1".

[74] GSM 03.60: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Service Description; Stage 2".

[75] GSM 03.64: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Overall description of the GPRS radio interface; Stage 2".

[76] GSM 04.60: "Digital cellular telecommunications system (Phase 2+); General Packet Radio Service (GPRS); Mobile Station - Base Station System (MS-BSS) interface; Radio Link Control and Medium Access Control (RLC/MAC) layer specification".

[77] IETF RFC 1034: "Domain names - Concepts and Facilities " (STD 7).

2 Definitions and abbreviations

Abbreviations used in this specification are listed in GSM 01.04

2.1 Random values

In a number of places in this Technical Specification, it is mentioned that some value must take a "random" value, in a given range, or more generally with some statistical distribution. Such cases interest only the Mobile Station.

It is required that there is a low probability that two MSs in the same conditions (including the case of two MSs of the same type from the same manufacturer) will choose the same value. Moreover, it is required that, if it happens that two MSs in similar conditions choose the same value, the probability of their choices being identical at the next occasion is the same as if their first choices had been different.

The meaning of such a specification is that any statistical test for these values, done on a series of similar events, will obtain a result statistically compatible with the specified distribution. This shall hold even in the cases where the tests are conducted with a subset of possible events, with some common parameters. Moreover, basic tests of independence of the values within the series shall pass.

Data against which correlation with the values shall not be found are the protocol state, or the IMSI, or identities or other unrelated information broadcast by the network, or the current TDMA frame number.

2.2 Vocabulary

The following terms are used in this Technical Specification:

- **idle mode:** In this mode, the mobile station is not allocated any dedicated channel; it listens to the CCCH and the BCCH;
- **group receive mode:** (only applicable for mobile stations supporting VGCS listening or VBS listening) In this mode, the mobile station is not allocated a dedicated channel with the network; it listens to the downlink of a voice broadcast channel or voice group call channel allocated to the cell. Occasionally, the mobile station has to listen to the BCCH of the serving cell as defined in GSM 03.22 and 05.08;
- **dedicated mode:** In this mode, the mobile station is allocated at least two dedicated channels, only one of them being a SACCH;
- **group transmit mode:** (only applicable for mobile stations supporting VGCS talking) In this mode, one mobile station of a voice group call is allocated two dedicated channels, one of them being a SACCH. These channels can be allocated to one mobile station at a time but to different mobile stations during the voice group call;
- **packet idle mode**: (only applicable for mobile stations supporting GPRS) In this mode, mobile station is not allocated any radio resource on a packet data physical channel; it listens to the PBCCH and PCCCH or, if those are not provided by the network, to the BCCH and the CCCH, see GSM 04.60.
- **packet transfer mode**: (only applicable for mobile stations supporting GPRS) In this mode, the mobile station is allocated radio resource on one or more packet data physical channels for the transfer of LLC PDUs.
- **main DCCH:** In Dedicated mode and group transmit mode, only two channels are used as DCCH, one being a SACCH, the other being a SDCCH or a FACCH; the SDCCH or FACCH is called here "the main DCCH";
- A channel is **activated** if it can be used for transmission, in particular for signalling, at least with UI frames. On the SACCH, whenever activated, it must be ensured that a contiguous stream of layer 2 frames is sent;
- A TCH is **connected** if circuit mode user data can be transferred. A TCH cannot be connected if it is not activated. A TCH which is activated but not connected is used only for signalling, i.e. as a DCCH;
- The data link of SAPI 0 on the main DCCH is called the **main signalling link**. Any message specified to be sent on the main signalling link is sent in acknowledged mode except when otherwise specified;
- The term **"to establish"** a link is a short form for **"to establish the multiframe mode"** on that data link. It is possible to send UI frames on a data link even if it is not established as soon as the corresponding channel is activated. Except when otherwise indicated, a data link layer establishment is done without an information field.
- **"channel set"** is used to identify TCHs that carry related user information flows, e.g., in a multislot configuration used to support circuit switched connection(s), which therefore need to be handled together.
- A **temporary block flow** (TBF) is a physical connection used by the two RR peer entities to support the uni-directional transfer of LLC PDUs on packet data physical channels, see GSM 04.60.
- **RLC/MAC block:** A RLC/MAC block is the protocol data unit exchanged between RLC/MAC entities, see GSM 04.60.
- A **GMM context** is established when a GPRS attach procedure is successfully completed.

-- **Network operation mode**

The three different network operation modes I, II, and III are defined in GSM 03.60 [74].

The network operation mode shall be indicated as system information. For proper operation, the network operation mode should be the same in each cell of one routing area.

-- **GPRS MS operation mode**

The three different GPRS MS operation modes A, B, and C are defined in GSM 03.60 [74].

- **Anonymous access** refers to limited service provisioning to an MS whose identity is unknown in the network.

3 Radio Resource management procedures

3.1 Overview/General

3.1.1 General

Radio Resource management procedures include the functions related to the management of the common transmission resources, e.g. the physical channels and the data link connections on control channels.

The general purpose of Radio Resource procedures is to establish, maintain and release RR connections that allow a point-to-point dialogue between the network and a mobile station. This includes the cell selection/reselection and the handover procedures. Moreover, Radio Resource management procedures include the reception of the uni-directional BCCH and CCCH when no RR connection is established. This permits automatic cell selection/reselection.

If VGCS listening or VBS listening are supported, the radio resource management also includes the functions for the reception of the voice group call channel or the voice broadcast channel, respectively, and the automatic cell reselection of the mobile station in Group receive mode.

If VGCS talking is supported, the radio resource management also includes the functions for the seizure and release of the voice group call channel.

If GPRS point-to-point services are supported, the radio resource management procedures also support functions related to the management of transmission resources on packet data physical channels and the broadcast of system information to support a mobile station in packet idle mode, see also GSM 04.60.

NOTE 1: This chapter includes some procedures used for multislot operation and for the TCH/H + TCH/H configuration which need not be supported by simple mobile stations.

NOTE 2: The procedures and the information content relating to the TCH/H + TCH/H configuration in RR messages is for further study.

3.1.2 Services provided to upper layers

A RR connection is a physical connection used by the two peer entities to support the upper layers' exchange of information flows.

3.1.2.1 Idle mode

In idle mode no RR connection exists.

The RR procedures include (on the mobile station side) those for automatic cell selection/reselection. The RR entity indicates to upper layers the unavailability of a BCCH/CCCH and the cell change when decided by the RR entity. Upper layers are advised of the BCCH broadcast information when a new cell has been selected, or when a relevant part of this information changes.

In Idle mode, upper layers can require the establishment of an RR connection.

3.1.2.2 Dedicated mode

In dedicated mode, the RR connection is a physical point-to-point bi-directional connection, and includes a SAPI 0 data link connection operating in multiframe mode on the main DCCH. If dedicated mode is established, RR procedures provide the following services:

- establishment/release of multiframe mode on data link layer connections other than SAPI 0, on the main DCCH or on the SACCH associated with the channel carrying the main signalling link;
- transfer of messages on any data link layer connection;
- indication of temporary unavailability of transmission (suspension, resuming);

- indication of loss of RR connection;
- automatic cell reselection and handover to maintain the RR connection;
- setting/change of the transmission mode on the physical channels, including change of type of channel, change of the coding/decoding/transcoding mode and setting of ciphering;
- allocation/release of an additional channel (for the TCH/H + TCH/H configuration);
- allocation/release of additional channels for multislot operation;
- release of an RR connection.

3.1.2.3 Group receive mode

Only applicable for mobile stations supporting VGCS listening or VBS listening.

In this mode, the RR procedures on the mobile station side provide the services:

- local connection to the voice broadcast channel or voice group call channel;
- reception of messages in unacknowledged mode;
- automatic cell reselection for the mobile station in Group receive mode;
- local disconnection from the received voice group call or broadcast call channels.

For mobile stations supporting both VGCS listening and VGCS transmit, in addition, the RR procedures on the mobile station side provide the service

- uplink access procedures to establish the RR connection.

3.1.2.4 Group transmit mode

Only applicable for mobile stations supporting VGCS talking.

In group transmit mode, the RR connection is a physical point-to-point bi-directional connection, and includes a SAPI 0 data link connection operating in multiframe mode on the main DCCH. If the group transmit mode is established, RR procedures provide the following services:

- transfer of messages on the SAPI 0 of the data link layer connection;
- indication of loss of RR connection;
- automatic cell reselection and handover to maintain the RR connection;
- setting of the transmission mode on the physical channels, change of type of channel and setting of ciphering;
- release of the RR connection..

3.1.2.5 Packet idle mode

Only applicable for mobile stations supporting GPRS.

In packet idle mode no temporary block flow exist.

Cell reselection in packet idle mode is specified in GSM 05.08. The RR sublayer (on the mobile station side) shall indicate to the upper layers the availability of a cell and of the cell change when decided by the RR sublayer. Upper layers are advised of system information broadcast in the cell when a new cell has been selected, and when a relevant part of this information changes.

In packet idle mode, upper layers can require the transfer of a LLC PDU which, implicitly, may trigger the establishment of a temporary block flow.

3.1.2.6 Packet transfer mode

Only applicable for mobile stations supporting GPRS.

In packet transfer mode, the mobile station is allocated radio resource providing a temporary block flow on one or more packet data physical channels. The RR sublayer provides the following services, see also GSM 04.60:

- transfer of LLC PDUs in acknowledged mode;
- transfer of LLC PDUs in unacknowledged mode;

Cell reselection in packet transfer mode is specified in GSM 05.08. When a new cell has been selected, the mobile station leaves the packet transfer mode, enters the packet idle mode where it switches to the new cell, read the system information and may then resume to packet transfer mode in the new cell.

3.1.3 Services required from data link and physical layers

The RR sublayer uses the services provided by the data link layer as defined in GSM 04.05.

Moreover, the RR sublayer directly uses services provided by the physical layer such as BCCH searching and transfer of RLC/MAC blocks, as defined in GSM 04.04.

3.1.4 Change of dedicated channels

3.1.4.1 Change of dedicated channels using SAPI = 0

In case a change of dedicated channels is required using a dedicated assignment and handover procedure, respectively, the RR sublayer will request the data link layer to suspend multiple frame operation before the mobile station leaves the old channel. When the channel change has been completed, layer 3 will request the data link layer to resume multiple frame operation again. The layer 2 suspend/resume procedures are described in GSM 04.05 and 04.06.

These procedures are specified in such a way that a loss of a layer 3 message cannot occur on the radio interface. However, messages sent from the mobile station to the network may be duplicated by the data link layer if a message has been transmitted but not yet completely acknowledged before the mobile station leaves the old channel (see GSM 04.06).

As the RR sublayer is controlling the channel change, a duplication of RR messages does not occur. However, there are some procedures for which a duplication is possible, e.g. DTMF procedures. For all upper layer procedures using the transport service of the RR sub-layer (e.g., MM and CM procedures), the request messages sent by the mobile station contain a sequence number in order to allow the network to detect duplicated messages, which are then ignored by the network. The procedures for sequenced transmission on layer 3 are described in subclause 3.1.4.2.

3.1.4.2 Change of dedicated channels using other SAPIs than 0

For SAPIs other than 0, the data link procedures described in GSM 04.06 do not provide any guarantee against message loss or duplication.

Therefore, if an application uses a SAPI other than 0 and if this application is sensitive to message loss or duplication, then it has to define its own protection mechanism. No general protection mechanism is provided by the protocol defined in this Technical Specification.

3.1.4.3 Sequenced message transfer operation

Upper layer messages sent using the RR sub-layer transport service from the mobile station to the network can be duplicated by the data link layer in the following case:

- a channel change of dedicated channels is required (assignment or handover procedure) and the last layer 2 frame has not been acknowledged by the peer data link layer before the mobile station leaves the old channel.

In this case, the mobile station does not know whether the network has received the message correctly. Therefore, the mobile station has to send the message again after the new dedicated channel is established (see GSM 04.06).

The network must be able to detect the duplicated received message. Therefore, each concerned upper layer message must be marked with a send sequence number.

To allow for different termination points in the infrastructure of the messages of different PDs, the sequence numbering is specific to each PD. For historical reasons, an exception is that messages sent with the CC, SS and MM PDs share the same sequence numbering. In the following, the phrase **upper layer message flow** refers to a flow of messages sharing the same sequence numbering. The different upper layer flows are MM+CC+SS, GCC, BCC, PDSS1 and PDSS2.

3.1.4.3.1 Variables and sequence numbers

3.1.4.3.1.1 Send state variable V(SD)

The RR sublayer of the mobile station shall have one associated send state variable V(SD) ("Send Duplicated") for each upper layer message flow. The send state variable denotes the sequence number of the next in sequence numbered message in the flow to be transmitted. The value of the corresponding send state variable shall be incremented by one with each numbered message transmission. Arithmetic operations on V(SD) are performed modulo 2.

3.1.4.3.1.2 Send sequence number N(SD)

At the time when such a message to be numbered is designated for transmission, the value of N(SD) for the message to be transferred is set equal to the value of the send state variable V(SD). See GSM 04.07.

3.1.4.3.2 Procedures for the initiation, transfer execution and termination of the sequenced message transfer operation

3.1.4.3.2.1 Initiation

The sequenced message transfer operation is initiated by establishing a RR connection. The send state variables V(SD) are set to 0.

3.1.4.3.2.2 Transfer Execution

The network must compare the send sequence numbers of pairs of subsequent messages in the same upper layer messages flow. In case the send sequence numbers of two subsequent messages in a flow are not identical, no duplication has occurred. In case the send sequence numbers are identical, the network must ignore the second one of the received messages.

3.1.4.3.2.3 Termination

The sequenced message transfer operation is terminated by the RR connection release procedure.

3.1.5 Procedure for Service Request and Contention Resolution

Upon seizure of the assigned dedicated channel, the mobile station establishes the main signalling link on this channel by sending a layer 2 SABM frame containing a layer 3 service request message. The data link layer will store this message to perform the contention resolution. The service request message will be returned by the network in the UA frame.

The data link layer in the mobile station compares the content of the information field (i.e. the layer 3 service request message) received in the UA frame with the stored message and leaves the channel in case they do not match. This procedure resolves contentions in the case where several mobile stations have accessed at the same random access slot and with the same random reference and one has succeeded due to capture. The full description of the procedure is given in GSM 04.06.

The purpose of the service request message is to indicate to the network which service the mobile station is requesting. This then allows the network to decide how to proceed (e.g. to authenticate or not).

The service request message must contain the identity of the mobile station and may include further information which can be sent without encryption.

The layer 3 service request message is typically one of the following:

- CM SERVICE REQUEST
- LOCATION UPDATING REQUEST
- IMSI DETACH
- PAGING RESPONSE
- CM RE-ESTABLISHMENT REQUEST
- NOTIFICATION RESPONSE
- IMMEDIATE SETUP
- RR INITIALISATION REQUEST

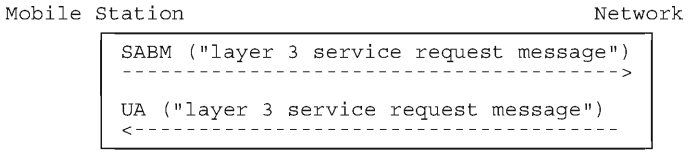


Figure 3.1/GSM 04.08 Service request and contention resolution

3.2 Idle mode and packet idle mode procedures

3.2.1 Mobile Station side

In idle mode, the MS listens to the BCCH and to the paging sub-channel for the paging group the MS belongs to in idle mode (cf. GSM 03.13); it measures the radio propagation for connection with other cells.

In packet idle mode (only applicable to mobile station supporting GPRS), and if PCCCH is present in the cell, the mobile station listens to the PBCCH and to the paging sub-channels corresponding to that. If PCCCH is not present in the cell, the mobile station listens to the BCCH and to the paging sub-channels corresponding to that. Paging sub-channels are monitored according to the paging groups determined for the mobile station in packet idle mode and its current DRX mode. The determination of paging groups for the mobile station is defined in GSM 05.02. The requirements for discontinuous reception (DRX) are defined in GSM 04.60 and in GSM 05.02. Moreover, the mobile station measures the radio propagation for connection with other cells.

Measurements are treated to assess the need of a cell change as specified in GSM 05.08. When the decision to change cells is made, the mobile station switches to the BCCH of the new cell. The broadcast information is then checked to verify the allowance to camp on this cell (cf. section 3.2.2). Dependent on the mobile station type and configuration, the mobile station may be required to try to read further BCCH and PBCCH information. If allowed, the cell change is confirmed, and the broadcast information is then treated for Mobility Management actions (cf. section 4). Similarly, physical contexts are updated (list of neighbouring cells frequencies, thresholds for some actions, etc. (cf. GSM 05.08 and section 3.2.2)).

3.2.1.1 Mobile station supporting GPRS

Only applicable to mobile stations supporting GPRS.

When the mobile station in packet idle mode switches to the BCCH of a new cell, the mobile station shall read SYSTEM INFORMATION TYPE 3, 4, 7 or 8 (SI 3, SI 4, SI 7 or SI 8). If the cell does not support GPRS, the mobile station is not allowed to do packet access in the cell. If GPRS is supported, the mobile station shall read SYSTEM INFORMATION TYPE 13 (SI 13) message.

As an option, if the mobile station receives SI 13 message in the cell without first having read SI 3, SI 4, SI 7 or SI 8 message, it may assume that GPRS is supported in the cell.

SI 13 message may indicate that PCCCH is present in the cell. Procedures in packet idle mode if PCCCH is present in the cell are further specified in GSM 04.60.

If PCCCH is not present in the cell, the mobile station in packet idle mode shall read optional SYSTEM INFORMATION TYPE 14 (SI 14) messages and optional SYSTEM INFORMATION TYPE 15 (SI 15) messages, if those are present in the cell. It shall continue to read SI 13 message repeatedly according to the requirements of GSM 05.08.

If the mobile station receives a MA_CHANGE_MARK and/or IM_CHANGE_MARK value that does not match the *change mark* value last received with the corresponding set of SI 14 or SI 15 messages, the mobile station shall delete the corresponding set of information. The mobile station shall then read the corresponding SI 14 or SI 15 messages until it has obtained a new consistent set of the required information.

NOTE: MA_CHANGE_MARK and IM_CHANGE_MARK information is regularly broadcast in SI 13 message when SI 14 and SI 15 messages are present in the cell. The mobile station may also receive such *change mark* information in, e.g., an assignment message.

If the mobile station is not able to read SI 13 message in the cell according to the requirements specified in GSM 05.08, the mobile station shall perform a complete refresh of the information provided in SI 14 and SI 15 messages.

If the information in SI 13 message indicates that SI 14 messages are present in the cell, the mobile station is not allowed to initiate packet access in the cell until it has obtained a consistent set of SI 14 information. The SI 13 message may also indicate that SI 1 message is necessary for packet access in the cell, in which case the mobile station is not allowed to do packet access until it has obtained the SI 1 information.

3.2.2 Network side

3.2.2.1 System information broadcasting

SYSTEM INFORMATION TYPE 2 to 4 messages, and optionally TYPE 1, 2bis, 2ter, 7, 8, 13, 14 and 15 and further types are regularly broadcast by the network on the BCCH. Based on this information the mobile station is able to decide whether and how it may gain access to the system via the current cell. The SYSTEM INFORMATION TYPE 2bis message shall be sent if and only if the EXT-IND bit in the Neighbour Cells Description IE in both the TYPE 2 and TYPE 2bis messages indicates that each IE only carries part of the BA. SYSTEM INFORMATION TYPE 2ter message shall be sent if and only if this is indicated in SYSTEM INFORMATION TYPE 3 message.

A GSM 900 mobile station which only supports the primary GSM band P-GSM 900 (cf. GSM 05.05) may consider the EXT-IND bit in the Neighbour Cells Description IE in the SYSTEM INFORMATION TYPE 2 message as a spare bit. If it does so it shall assume that the information element carries the complete BA and it shall ignore any SYSTEM INFORMATION TYPE 2bis and 2ter messages.

If the additional cell reselection parameters are broadcast then SYSTEM INFORMATION TYPE 3 message shall always contain these parameters. In addition to SYSTEM INFORMATION TYPE 3 at least either SYSTEM INFORMATION TYPE 4 or SYSTEM INFORMATION TYPE 7 and 8 messages shall contain these parameters too.

SYSTEM INFORMATION TYPE 13 message shall be sent on BCCH if and only if GPRS is supported in the cell. The presence of SI 13 message is indicated in SYSTEM INFORMATION TYPE 3, 4, and if sent, in TYPE 7 and 8 messages. If PCCCH is present in the cell, additional system information related to GPRS is sent on PBCCH, see GSM 04.60.

If PCCCH is not present in the cell, the necessary system information related to GPRS is contained in SI 13 message, and optionally SYSTEM INFORMATION TYPE 14 and SYSTEM INFORMATION TYPE 15 messages.

If RF hopping channels are used for packet data channels in the cell, then either SYSTEM INFORMATION TYPE 1 or SYSTEM INFORMATION TYPE 14 or both types of messages shall be provided in the cell. The presence of SI 14 messages shall be indicated in SI 13 message. When RF hopping channels are used for packet data channels and they rely on the information in SYSTEM INFORMATION TYPE 1 message, then this in which case the dependency on SI 1 message shall be indicated in SI 13 message.

SYSTEM INFORMATION TYPE 15 messages shall be provided if interference measurements shall be performed by the mobile station, see GSM 05.08. The presence of SI 15 messages shall be indicated in SI 13 message.

NOTE 1: The allowed scheduling of SYSTEM INFORMATION messages on the BCCH are specified in GSM 05.02.

NOTE 2: The network should take into account limitations of certain mobile stations to understand SYSTEM INFORMATION TYPE 2bis, TYPE 2ter, the EXT-IND bit in the Neighbour Cells Description, the indication of 2ter in SYSTEM INFORMATION TYPE 3 and formats used in the Neighbour Cells Description IE and Cell Channel Description IE used in SYSTEM INFORMATION messages, see this section, section 10.5.2.1b, and section 10.5.2.22.

The information broadcast may be grouped in the following classes:

- information giving unique identification of the current network, location area and cell;
- information used for candidate cell measurements for handover and cell selection procedures;
- information describing the current control channel structure;
- information controlling the random access channel utilization;
- information defining different options supported within the cell; and
- information about the length of the part of the message belonging to the phase 1 protocol.

The network may send to the mobile station BCCH scheduling information as specified below:

1) The BCCH scheduling information may be contained in the SYSTEM INFORMATION TYPE 9 messages. If so, SYSTEM INFORMATION TYPE 3 specifies where to find SYSTEM INFORMATION TYPE 9 messages carrying BCCH scheduling information.

2) If the mobile station has received BCCH scheduling information, it shall assume that this BCCH scheduling information is valid in the location area until new scheduling information is received. It may store the information in the ME and assume its validity after switch on in the same location area.

3) The network need not indicate the schedule of all SYSTEM INFORMATION messages in SYSTEM INFORMATION 9. For any System Information message, the MS shall monitor all blocks specified in GSM 05.02 for that System Information message and all blocks specified in the SYSTEM INFORMATION TYPE 9 message for that System Information message.

4) When the mobile station detects that the BCCH information is not scheduled as defined in the last received SI 9 message, it shall read the SYSTEM INFORMATION TYPE 3 message. If presence of BCCH scheduling information in SYSTEM INFORMATION TYPE 9 message is indicated, it shall try to read the information and continue as in 2 above. If presence of BCCH scheduling information in SYSTEM INFORMATION TYPE 9 message is not indicated, it shall assume that there is no valid BCCH scheduling information.

3.2.2.2 Paging

The network is required to send valid layer 3 messages continuously on all paging subchannels on CCCH.

3.3 RR connection establishment

3.3.1 RR connection establishment initiated by the mobile station

The purpose of the immediate assignment procedure is to establish an RR connection between the mobile station and the network.

3.3.1.1 Entering the dedicated mode : immediate assignment procedure

The immediate assignment procedure can only be initiated by the RR entity of the mobile station. Initiation is triggered by request from the MM sublayer or LLC layer to enter the dedicated mode or by the RR entity in response to a PAGING REQUEST message. Upon such a request,

- if access to the network is allowed (as defined in 3.3.1.1.1), the RR entity of the mobile station initiates the immediate assignment procedure as defined in section 3.3.1.1.2;

- otherwise, it rejects the request.

The request from the MM sublayer to establish an RR connection specifies an establishment cause. Similarly, the request from the RR entity to establish a RR connection in response to a PAGING REQUEST 1, 2 or 3 message specifies one of the establishment causes "answer to paging".

3.3.1.1.1 Permission to access the network

All mobile stations with an inserted SIM are members of one out of 10 access classes numbered 0 to 9. The access class number is stored in the SIM. In addition, mobile stations may be members of one or more out of 5 special access classes (access classes 11 to 15) (see GSM 02.11), this is also held on the SIM card.

The system information messages on the BCCH broadcast the list of authorized access classes and authorized special access classes in the system information messages, and whether emergency calls are allowed in the cell to all mobile stations or only to the members of authorized special access classes.

If the establishment cause for the request of the MM sublayer is not "emergency call", access to the network is allowed if and only if the mobile station is a member of at least one authorized:

- access class; or

- special access class.

If the establishment cause for the request of the MM sublayer is "emergency call", access to the network is allowed if and only if:

- emergency calls are allowed to all mobile stations in the cell; or

- the mobile station is a member of at least one authorized special access class.

3.3.1.1.2 Initiation of the immediate assignment procedure

The RR entity of the mobile station initiates the immediate assignment procedure by scheduling the sending on the RACH and leaving idle mode (in particular, the mobile station shall ignore PAGING REQUEST messages).

It then sends maximally M + 1 CHANNEL REQUEST messages on the RACH in a way such that:

- the number of slots belonging to the mobile station's RACH between initiation of the immediate assignment procedure and the first CHANNEL REQUEST message (excluding the slot containing the message itself) is a random value drawn randomly for each new initial assignment initiation with uniform probability distribution in the set {0, 1, ..., max (T,8) - 1};

- the number of slots belonging to the mobile station's RACH between two successive CHANNEL REQUEST messages (excluding the slots containing the messages themselves) is a random value drawn randomly for each new transmission with uniform probability distribution in the set
  {S, S + 1, ..., S + T - 1};

Here, T is the value of the parameter "Tx-integer" broadcast on the BCCH;

M is the value of the parameter "max retrans" broadcast on the BCCH;

S is a parameter depending on the CCCH configuration and on the value of Tx-integer as defined in table 3.1/GSM 04.08.

The CHANNEL REQUEST messages are sent on the RACH (cf. section 1.5) and contain as parameters:

- an establishment cause which corresponds to the establishment cause given by the MM sublayer and the broadcast NECI value, or which corresponds to one of the establishment causes "answer to paging" given by the RR entity in response to a PAGING REQUEST message including the Channel Needed information;

- a random reference which is drawn randomly from a uniform probability distribution for every new transmission.

After sending the first CHANNEL REQUEST message, the mobile station shall start listening to the BCCH; it shall also listen to the full downlink CCCH timeslot corresponding to its CCCH group.

Having sent M + 1 CHANNEL REQUEST messages, the RR entity of the mobile station starts timer T3126. At expiry of timer T3126, the immediate assignment procedure is aborted; if the immediate assignment procedure was triggered by a request from the MM sublayer, a random access failure is indicated to the MM sublayer.

Table 3.1/GSM 04.08: Values of parameter S

TX-integer	non combined CCCH	combined CCH/SDCCH
3,8,14,50	55	41
4,9,16	76	52
5,10,20	109	58
6,11,25	163	86
7,12,32	217	115

3.3.1.1.3 Answer from the network

3.3.1.1.3.1 On receipt of a CHANNEL REQUEST message

The network may allocate a dedicated channel to the mobile station by sending an IMMEDIATE ASSIGNMENT message or IMMEDIATE ASSIGNMENT EXTENDED message in unacknowledged mode on the same CCCH timeslot on which it has received the CHANNEL REQUEST. There is no further restriction on what part of the downlink CCCH an IMMEDIATE ASSIGNMENT message or IMMEDIATE ASSIGNMENT EXTENDED message can be sent. The type of channel allocated (SDCCH or TCH; the channel mode shall be set to signalling only) is a network operator decision. Timer T3101 is then started on the network side.

NOTE: There are two types of immediate assignment messages:

- IMMEDIATE ASSIGNMENT message, containing assignment information for one mobile station only;
- IMMEDIATE ASSIGNMENT EXTENDED message, containing assignment information for two mobile stations at the same time.

The IMMEDIATE ASSIGNMENT or IMMEDIATE ASSIGNMENT EXTENDED message contains:

- the description of the assigned channel;
- the information field of the CHANNEL REQUEST message and the frame number of the frame in which the CHANNEL REQUEST message was received;
- the initial timing advance (cf. GSM 04.04);
- optionally, a starting time indication.

If frequency hopping is applied, the mobile station uses the last CA received on the BCCH to decode the Mobile Allocation.

On receipt of an IMMEDIATE ASSIGNMENT or IMMEDIATE ASSIGNMENT EXTENDED message corresponding to one of its 3 last CHANNEL REQUEST messages, the mobile station stops T3126 (if running), stops sending CHANNEL REQUEST messages, switches to the assigned channels, sets the channel mode to signalling only and activates the assigned channels. It then establishes the main signalling link with an SABM containing an information field (see section 3.1.5).

An IMMEDIATE ASSIGNMENT or IMMEDIATE ASSIGNMENT EXTENDED message may indicate a frequency change in progress, with a starting time and possibly alternative channel descriptions.

In the case of the reception of an IMMEDIATE ASSIGNMENT EXTENDED message, or of an IMMEDIATE ASSIGNMENT message which contains only the description of a channel to be used after the starting time, the mobile

station shall wait up to the starting time before accessing the channel. If the starting time has already elapsed, the mobile shall access the channel as an immediate reaction to the reception of the message (see GSM 05.10 for the timing constraints).

If the message contains both the description of a channel to be used after the indicated time and of a channel to be used before, the mobile station accesses a channel as an immediate reaction to the reception of the message. If the moment the mobile station is ready to access is before the indicated time, the mobile station accesses the channels described for before the starting time. The mobile station then changes to the channel described for after the starting time at the indicated time. New parameters can be frequency list and MAIO. Other parameters describing the channel to be used before the starting time are taken from the description of the channel defined for use after the starting time. If the moment the mobile station is ready to access is after the starting time, the mobile station accesses the channel described for after the starting time.

If frequency hopping is applied, the mobile station uses the last CA received on the BCCH.

3.3.1.1.3.2 Assignment rejection

If no channel is available for assignment, the network may send to the mobile station an IMMEDIATE ASSIGNMENT REJECT message in unacknowledged mode on the same CCCH timeslot on which the channel request message was received. There is no further restriction on what part of the downlink CCCH timeslot an IMMEDIATE ASSIGNMENT REJECT message can be sent. This message contains the request reference and a wait indication.

On receipt of an IMMEDIATE ASSIGNMENT REJECT message corresponding to one of its 3 last CHANNEL REQUEST messages, the mobile station, stops sending CHANNEL REQUEST messages, starts timer T3122 with the indicated value, ("wait indication" information element), starts T3126 if it has not already been started, and listens to the downlink CCCH until T3126 expires. During this time, additional IMMEDIATE ASSIGNMENT REJECT messages are ignored, but any immediate assignment corresponding to any other of its 3 last CHANNEL REQUEST messages make the mobile station follow the procedure in section 3.3.1.2. If no such immediate assignment is received, the mobile station returns to CCCH idle mode (listening to its paging channel).

As an option the mobile station may return to CCCH idle mode as soon as it has received responses from the network on all, or in case more than 3 were sent the last 3, of its CHANNEL REQUEST messages.

The mobile station is not allowed to make a new attempt to establish a non emergency RR connection in the same cell until T3122 expires. Provided that an IMMEDIATE ASSIGNMENT REJECT message has not been received for an emergency RR connection attempt, the mobile station may attempt to enter the dedicated mode for an emergency call in the same cell before T3122 has expired.

The Wait Indication IE (i.e. T3122) relates to the cell from which it was received.

The mobile station in packet idle mode (only applicable to mobile station supporting GPRS) may initiate packet access in the same cell before T3122 has expired, see GSM 04.60 and section 3.5.2.1.3.4.

After T3122 expiry, no CHANNEL REQUEST message shall be sent as a response to a page until a PAGING REQUEST message for the mobile station is received.

3.3.1.1.4 Assignment completion

The immediate assignment procedure is terminated on the network side when the main signalling link is established. Timer T3101 is stopped and the MM sublayer on the network side is informed that the RR entity has entered the dedicated mode.

On the mobile station side, the procedure is terminated when the establishment of the main signalling link is confirmed. The MM sublayer is informed that the RR entity has entered the dedicated mode.

3.3.1.1.4.1 Early classmark sending

Early classmark sending consists in the mobile station sending as early as possible after access a CLASSMARK CHANGE message to provide the network with additional classmark information.

A mobile station which implements the « Controlled Early Classmark Sending » option shall perform the early classmark sending if and only if explicitly accepted by the network, as indicated in the last reception in the accessed cell of the SYSTEM INFORMATION TYPE 3 message.

A mobile station which implements one or more of the « multiple band support » options shall also implement the « Controlled Early Classmark Sending » option.

A mobile station which implements the « multislot capability » option shall also implement the « Controlled Early Classmark Sending » option.

A mobile station that implements some form of treatment of UCS2 alphabet (see TS GSM 03.38) encoded character string (e.g., in short message, or in USSD string) may indicate so in the classmark. (An example is a Mobile Equipment able to display UCS2 encoded character string.) In such a case, it should also implement the « Controlled Early Classmark Sending » option. It is the mobile station responsibility to provide the UCS2 support information in due time. If the network needs this information and the mobile station did not provide it, the network may assume that the Mobile Equipment does not support UCS2.

A mobile station which implements the R-GSM band (see GSM 05.05) shall also implement the « Controlled Early Classmark Sending » option.

A mobile station which implements the extended measurement function shall also implement the « Controlled Early Classmark Sending » option. $(MAFA)$

A mobile station which implements the «GPRS» option shall also implement the « Controlled Early Classmark Sending » option.

A mobile station which implements the « Controlled Early Classmark Sending » option shall indicate it in the classmark (ES IND bit).

3.3.1.1.4.2 GPRS suspension procedure

This procedure enables the network to suspend GPRS services packet flow in the downlink direction.

The GPRS suspension procedure is initiated by the mobile station by sending a GPRS SUSPENSION REQUEST message. This can be done as early as possible after access but shall be done after sending a CLASSMARK CHANGE message. The RR sublayer of the mobile station shall indicate a RR GPRS suspend condition to the MM sublayer, see section 4.

When a mobile station which is IMSI attached for GPRS services (section 4) enters the dedicated mode, and when the mobile station limitations make it unable to handle both dedicated mode and either packet idle mode or packet transfer mode simultaneously, the mobile station shall perform the GPRS suspension procedure.

3.3.1.1.5 Abnormal cases

If a lower layer failure occurs on the mobile station side on the new channel before the successful establishment of the main signalling link, the allocated channels are released; the subsequent behaviour of the mobile station depends on the type of failure and previous actions.

- If the failure is due to information field mismatch in the contention resolution procedure, see section 3.1.5, and no repetition as described in this paragraph has been performed, the immediate assignment procedure shall be repeated.
- If the failure is due to any other reason or if a repetition triggered by a contention resolution failure has been performed. The mobile station returns to idle mode (RR connection establishment failure), transactions in progress are aborted and cell reselection then may take place.

If the information available in the mobile station, after the reception of an IMMEDIATE ASSIGNMENT message does not satisfactorily define a channel, an RR connection establishment failure has occurred.

If the Mobile Allocation IE indexes frequencies in more than one frequency band then a RR connection establishment failure has occurred.

If an IMMEDIATE ASSIGNMENT message indicates (a) channel(s) in a different frequency band to which the CHANNEL REQUEST message was sent then, if the frequency band is supported by the mobile station, the mobile station shall access the indicated channel(s) with the same power control level as used for the CHANNEL REQUEST message.

If an IMMEDIATE ASSIGNMENT message indicates a channel in non-supported frequency band then a RR connection establishment failure has occurred.

On the network side, if timer T3101 elapses before the main signalling link is established, the newly allocated channels are released and the request is forgotten. Note that the network has no means to distinguish repeated attempts from initial attempts from a mobile station.

3.3.1.2 Entering the group transmit mode: uplink access procedure

Only applicable for mobile stations supporting « VGCS transmit ».

The purpose of the uplink control procedure is to establish an RR connection on a VGCS channel between a mobile station which is in group receive mode on that channel and the network.

The mobile station enters the group transmit mode when a successful establishment of the RR connection is indicated. The channel mode assumed by the mobile station is the one derived from the channel description.

3.3.1.2.1 Mobile station side

3.3.1.2.1.1 Uplink investigation procedure

The mobile station in group receive mode shall consider the uplink as free if the last message indicating the uplink as being free was received less than 480 ms ago and if no UPLINK BUSY message has been received since the last message indicating the uplink as free.

On receipt of a request from the upper layer to access the uplink and if the uplink is not free, the mobile station starts the timer T3128.

If the uplink is free or becomes free before expiry of timer T3128, then the uplink investigation procedure is terminated, the mobile station shall stop T3128, and start the uplink access procedure.

NOTE: The start of the uplink access procedure is not subject to the access class of the mobile station.

If the uplink is not indicated free before the timer expires, the mobile station shall remain in the group receive mode and indicate a reject of the uplink request to the upper layer.

3.3.1.2.1.2 Uplink access procedure

The mobile station shall send UPLINK ACCESS messages on the voice group call channel with the appropriate establishment cause. The first UPLINK ACCESS message shall be transmitted by the mobile station with a random delay between 0 and 20ms. The UPLINK ACCESS messages shall be repeated after a further period of 100ms plus a random delay between 0 and 20ms.

Comment [FR1]: ASCI the delay shall be added only just after the change of status of the uplink and not in the other cases. In addition ms to be changed in multiple of frame.

If an uplink identity code (UIC) of the current cell has been provided by the network in the UPLINK FREE message, the mobile station shall use this UIC IE for the coding of the UPLINK ACCESS messages (see GSM 05.03). If no UIC is provided, the mobile station shall use the BSIC received from the current cell, for instance from the initial synchronization.

Having sent the first UPLINK ACCESS message, the mobile station starts timer T3130. At expiry of timer T3130, the mobile station shall repeat the same procedure if the uplink is free. A maximum of three attempts is allowed and after that a rejection of the uplink request is indicated to the upper layers.

If no VGCS UPLINK GRANT or UPLINK BUSY message is received by the mobile station 480 ms after having sent the first UPLINK ACCESS message, the mobile station shall stop sending UPLINK ACCESS messages and wait in order to receive a VGCS UPLINK GRANT or UPLINK BUSY message.

On receipt of an VGCS UPLINK GRANT message corresponding to one of its UPLINK ACCESS messages, the mobile station stops T3130, stops sending UPLINK ACCESS messages, and establishes the main signalling link with an SABM containing the TALKER INDICATION message in the information field. Early classmark sending shall be performed if applicable. If a UA is received containing the message sent, the mobile station enters the group transmit mode and indicates the successful seizure of the uplink to the upper layer. If a UA is received with a message different from the message sent, the mobile station shall remain in the group receive mode and indicate the rejection of the uplink request to the upper layers.

When receiving an UPLINK BUSY message or a VGCS UPLINK GRANT message aimed to another mobile station (i.e., not corresponding to one of its UPLINK ACCESS messages), the mobile station stops T3130 and stops sending UPLINK ACCESS messages. The mobile shall remain in the group receive mode and shall indicate a rejection of the uplink request to the upper layers.

3.3.1.2.2 Network side

On receipt of an UPLINK ACCESS message the network shall perform, if necessary, contention resolution and grant the uplink to one mobile station by sending a VGCS UPLINK GRANT message to the mobile station in unacknowledged mode on the main signalling link. Furthermore, the network shall provide UPLINK BUSY messages on the main signalling link in all cells of the group call area. After having sent the first message, the network starts T3115. If the timer expires before the reception of a correctly decoded frame from the MS, the network repeats the VGCS UPLINK GRANT message to the mobile station. If the VGCS UPLINK GRANT message has been repeated Ny2 times without a correctly decoded frame being received from the MS, the network shall stop sending VGCS UPLINK GRANT messages and provide an UPLINK FREE message on the main signalling channel and wait for a new UPLINK ACCESS message. The correct decoding of a frame means that the decoding algorithm and the error detection tests, if any, indicate no error.

After the data link layer is established, the RR entity of the network shall analyse the TALKER INDICATION message received from the mobile station, adapt the RR procedures to the new classmark if necessary and provide the mobile subscriber identity to the upper layer.

3.3.1.2.3 Abnormal cases

If a lower link failure has occured or an indication of the release of the data link layer was provided by the lower layer and no RR release request was previously received from the upper layer, the network shall provide an UPLINK FREE message on the main signalling channel and wait for a new UPLINK ACCESS message.

3.3.1.3 Dedicated mode and GPRS

A mobile station whose Channel Request message contained a packet access establishment cause may receive an Immediate Assignment message to a Channel which is to be used in dedicated mode. A mobile station supporting the <<GPRS>> option shall obey this command. When establishing the main signalling link the information field in the SABM shall contain an RR INITIALISATION REQUEST message.

This message contains:

TLLI,

MS Classmark type 2

Ciphering Key Sequence Number

MAC Mode and Channel Coding Requested

Channel Request Description

Following a successful contention resolution procedure, the mobile station shall implement the Early Classmark Sending option. Then, the upper layers in the mobile station shall wait for commands from the network, eg for the allocation of a GPRS resource.

While on the dedicated channel the mobile station shall obey the RR management procedures of 04.08, in particular the mobile station shall send measurement reports on the SACCH.

3.3.2 Paging procedure for RR connection establishment

The network can initiate the establishment of an RR connection by the paging procedure for RR connection establishment. Such a procedure can only be initiated by the network.

3.3.2.1 Paging initiation by the network

The network initiates the paging procedure to trigger RR connection establishment by broadcasting a paging request message on the appropriate paging subchannel on CCCH or PCCCH, and starts timer T3113.The paging subchannels on CCCH and PCCCH are specified in GSM 05.02 and GSM 03.13.

The network may also send paging related information on PACCH to a mobile station in packet transfer mode, see section 3.3.2.1.3.

The network may also broadcast paging related information on any voice broadcast or voice group call channel downlink.

3.3.2.1.1 Paging initiation using paging subchannel on CCCH

Paging initiation using the paging subchannel on CCCH is used when sending paging information to a mobile station in idle mode. It is also used when sending paging information to a mobile station in packet idle mode, if PCCCH is not present in the cell.

NOTE 1: There are 3 types of paging messages which may be used on CCCH:

- PAGING REQUEST TYPE 1;
- PAGING REQUEST TYPE 2; and
- PAGING REQUEST TYPE 3.

In a PAGING REQUEST message on CCCH to trigger RR connection establishment, the mobile station shall be identified by the TMSI (non-GPRS TMSI) or its IMSI. If the mobile station is identified by the TMSI, it shall proceed as specified in section 3.3.2.2.

If the mobile station in packet idle mode is identified by its IMSI, it shall parse the message for a corresponding *Packet Page Indication* field:

- if the *Packet Page Indication* field indicates a paging procedure for RR connection establishment, or the field is not present in the message, the mobile station shall proceed as specified in section 3.3.2.2;
- if the *Packet Page Indication* field indicates a packet paging procedure, the mobile station shall proceed as specified in section 3.5.1.2.

A PAGING REQUEST message on CCCH includes for each mobile station that is paged to trigger RR connection establishment an indication which defines how mobiles of different capabilities shall code the establishment cause field in the CHANNEL REQUEST message. The information received in the CHANNEL REQUEST can be used by the network to assign a suitable channel.

A PAGING REQUEST message on CCCH may include more than one mobile station identification.

A PAGING REQUEST TYPE 1 message on CCCH may have additionally a notification message coded in the P1 rest octets information element.

A PAGING REQUEST message on CCCH may also include priority levels related to the mobile station identifications. A mobile station in group receive mode supporting eMLPP shall take into account this information to decide whether to respond to this PAGING REQUEST and, if the call is answered, the mobile station shall store the priority level for the duration of the call. A mobile station not supporting eMLPP shall ignore this information element when received in a PAGING REQUEST message.

NOTE 2: A mobile station not supporting VGCS or VBS may ignore this information element when received in a PAGING REQUEST message, since the priority level is also provided in the SETUP message.

If VGCS or VBS is supported by the network and the network supports reduced NCH monitoring, messages sent on the PCH may also include an indication of the change of the information sent on the NCH (see section 3.3.3.2).

The choice of the message type depends on the number of mobile stations to be paged and of the types of identities that are used. The maximum number of paged mobile stations per message is 4 when using only TMSIs for identification of the mobile stations.

The mobile station in idle mode is required to receive and analyse the paging messages and immediate assignment messages sent on the paging subchannel corresponding to its paging subgroup, as specified in GSM 05.02.

NOTE 3: The possible immediate assignment messages are: the IMMEDIATE ASSIGNMENT, the IMMEDIATE ASSIGNMENT EXTENDED and the IMMEDIATE ASSIGNMENT REJECT messages.

The paging and immediate assignment type messages contain a page mode information element. This information element controls possible additional requirements on mobile stations belonging to the paging subgroup corresponding to the paging subchannel the message was sent on. This implies that a given mobile station shall take into account the page mode information element of any message sent on its own paging subchannel whatever the nature of this message (paging messages or immediate assignment messages). This further implies that the mobile station does not take into account page mode information element of messages sent on paging subchannels other than its own paging subchannel. The requirements yielded by the page mode information element are as follows:

a) normal paging: no additional requirements;

b) extended paging: the mobile station is required in addition to receive and analyse the next but one message on the PCH;

c) paging reorganization: The mobile station shall receive all messages on the CCCH regardless of the BS-AG-BLKS-RES setting. It is required to receive all BCCH messages. When the mobile station receives the next message to its (possibly new) paging subgroup the subsequent action is defined in the page mode information element in that message.

d) same as before: No change of page mode from the previous page mode.

Note that a mobile station takes into account the page mode information only in messages of its own paging subchannel whatever the currently applied requirements (a, b, c or d).

When the mobile station selects a new PCH, the initial page mode in the mobile station shall be set to paging reorganization. If a message in the paging subchannel is not received correctly, the message is ignored and the previous page mode is assumed.

3.3.2.1.2 Paging initiation using paging subchannel on PCCCH

Paging initiation using a paging subchannel on PCCCH, see GSM 04.60, applies when sending paging information to a mobile station in packet idle mode and PCCCH is provided in the cell.

The paging initiation procedure and the paging request message used on PCCCH are specified in GSM 04.60.

3.3.2.1.3 Paging initiation using PACCH

Paging initiation using PACCH, see GSM 04.60, applies to a mobile station in packet transfer mode.

The paging initiation procedure and the message used to carry paging related information on PACCH are specified in GSM 04.60.

3.3.2.2 Paging response

Upon receipt of a paging request message, or other message containing information to trigger the establishment of a RR connection, and if access to the network is allowed, the addressed mobile station shall, when camped on a cell as specified in GSM 03.22, initiate the immediate assignment procedure as specified in 3.3.1. The establishment of the main signalling link is then initiated by use of an SABM with information field containing the PAGING RESPONSE message (see section 3.1.5). The MM sublayer in the mobile station is informed that the RR entity has entered the dedicated mode.

Upon receipt of the PAGING RESPONSE message the network stops timer T3113. The MM sublayer in the network is informed that an RR connection exists.

3.3.2.3 Abnormal cases

Lower layer failure occurring during the immediate assignment procedure is treated as specified for that procedure.

If timer T3113 expires and a PAGING RESPONSE message has not been received, the network may repeat the paging request message and start timer T3113 again. The number of successive paging attempts is a network dependent choice.

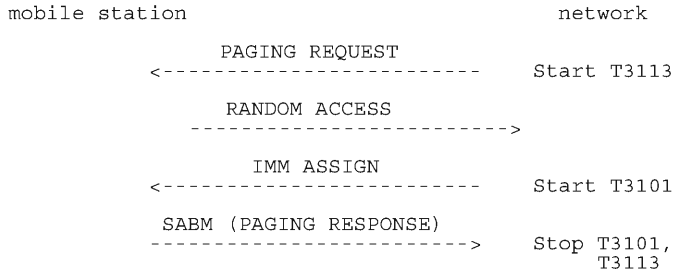


Figure 3.2/GSM 04.08 Paging sequence

3.3.3 Notification procedure

The support of notification procedure is mandatory for mobile stations supporting « VGCS receive » and/or « VBS receive ».

The network informs the mobile station of starting or on-going voice broadcast calls and voice group calls with the notification procedure.

In cases where the mobile station has initiated a VGCS call, if the channel mode modify procedure is applied to turn the dedicated channel into a VGCS channel and ciphering may be applied for that call, in this case the network should suspend transmission of notification messages until ciphering with the group cipher key has started on the dedicated channel.

3.3.3.1 Notification of a call

The mobile station may receive a notification that a voice broadcast call or a voice group call is established. Notifications may be sent on the NCH, on the PCH, on SACCH in dedicated mode or on the FACCH when in group receive mode. The presence of an NCH is indicated on the PCH in the Pi Rest Octets IE. A notification contains the group call reference and possibly other related information. This notification may be contained:

- in a NOTIFICATION/NCH message sent on the NCH to notify mobile stations of VBS or VGCS calls in the current cell, possibly together with a description of the related VBS or VGCS channel;
- in a NOTIFICATION/FACCH message sent in unacknowledged mode on the main DCCH to notify mobile stations in dedicated mode or on the main DCCH of a VGCS or VBS channel, of other VBS or VGCS calls in the current cell, possibly together with a description of the related VBS or VGCS channel.
- in the rest octets part of a PAGING REQUEST TYPE 1 message.

A mobile station supporting neither VGCS listening nor VBS listening may ignore the notifications sent on the NCH or PCH. It may also ignore the notifications sent on the main DCCH except that an RR-STATUS message shall be sent to the network with cause #97, "message not existent or not implemented".

Upon receipt of every notification message a mobile station supporting VGCS listening or VBS listening shall give an indication containing the notified group call reference(s) to upper layers in the mobile station which may then decide:

- not to react on the notification, or

- join the voice broadcast call or the voice group call, if needed after having stopped on going activities.

3.3.3.2 Joining a VGCS or VBS call

In order to join a VGCS or a VBS call the following procedures apply.

In this subclause, the term **notification** refers to the notification which has triggered the decision to join a VGCS or VBS call.

If the notification on the main DCCH concerns a VBS or VGCS in the current cell and does not contain a description of the VGCS or VBS channel, the mobile station shall read the corresponding notification on the NCH.

If the description of the VGCS or VBS channel was included in the notification for the current cell, RR connection establishment shall not be initiated, instead, the mobile station shall enter the group receive mode.

If no description for the VGCS or VBS channel is included in the notification, the mobile station shall establish an RR connection in dedicated mode in order to respond to the notification.

3.3.3.3 Reduced NCH monitoring mechanism

This section applies to mobile stations which read the NCH in idle mode in order to receive the notification messages for the voice broadcast call and the voice group call, which read the PCH to receive pagings and which aim at reducing the reception load.

A reduced NCH monitoring mechanism may be used on the NCH. When the mobile station in idle mode enters a cell and deduces from the BCCH that an NCH is present, it shall read the NCH until it has received at least two messages on the NCH indicating NLN, with the two last received NLN being identical. Then it may stop reading the NCH until it receives on the PCH an NLN(PCH) different from the last previously received NLN or on the SACCH an NLN(SACCH) different from the last previously received NLN..

A mobile is able to determine the reduced NCH monitoring is active in the network if it receives an NLN in any message. Once received, the mobile shall assume that NCH monitoring is active for a certain period of time which is not specified.

For this, parameters are provided:

- **NLN:** Notification List Number;

  The NLN is a modulo 4 counter which is changed every time a notification for a new VGCS or VBS call is started on the NCH. If the reduced NCH monitoring is indicated, the NLN provides information on new notifications provided on the NCH.

- NLN status :
  The NLN status is a single bit field which indicates the status of the content of the NOTIFICATION/NCH messages for a particular NLN value. A change of the NLN status field indicates a change of information on the NCH which is not related to new calls (e.g. There may have been a release of a previous notified call or change of priority, etc ...).

If the reduced NCH monitoring is active in the network, the network has to provide both NLN and NLN status parameters.

These parameters may be provided on the NCH, PCH and SACCH:

- **NLN(NCH):** Notification List Number (received on the NCH).
- **NLN(PCH):** Notification List Number (received on the PCH).
- **NLN(SACCH):** Notification List Number (received on the SACCH).
- **NLN status(PCH):** NLN status (received on the PCH).
- **NLN status(SACCH):** NLN status (received on the SACCH).

A mobile station supporting neither VGCS listening nor VBS listening shall ignore the NLN(NCH),NLN(PCH), NLN(SACCH) and NLN status fields.

If a mobile station (supporting VGCS listening and/or VBS listening) receives a NLN parameters on the NLN(PCH) or NLN(SACCH) field different from the last received NLN value it shall read the NCH until it has received at least two messages on the NCH indicating NLN with the two last received NLN being identical.

If a message in the paging subchannel is not received correctly, or if a paging message does not contain the information on the notification status, the mobile station shall read the NCH until it has received at least two messages on the NCH indicating NLN, with the two last received NLN being identical

3.4 Procedures in dedicated mode and in group transmit mode

Procedures described in this section apply to the dedicated mode and/or the group transmit mode.

Those procedures which are specific for group transmit mode or refer to transitions to the group transmit mode are only applicable for mobile stations supporting VGCS talking.

Direct transition between dedicated mode and group transmit mode is possible in both directions by use of the following procedures:

- Channel assignment procedure;
- Handover procedure;
- Channel mode modify procedure.

3.4.1 SACCH procedures

3.4.1.1 General

In dedicated mode and group transmit mode, the SACCH is used in signalling layer at least for measurement results transmission from the mobile station.

The SACCH has the particularity that continuous transmission must occur in both directions at least on the channel carrying the main signalling link. For that purpose, in the mobile station to network direction, measurement result messages are sent at each possible occasion when nothing else has to be sent (see section 3.4.1.2). Similarly, SYSTEM INFORMATION TYPE 5, 6 and optionally 5bis and 5ter messages are sent in the network to mobile station direction in UI frames when nothing else has to be sent.

In a multislot configuration the SYSTEM INFORMATION TYPE 5, 6 and optionally 5bis and 5ter messages shall be sent on the SACCH associated with the channel carrying the main signalling link.

In a multislot configuration the mobile station shall ignore all messages received on the SACCH(s) that are not associated with the channel carrying the main signalling link.

On a VGCS channel, the network may send additional or alternative system information messages for both mobile stations in group transmit mode and those in group receive mode (see section 3.4.15.2.1).

A mobile station with extended measurement capabilities which receives EXTENDED MEASUREMENT ORDER (EMO) messages on the SACCH, shall perform and report extended measurements, see section 3.4.1.3. $(MAFA)$

The SYSTEM INFORMATION TYPE 5bis message shall be sent if and only if the EXT IND bit in the Neighbour Cell Description information element in both the SYSTEM INFORMATION TYPE 5 and TYPE 5bis messages indicates that each information element only carries part of the BA.

A GSM 900 mobile station which only supports the primary GSM band P-GSM 900 (cf. GSM 05.05) may consider the EXT-IND bit in the Neighbour Cells Description IE in the SYSTEM INFORMATION TYPE 5 message bit as a spare bit, assume that the information element carries the complete BA, and ignore any SYSTEM INFORMATION TYPE 5bis messages.

NOTE: The network should take into account limitations of certain mobile stations to understand SYSTEM INFORMATION TYPE 5ter and TYPE 5bis messages, the EXT-IND bit in the Neighbour Cells Description, and formats used in the Neighbour Cells Description information element and Cell Channel Description information element used in SYSTEM INFORMATION messages, see section 10.5.2.1b, and section 10.5.2.22.

As specified in GSM 05.08, problems occurring in the reception of SACCH frames are interpreted as a loss of communication means and appropriate procedures are then triggered as specified in section 3.4.13.

3.4.1.2 Measurement report

When in dedicated mode or group transmit mode, the mobile station regularly sends MEASUREMENT REPORT messages to the network. These messages contain measurements results about reception characteristics from the current cell and from neighbour cells. The BA (list) which is the basis for the measurements is derived from information received on the BCCH in System Information 2 and optionally 2bis and/or 2ter and on the SACCH in System Information 5 and optionally 5bis and/or 5ter.

When the information is received in more than one message the mobile station shall only combine information from messages received on the same channel and indicating the same value of the BCCH allocation sequence number without any message indicating a different value of the BCCH allocation sequence number received in between. If neighbouring cell information for the serving cell is not available, the mobile station indicates this in the MEASUREMENT REPORT message. These measurement results are obtained as specified in GSM 05.08.

These messages are sent on the slow ACCH, in unacknowledged mode.

If no other message is scheduled on the SACCH at the instant when a layer 2 frame is due to be sent, then the mobile station shall send a MEASUREMENT REPORT message or an EXTENDED MEASUREMENT REPORT message (see section 3.4.1.3) $(MAFA)$ in that frame. The interval between two successive layer 2 frames containing MEASUREMENT REPORT messages shall not exceed one layer 2 frame.

3.4.1.3 Extended measurement report $(MAFA)$

Only applicable to mobile stations which support extended measurement.

When in dedicated mode or group transmit mode, a mobile station may receive an EXTENDED MEASUREMENT ORDER (EMO) message, from the network. The mobile station shall then, as defined in GSM 05.08, for one reporting period perform measurements on the frequencies specified by this EMO message. The mobile station shall thereafter send an EXTENDED MEASUREMENT REPORT message. This message contains the measurement results as defined in GSM 05.08.

If the mobile station has not started to send its EXTENDED MEASUREMENT REPORT within 10 seconds after the reception of the EMO message, no EXTENDED MEASUREMENT REPORT shall be sent. The mobile station shall after a successful channel change abort any pending measurements or reporting related to an EMO message received on the old channel.

If a mobile station receives an EMO message indicating the same value of the sequence code as an EMO message received earlier on the same channel without having received any EMO message indicating a different value of the sequence code in between, that EMO message shall be ignored. If the mobile station, before the reporting related to an EMO message has started, receives a new EMO message with a different value of the sequence code, any pending measurements or reporting related to the earlier EMO message shall be aborted and the new message treated.

The EMO message and the EXTENDED MEASUREMENT REPORT message are sent on the SACCH, in unacknowledged mode.

3.4.2 Transfer of messages and link layer service provision

When in dedicated mode or in group transmit mode, upper layers can send messages in multiframe or unacknowledged mode on SAPI 0.

Moreover, but only when in dedicated mode, upper layers have access to the full link layer services for SAPIs other than 0, with the exception of the error indication and local end release that are directly treated by the RR sublayer, as specified in particular places of section 3.

3.4.3 Channel assignment procedure

In dedicated mode or in group transmit mode, an intracell change of channel can be requested by upper layers for changing the channel type, or decided by the RR sublayer, e.g. for an internal handover. This change may be performed through the dedicated channel assignment procedure.

The purpose of the channel assignment procedure is to completely modify the physical channel configuration of the mobile station without frequency redefinition or change in synchronization while staying in the same cell.

This procedure shall not be used for changing between dependent configurations, i.e. those sharing Radio Resource for the main signalling link. An example of dependent channels is a full rate channel and one of the corresponding half rate channels. In multislot operation however, it is allowed to use the same timeslots before and after the assignment, as long as the main signalling link has been changed. The only procedures provided for changing between dependent configurations for the main signalling link are the additional assignment and the partial release procedures.

The channel assignment procedure happens only in dedicated mode and in group transmit mode. This procedure cannot be used in the idle mode; in this case the immediate assignment procedure is used.

The channel assignment procedure includes:

- the suspension of normal operation except for RR management (layer 3).
- the release of the main signalling link, and of the other data links as defined in section 3.1.4, and the disconnection of TCHs if any.
- the deactivation of previously assigned channels (layer 1)
- the activation of the new channels and their connection if applicable.
- The triggering of the establishment of the data link connections for SAPI = 0.

The channel assignment procedure is always initiated by the network.

3.4.3.1 Channel assignment initiation

The network initiates the channel assignment procedure by sending an ASSIGNMENT COMMAND message to the mobile station on the main signalling link. It then starts timer T3107.

NOTE: The network should take into account limitations of certain mobile stations to understand formats used in the Frequency List IE and Cell Channel Description IE used in the ASSIGNMENT COMMAND message, see section 10.5.2.13 and section 10.5.2.1b.

When sending this message on the network side, and when receiving it on the mobile station side, all transmission of signalling layer messages except for those RR messages needed for this procedure and for abnormal cases is suspended until resumption is indicated. These RR messages can be deduced from sections 3.4.3 and 8.8 Radio Resource management.

Upon receipt of the ASSIGNMENT COMMAND message, the mobile station initiates a local end release of link layer connections, disconnects the physical channels, commands the switching to the assigned channels and initiates the establishment of lower layer connections (this includes the activation of the channels, their connection and the establishment of the main signalling links).

The ASSIGNMENT COMMAND message contains the description of the new configuration, including for the multislot configuration and the TCH/H + TCH/H + ACCHs configuration, the exact ACCHs to be used and a power command. The power level defined in this power command shall be used by the mobile station for the initial power on the new channel(s). It shall not affect the power used on the old channel(s). The message may also contain definitions of the channel mode to be applied for one or several channel sets. If a previously undefined channel set is defined by the ASSIGNMENT COMMAND message, a definition of the channel mode for the new channel set shall be included in the message.

An ASSIGNMENT COMMAND message may indicate a frequency change in progress, with a starting time and possibly alternative channel descriptions.

In the case of the reception of an ASSIGNMENT COMMAND message which contains only the description of a channel to be used after the starting time, the mobile station shall wait up to the starting time before accessing the channel. If the starting time has already elapsed, the mobile shall access the channel as an immediate reaction to the reception of the message (see GSM 05.10 for the timing constraints).

If the message contains both the description of a channel to be used after the indicated time and of a channel to be used before, the mobile station accesses a channel as an immediate reaction to the reception of the message. If the moment the mobile station is ready to access is before the indicated time, the mobile station accesses the channels described for before the starting time. The mobile station then changes to the channel described for after the starting time at the indicated time. New parameters can be frequency list, MAIO and HSN. Other parameters describing the allocated channels must be identical to the parameters described for before the starting time. If the moment the mobile station is ready to access is after the starting time, the mobile station accesses the channel described for after the starting time.

If frequency hopping is applied, the cell allocation if present in the message is used to decode the mobile allocation. If the cell allocation is not included, the mobile station uses its current cell allocation, the current CA is the last CA received on the BCCH. Afterward, the current CA may be changed by some messages sent on the main signalling link containing a CA (the possible messages are: ASSIGNMENT COMMAND, HANDOVER COMMAND and FREQUENCY REDEFINITION). Note that there are cases in which the current CA is undefined, see section 3.4.3.3.

The ASSIGNMENT COMMAND message may contain a cipher mode setting IE. In that case, this ciphering mode has to be applied on the new channel. If no such information is present, the ciphering mode is the same as on the previous channel. In either case the ciphering key shall not be changed. The ASSIGNMENT COMMAND message shall not contain a cipher mode setting IE that indicates "start ciphering" unless a CIPHERING MODE COMMAND message has been transmitted earlier in the RR connection: if such an ASSIGNMENT COMMAND message is received it shall be regarded as erroneous, an ASSIGNMENT FAILURE with cause "Protocol error unspecified" message shall be returned immediately, and no further action taken.

In a voice group call, the ASSIGNMENT COMMAND message may contain a VGCS target mode information element defining which RR mode is to be used on the new channel (i.e. dedicated mode or group transmit mode). If this information element is not present, the mode shall be assumed to be the same as on the previous channel. The VGCS target mode information element shall also indicate the group cipher key number for the group cipher key to be used on the new channel or if the new channel is non ciphered. If the information element is not present, the ciphering mode and group cipher key shall be the same as on the previous channel. Mobile stations not supporting VGCS talking shall ignore the ASSIGNMENT COMMAND message if the VGCS target mode information element is included in the message and shall send an RR STATUS message to the network with cause #96. If a VGCS target mode information element and a cipher mode setting information element is included in the same message, then a mobile station supporting VGCS talking mobile shall regard the ASSIGNMENT COMMAND message as erroneous, an ASSIGNMENT FAILURE message with cause "Protocol error unspecified" shall be returned immediately, and no further action taken.

3.4.3.2 Assignment completion

After the main signalling link is successfully established, the mobile station returns an ASSIGNMENT COMPLETE message, specifying cause "normal event", to the network on the main DCCH.

The sending of this message on the mobile station side and its receipt on the network side allow the resumption of the transmission of signalling layer messages other than those belonging to RR management.

At the receipt of the ASSIGNMENT COMPLETE message, the network releases the previously allocated resources and stops timer T3107.

3.4.3.3 Abnormal cases

If the mobile station has no current CA and if it needs a CA to analyse the ASSIGNMENT COMMAND message, it stays on the current channel(s) and sends an ASSIGNMENT FAILURE message with cause "no cell allocation available".

If the ASSIGNMENT COMMAND message instructs the mobile station to use a Channel Description or Mode that it does not support, or if the Channel Mode to use is not defined for all channel sets, then the mobile station shall return an ASSIGNMENT FAILURE message with cause "channel mode unacceptable", and the mobile station shall remain on the current channel(s) and uses the old Channel Description or Channel Mode(s).

If the ASSIGNMENT COMMAND message instructs the mobile station to use a frequency that it is not capable of, then the mobile station shall return an ASSIGNMENT FAILURE message with cause "frequency not implemented", and the mobile station shall remain on the current channel(s).

If the mobile station receives an ASSIGNMENT COMMAND message with a Frequency List IE indicating frequencies that are not all in one band, then the mobile station shall stay on the current channel(s) and send an ASSIGNMENT FAILURE message with cause "frequency not implemented". If the mobile station receives an ASSIGNMENT COMMAND message with a Mobile Allocation IE indexing frequencies that are not all in one band, then the mobile station shall stay on the current channel(s) and send an ASSIGNMENT FAILURE message with cause "frequency not implemented".

NOTE: An ASSIGNMENT COMMAND message sent to a multi band mobile station shall not be considered invalid because it indicates frequencies that are all in a different frequency band to that of the current channel.

On the mobile station side, if a lower layer failure happens on the new channel before the ASSIGNMENT COMPLETE message has been sent, the mobile station deactivates the new channels, reactivates the old channels, reconnects the TCHs if any and triggers the establishment of the main signalling link. It then sends a ASSIGNMENT FAILURE message, cause "protocol error unspecified" on the main DCCH and resumes the normal operation, as if no assignment attempt had occurred. The operational parameters (e.g. ciphering mode) when returning on the old channel are those applied before the procedure.

When receiving the ASSIGNMENT FAILURE message, the network stops T3107.

If a lower layer failure happens while attempting to connect back to the old channels, the radio link failure procedure is applied (see section 3.4.13.2 for dedicated mode and 3.4.13.5 for group transmit mode).

On the network side, if timer T3107 elapses before either the ASSIGNMENT COMPLETE message has been received on the new channels or an ASSIGNMENT FAILURE message is received on the old channels, the old channels and the new channels are released if they both were dedicated channels and, unless the mobile station has re-established the call, all contexts related to the connections with that mobile station are cleared. If one of the channels was a VGCS channel, it shall be maintained and the uplink shall be set free. If both channels were VGCS channels, the network shall maintain one of the channels and the uplink shall be set free.

On the network side, lower layer failure occurring on the old channels after the sending of the ASSIGNMENT COMMAND message are ignored. Lower layer failures occurring after the receipt of the SABM Frame on the new main signalling link are treated following the general rules (cf. section 3.5.2).

3.4.4 Handover procedure

In dedicated mode or group transmit mode, an intercell or intracell change of channel(s) can be requested by the network RR sublayer. This change may be performed through the handover procedure

NOTE: The decision to do a handover and the choice of the new cell is out of the scope of this technical specification.

The purpose of the handover procedure is to completely modify the channels allocated to the mobile station e.g. when the cell is changed. A change in the channel configuration nature is possible. This procedure is used only while in dedicated mode or group transmit mode.

The handover procedure shall not be used for changing between dependent configurations (see section 3.4.3).

The handover procedure includes:

- The suspension of normal operation except for RR management (layer 3).
- The disconnection of the main signalling link, and of the other links via local end release (layer 2), and the disconnection of the TCH(s) if any.
- The disconnection and the deactivation of previously assigned channels and their release (layer 1).
- The activation of the new channels, and their connection if applicable.
- The triggering of the establishment of data link connection for SAPI = 0 on the new channels.

The handover procedure is always initiated by the network.

3.4.4.1 Handover initiation

The network initiates the handover procedure by sending a HANDOVER COMMAND message to the mobile station on the main DCCH. It then starts timer T3103.

NOTE: The network should take into account limitations of certain mobile stations to understand formats used in the Frequency List IE, Frequency Short List IE, and Cell Channel Description IE used in the HANDOVER COMMAND message, see section 10.5.2.13, section 10.5.2.14, and section 10.5.2.1b.

When sending this message on the network side, and when receiving it on the mobile station side, all transmission of signalling layer messages except for those RR messages needed for this procedure and for abnormal cases, is suspended until resuming is indicated. These RR messages can be deduced from section 3.4.3 and 8.5.1 "Radio Resource management".

Upon receipt of the HANDOVER COMMAND message, the mobile station initiates, as described in section 3.1.4, the release of link layer connections, disconnects the physical channels, commands the switching to the assigned channels and initiates the establishment of lower layer connections (this includes the activation of the channels, their connection and the establishment of the data links).

The HANDOVER COMMAND message contains:

- The characteristics of the new channels, including for the multislot configuration and the TCH/H + TCH/H + ACCHs configuration the exact ACCHs to be used. The message may also contain definitions of the channel mode to be applied for one or several channel sets. If a previously undefined channel set is defined by the HANDOVER COMMAND message, a definition of the channel mode for the new channel set shall be included in the message.

- The characteristics of the new cell that are necessary to successfully communicate (e.g. frequency list in the case of slow frequency hopping), including the data that allows the mobile station to use the pre-knowledge about synchronization it acquires by the measurement process (i.e. BSIC + BCCH frequency).

- A power command (cf. GSM 05.08). The power level defined in this power command shall be used by the mobile station for the initial power on the new channel(s). It shall not affect the power used on the old channel(s).

- An indication of the physical channel establishment procedure to be used.

- A handover reference, used as specified in the following section. The choice of the handover reference by the network is out of the scope of this specification and left to the manufacturers.

- Optionally a timing advance to be used on the new cell.

- Optionally a cipher mode setting. In that case, this ciphering mode has to be applied on the new channel. If no such information is present, the ciphering mode is the same as on the previous channel. In either case the ciphering key shall not be changed. The HANDOVER COMMAND message shall not contain a cipher mode setting IE that indicates "start ciphering" unless a CIPHERING MODE COMMAND message has been transmitted previously in this instance of the dedicated mode: if such a HANDOVER COMMAND message is received it shall be regarded as erroneous, a HANDOVER FAILURE message with cause "Protocol error unspecified" shall be returned immediately, and no further action taken.

- Optionally, in a voice group call, a VGCS target mode information element defining which RR mode is to be used on the new channel (i.e. dedicated mode or group transmit mode). If this information element is not present, the mode shall be assumed to be the same as on the previous channel. The VGCS target mode information element shall also indicate the group cipher key number for the group cipher key to be used on the new channel or if the new channel is non ciphered. If the information element is not present, the ciphering mode and ciphering key shall be the same as on the previous channel. Mobile stations not supporting VGCS talking shall ignore the HANDOVER COMMAND message if the VGCS target mode information element is included in the message and shall send an RR STATUS message to the network with cause #96. If a VGCS target mode information element and a cipher mode setting information element is included in the same message, then a mobile station supporting VGCS talking shall regard the HANDOVER COMMAND message as erroneous, an

HANDOVER FAILURE message with cause "Protocol error unspecified" shall be returned immediately, and no further action taken.

In addition, a HANDOVER COMMAND message may indicate a frequency change in progress, with a starting time and possibly alternative channel descriptions.

In the case of the reception of a HANDOVER COMMAND message which contains only the description of a channel to be used after the starting time, the mobile station shall wait up to the starting time before accessing the channel. If the starting time has already elapsed, the mobile shall access the channel as an immediate reaction to the reception of the message (see GSM 05.10 for the timing constraints).

If the message contains both the description of a channel to be used after the indicated time and of a channel to be used before, the mobile station accesses a channel as an immediate reaction to the reception of the message. If the moment the mobile station is ready to access is before the indicated time, the mobile station accesses the channels described for before the starting time. The mobile station then changes to the channel described for after the starting time at the indicated time. New parameters can be frequency list, MAIO and HSN. Other parameters describing the allocated channels must be identical to the parameters described for before the starting time. If the moment the mobile station is ready to access is after the starting time, the mobile station accesses the channel described for after the starting time.

3.4.4.2 Physical channel establishment

Four procedures are defined. The support of three of them is mandatory in the mobile station. The pseudo-synchronization case is optional in the mobile station. A pseudo-synchronized handover can be commanded only to a mobile station that can support it, as indicated in the classmark.

3.4.4.2.1 Finely synchronized cell case

If the mobile station knows that the timing advance with the new cell is not out of range, i.e. smaller than or equal to the maximum timing advance that can be coded as specified in GSM 04.04, or if the new cell does accept out of range timing advance as indicated in the HANDOVER COMMAND message, the mobile station proceeds as follows.

After having switched to the assigned channels, the mobile station sends four times the HANDOVER ACCESS message in four successive layer 1 frames on the main DCCH. This message is sent in an access burst. Its content is reduced to the handover reference information element. The transmission of these four messages is optional if so indicated by the network in the HANDOVER COMMAND message.

It then activates the channels in sending and receiving mode and connects the channels if need be.

If applicable, ciphering is immediately started . The access bursts are not ciphered.

3.4.4.2.2 Non synchronized cell case

After having switched to the assigned channels, the mobile station starts repeating the HANDOVER ACCESS message in successive layer 1 frames on the main DCCH. This message is sent in an access burst. Its content is reduced to the handover reference information element. The mobile station starts timer T3124 at the start point of the timeslot in which the HANDOVER ACCESS message is sent the first time.

The mobile station then activates the channels in receiving mode and connects the channels if need be (only for reception).

If applicable, deciphering is then immediately started . The access bursts are not ciphered.

When the network has the RF characteristics that are necessary, it sends in unacknowledged mode a PHYSICAL INFORMATION message to the mobile station on the main DCCH. If applicable, ciphering and deciphering is immediately started (i.e., before even the reception of a correct access burst), and the message is sent enciphered.

The PHYSICAL INFORMATION message contains various physical layer related information, allowing a proper transmission by the mobile station.

When sending the PHYSICAL INFORMATION message, the network starts timer T3105. If this timer times out before the reception of a correctly decoded layer 2 frame in format A or B (see GSM 04.06), or a correctly decoded TCH frame from the mobile station, the network repeats the PHYSICAL INFORMATION message and restarts timer T3105. The maximum number of repetitions is Ny1.

The correct decoding of a frame means that the decoding algorithm and the error detection tests, if any, indicate no error.

When the mobile station receives a PHYSICAL INFORMATION message, it stops timer T3124, stops sending access bursts, activates the physical channels in sending and receiving mode and connects the channels if need be. If the allocated channel is an SDCCH (+ SACCH), performance of the mobile station must enable the mobile station to accept a correct PHYSICAL INFORMATION message sent by the network in any block while T3124 is running.

3.4.4.2.3 Pseudo-synchronized cell case

The details of the use of this procedure are described in GSM 05.10. The mobile station computes the timing advance to be used with the new cell from the real time difference value given in the HANDOVER COMMAND message. If the mobile station knows that the timing advance with the new cell is not out of range , i.e. smaller or equal to the maximum timing advance that can be coded as specified in GSM 04.04, or if the new cell accepts an out of range timing advance as indicated in the HANDOVER COMMAND message, the mobile station switches to the new channel and proceeds as follows.

After having switched to the assigned channels, the mobile station sends in four successive slots on the main DCCH a HANDOVER ACCESS message. This message is sent in random mode and thus does not follow the basic format. Its content is reduced to the handover reference information element. The transmission of these four messages is optional if so indicated by the network in the HANDOVER COMMAND message.

The mobile station then activates the channels in sending and receiving mode and connects the channels if need be. The mobile station may activate the channels in receiving mode and connect the channels while sending access bursts.

If applicable, ciphering is then immediately started. The access bursts are not ciphered.

3.4.4.2.4 Pre-synchronized cell case

The details of the use of this procedure are described in GSM 05.10. The mobile station switches to the new channel and proceeds as follows.

After having switched to the assigned channels, the mobile station sends in four successive slots on the main DCCH a HANDOVER ACCESS message. This message is sent in an access burst and thus does not follow the basic format. Its content is reduced to the handover reference information element. The transmission of these four messages is optional if so indicated by the network in the HANDOVER COMMAND message.

The mobile station then activates the channel in sending and receiving mode and connects the channels if need be. The timing advance value to be used with the new cell is:

- either the value contained in the HANDOVER COMMAND message if the timing advance information element is present;
- or the default value for pre-synchronized handover as defined in GSM 05.10, if the timing advance information element is not included in the HANDOVER COMMAND message. The MS may activate the channels in receiving mode and connect the channels while sending access bursts.

If applicable, ciphering is immediately started. The access bursts are not ciphered.

3.4.4.3 Handover completion

After lower layer connections are successfully established, the mobile station returns a HANDOVER COMPLETE message, specifying cause "normal event", to the network on the main DCCH.

The sending of this message on the mobile station side and its receipt on the network side allow the resumption of the transmission of signalling layer messages other than those for RR management.

When receiving the HANDOVER COMPLETE message, the network stops timer T3103 and releases the old channels.

If requested to do so in the HANDOVER COMMAND message, the mobile station includes the observed time difference it has measured when performing the handover, corrected by half the timing advance, in the HANDOVER COMPLETE message (detailed specifications are given in GSM 05.10).

3.4.4.4 Abnormal cases

In the case of a synchronous or pseudo-synchronous handover, if the mobile station knows that the timing advance with the new cell is out of range, i.e. is bigger than the maximum timing advance that can be coded as specified in GSM 04.04, and if the new cell does not accept out of range timing advance as indicated in the HANDOVER COMMAND message, the mobile station sends a HANDOVER FAILURE message, cause "handover impossible, timing advance out of range", on the main signalling link and does not attempt that handover.

If the HANDOVER COMMAND message instructs the mobile station to use a Channel Description or Mode that it does not support, or if the Channel Mode to use is not defined for all channel sets, then the MS shall return a HANDOVER FAILURE message with cause "channel mode unacceptable", and the MS shall remain on the current channel(s) and uses the old Channel Description or Mode(s).

If the HANDOVER COMMAND message instructs the mobile station to use a frequency that it is not capable of, then the mobile station shall return a HANDOVER FAILURE message with cause "frequency not implemented", and the mobile station shall remain on the current channel(s).

If the mobile station receives a HANDOVER COMMAND message with a Frequency List IE or Frequency Short List IE indicating frequencies that are not all in one band, then the mobile station shall stay on the current channel(s) and send a HANDOVER FAILURE message with cause "frequency not implemented". If the mobile station receives a HANDOVER COMMAND message with a Mobile Allocation IE indexing frequencies that are not all in one band, then the mobile station shall stay on the current channel(s) and send a HANDOVER FAILURE message with cause "frequency not implemented".

NOTE: A HANDOVER COMMAND message sent to a multi band mobile station shall not be considered invalid because it indicates target channel frequencies that are all in a different frequency band to that of the ARFCN in the Cell Description IE.

On the mobile station side, if timer T3124 times out (only in the non- synchronized case) or if a lower layer failure happens on the new channel before the HANDOVER COMPLETE message has been sent, the mobile station deactivates the new channels, reactivates the old channels, reconnects the TCHs if any and triggers the establishment of the main signalling link. It then sends a HANDOVER FAILURE message on the main signalling link and resumes normal operation as if no handover attempt had occurred. The operational parameters (e.g. ciphering mode) when returning on the old channel are those applied before the HANDOVER COMMAND message was received.

When the HANDOVER FAILURE message has been received, the network releases the new channels if they were dedicated channels and stops timers T3105 and stops T3103 in the non-synchronized case. If the new channels were VGCS channels, they shall be maintained.

If a lower layer failure happens while attempting to connect back to the old channels, the standard rules are applied (cf. section 3.4.13.2 for dedicated mode and 3.4.13.5 for group transmit mode).

On the network side, if timer T3103 elapses before either the HANDOVER COMPLETE message is received on the new channels, or a HANDOVER FAILURE message is received on the old channels, or the mobile station has re-established the call, the old channels are released if they were dedicated channels and all contexts related to the connections with that mobile station are cleared. If the old channel was a VGCS channel, it shall be maintained and the uplink shall be set free.

On the network side, if neither a correctly layer 2 frame in format A or B nor a correctly TCH frame have been received from the mobile station on the new channel, the newly allocated channels are released if they were dedicated channels. If the new channels were VGCS channels, they shall be maintained and the uplink shall be set free..

On the network side, lower layer failures occurring on the old channels after the sending of the HANDOVER COMMAND message are ignored. Lower layer failures occurring after the receipt of the SABM frame on the new main signalling link are treated following a general scheme (cf. section 3.4.13.2 for dedicated mode and 3.4.13.5 for group transmit mode).

3.4.5 Frequency redefinition procedure

In dedicated mode and group transmit mode, this procedure is used by the network to change the frequencies and hopping sequences of the allocated channels. This is meaningful only in the case of frequency hopping.

The network sends to the mobile station a FREQUENCY REDEFINITION message containing the new parameters together with a starting time indication.

NOTE: The network should take into account limitations of certain mobile stations to understand formats used in the Cell Channel Description IE used in the FREQUENCY REDEFINITION message, see section 10.5.2.13.

When receiving such a message, the mobile station modifies the frequencies/hopping sequences it uses at the exact indicated time slot, i.e. the indicated time slot is the first with new parameters. All other functions are not disturbed by this change. New parameters can be the cell channel description, the mobile allocation and the MAIO. In case of multislot configuration, the Channel Description IE shall describe the channel carrying the main signalling link, the new parameters however, shall be used for all assigned timeslots. Other parameters describing the allocated channels must be identical to the current parameters.

3.4.5.1 Abnormal cases

If the mobile station receives a FREQUENCY REDEFINITION message with a Mobile Allocation IE indexing frequencies that are not all in one band and a Starting Time IE indicating a time that has not elapsed, then the mobile station shall stay on the current channel(s) and send a RR STATUS message with cause "frequency not implemented".

If the mobile station receives a FREQUENCY REDEFINITION message with a Mobile Allocation IE indexing frequencies that are not all in one band and a Starting Time IE indicating a time that has elapsed, then the mobile station shall locally abort the radio connection and, if permitted, attempt Call Re-establishment.

If the mobile station receives a FREQUENCY REDEFENITION message on a channel for which it has a pending redefinition (defined by the immediate assignment, assignment or handover procedure or a previous frequency redefinition procedure) the frequencies, hopping and starting time parameters defined by the new frequency redefinition procedure supersedes those of the pending one.

NOTE: A FREQUENCY REDEFINITION message sent to a multi band mobile station shall not be considered invalid because it indicates new frequencies that are all in a different frequency band to that of the ARFCN of the serving cell.

3.4.6 Channel mode modify procedure

In dedicated mode or group transmit mode, higher layers can request the setting of the channel mode.

The channel mode modify procedure allows the network to request the mobile station to set the channel mode for one channel or one channel set. The procedure shall not be used if the multislot configuration contains more than one channel set. The channel mode covers the coding, decoding and transcoding mode used on the indicated channel.

This procedure is always initiated by the network.

NOTE: Direct transitions between full rate speech coder version 1 and full rate speech coder version 2 (and vice versa) may cause unpleasant audio bursts.

3.4.6.1 Normal channel mode modify procedure

3.4.6.1.1 Initiation of the channel mode modify procedure

The network initiates the procedure by sending a CHANNEL MODE MODIFY message to the mobile station. This message contains:

- a channel description of the channel(s) on which the mode in the CHANNEL MODE MODIFY message shall be applied; and
- the mode to be used on that channel, or on all the channels of a channel set in a multislot configuration.

3.4.6.1.2 Completion of channel mode modify procedure

When it has received the CHANNEL MODE MODIFY message, the mobile station sets the mode for the indicated channel, and if that is in a multislot configuration, the whole channel set and then replies by a CHANNEL MODE MODIFY ACKNOWLEDGE message indicating the ordered channel mode.

This applies whether the mode commanded by the CHANNEL MODE MODIFY is different from the one used by the mobile station or whether it is already in use.

3.4.6.1.3 Abnormal cases

No specific action for a lower layer failure is specified in this section. If the mobile station does not support the indicated mode, it shall retain the old mode and return the associated channel mode information in the CHANNEL MODE MODIFY ACKNOWLEDGE message.

3.4.6.2 Channel mode modify procedure for a voice group call talker

3.4.6.2.1 Initiation of the channel mode modify procedure

The network initiates the procedure by sending a CHANNEL MODE MODIFY message to the mobile station. This message contains:

- a channel description of the channel on which the CHANNEL MODE MODIFY message is sent; and
- the new channel mode to be used on the channel; and
- optionally, the VGCS target mode information element defining which RR mode is to be used with the new channel mode (i.e. dedicated mode or group transmit mode). If this information element is not present, the RR mode shall be assumed to be the same as with the previous channel mode. The VGCS target mode information element shall also indicate the group cipher key number for the group cipher key to be used on the new channel or if the new channel is non ciphered. If the information element is not present, the ciphering mode and ciphering key shall be the same as with the previous channel mode. Mobile stations not supporting VGCS talking shall ignore the CHANNEL MODE MODIFY message if the VGCS target mode information element is included in the message and shall send an RR STATUS message to the network with cause #96.

The start of ciphering with a group cipher key with the new channel mode is only possible when the mode on the old channel was not ciphered.

If a VGCS target mode information element indicating a group cipher key number is included in the message and the previous mode is not non ciphered and the group cipher key number is different to the previous cipher key number, the mobile station shall behave as if it would not support the indicated channel mode.

3.4.6.2.2 Completion of mode change procedure

When it has received the CHANNEL MODE MODIFY message, the mobile station changes the mode for the indicated channel and then replies by a CHANNEL MODE MODIFY ACKNOWLEDGE message indicating the new channel mode.

3.4.6.2.3 Abnormal cases

No specific action for a lower layer failure is specified in this section. If the mobile station does not support the indicated mode, it shall retain the old mode and return the associated channel mode information in the CHANNEL MODE MODIFY ACKNOWLEDGE message.

3.4.7 Ciphering mode setting procedure

In dedicated mode, the ciphering mode setting procedure is used by the network to set the ciphering mode, i.e. whether or not the transmission is ciphered, and if so which algorithm to use. The procedure shall only be used to change from "not ciphered" mode to "ciphered" mode, or vice-versa, or to pass a CIPHERING MODE COMMAND message to the mobile station while remaining in the "not ciphered" mode. The ciphering mode setting procedure is always triggered by the network and it only applies to dedicated resources.

The cipher mode setting procedure shall not be applied in group transmit mode.

3.4.7.1 Ciphering mode setting initiation

The network initiates the ciphering mode setting procedure by sending a CIPHERING MODE COMMAND message to the mobile station on the main signalling link, indicating whether ciphering shall be used or not, and if yes which algorithm to use.

Additionally, the network may, by the use of the cipher response information element, request the mobile station to include its IMEISV in the CIPHERING MODE COMPLETE message.

The new mode is applied for reception on the network side after the message has been sent.

3.4.7.2 Ciphering mode setting completion

Whenever the mobile station receives a valid CIPHERING MODE COMMAND message, it shall, if a SIM is present and considered valid by the ME and the ciphering key sequence number stored on the SIM indicates that a ciphering key is available, load the ciphering key stored on the SIM into the ME. A valid CIPHERING MODE COMMAND message is defined to be one of the following:

- one that indicates "start ciphering" and is received by the mobile station in the "not ciphered" mode;
- one that indicates "no ciphering" and is received by the MS in the "not ciphered" mode; or
- one that indicates "no ciphering" and is received by the mobile station in the "ciphered" mode.

Other CIPHERING MODE COMMAND messages shall be regarded as erroneous, an RR STATUS message with cause "Protocol error unspecified" shall be returned, and no further action taken.

Upon receipt of the CIPHERING MODE COMMAND message indicating ciphering, the mobile station shall start transmission and reception in the indicated mode.

When the appropriate action on the CIPHERING MODE COMMAND has been taken, the mobile station sends back a CIPHERING MODE COMPLETE message. If the "cipher response" field of the cipher response information element in the CIPHERING MODE COMMAND message specified "IMEI must be included" the mobile station shall include its IMEISV in the CIPHERING MODE COMPLETE message.

Upon receipt of the CIPHERING MODE COMPLETE message or any other correct layer 2 frame which was sent in the new mode, the network starts transmission in the new mode.

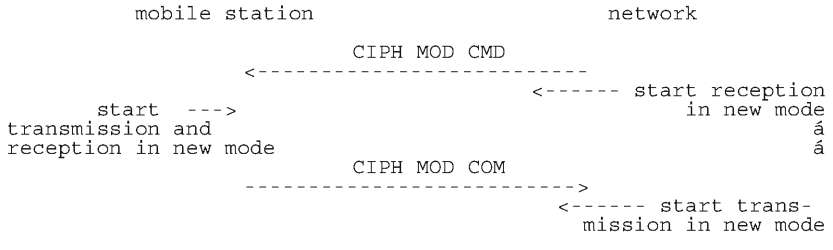


Figure 3.3/GSM 04.08: Ciphering mode setting sequence

3.4.8 Additional channel assignment procedure

NOTE: In the present state of GSM 04.03, this procedure is only possible for the TCH/H + ACCHs to TCH/H + TCH/H + ACCHs transition. As a consequence it is not needed for simple mobile stations. The description of the procedure is in general terms to cope with possible evolution.

In dedicated mode, a change of channel configuration to include an additional channel can be requested by upper layers.

The additional channel assignment procedure shall not be applied in group transmit mode,

The purpose of the additional assignment procedure is to allocate an additional dedicated channel to a mobile station while keeping the previously allocated channels. In particular the main DCCH and the SACCH are not modified, and signalling exchanges are not interrupted.

The additional assignment procedure may happen only in dedicated mode. It is used for instance for the transition from the TCH/H + ACCHs configuration to the TCH/H + TCH/H + ACCHs configuration.

The additional assignment procedure is always initiated by the network.

3.4.8.1 Additional assignment procedure initiation

The network initiates the procedure by sending an ADDITIONAL ASSIGNMENT message to the mobile station on the main DCCH. The ADDITIONAL ASSIGNMENT message contains the description of the newly assigned channel.

On receipt of the message, the mobile station activates the new channel.

3.4.8.2 Additional assignment procedure completion

The mobile station sends an ASSIGNMENT COMPLETE message to the network on the channel, on which it receives the ADDITIONAL ASSIGNMENT message.

3.4.8.3 Abnormal cases

A lower layer failure occurring during the procedure is treated according to the general case (see section 3. 4.13.2).

The network considers the channel as allocated from the sending of the ADDITIONAL ASSIGNMENT message. As a consequence, if a re-establishment occurs, the network will consider the context as if the mobile station has received the message, and the new configuration allocated after the re-establishment may differ from the one the mobile station had before the re-establishment.

3.4.9 Partial channel release procedure

In dedicated mode, a change of channel configuration to release one channel can be requested by upper layers.

The partial channel release procedure shall not be applied in group transmit mode.

The purpose of this procedure is to deactivate part of the dedicated channels in use. The channel configuration remains dedicated.

NOTE: In the present state of GSM 04.03, this procedure is only possible for the TCH/H + TCH/H + ACCHs to TCH/H + ACCHs transition. As a consequence it is not needed for simple mobile stations.

The partial release procedure is always initiated by the network.

3.4.9.1 Partial release procedure initiation

The network initiates the partial release by sending a PARTIAL RELEASE message to the mobile station on the main DCCH.

On receipt of the PARTIAL RELEASE message the mobile station:

- Initiates the disconnection of all the link layer connections carried by the channel to be released;
- Simultaneously initiates the connection on remaining channels of the data link layer connections that have been released;
- Deactivates the physical channels to be released.
- Sends a PARTIAL RELEASE COMPLETE to the network on the (possibly new) main signalling link.

3.4.9.2 Abnormal cases

A lower layer failure is treated following the general rules as specified in section 3. 4.13.2.

Moreover, on the network side, the channel configuration nature is set from the sending of the PARTIAL RELEASE message onward. As a consequence, any new assignment after a re-establishment may concern a different channel configuration nature from the one known by the mobile station before the re-establishment.

3.4.10 Classmark change procedure

In dedicated mode or in group transmit mode, this procedure allows the mobile station to indicate to the network a change of characteristics reflected in the classmark (e.g. due to addition of power amplification). Furthermore, a mobile station which implements the « controlled early classmark sending » option may also send a CLASSMARK CHANGE message as described in clause 3.3.1.1.4, even if no change of characteristics has occurred.

The mobile station sends a CLASSMARK CHANGE message to the network. This message contains the new mobile station classmark 2 information element. It may also contain a Classmark 3 Information Element. There is no acknowledgement from the network at layer 3.

3.4.11 Classmark interrogation procedure

This procedure allows the network to request additional classmark information from the mobile station (e.g. if the information initially sent by the mobile station is not sufficient for network decisions).

3.4.11.1 Classmark interrogation initiation

The network initiates the classmark interrogation procedure by sending a CLASSMARK ENQUIRY message to the mobile station on the main DCCH.

3.4.11.2 Classmark interrogation completion

On receipt of the CLASSMARK ENQUIRY message the mobile station sends a CLASSMARK CHANGE message to the network on the main DCCH. This message contains the mobile station classmark 2 information element. It may also contain a Classmark 3 Information Element.

3.4.12 Indication of notifications and paging information

Only applicable for mobile stations supporting VGCS listening or VBS listening:

In dedicated mode or in group transmit mode, the RR entity shall provide indications to the upper layer on all received notifications for voice group calls or voice broadcast calls according to the VGCS or VBS subscription data stored in the mobile station. The indication shall include the notified group or broadcast call reference and possibly the related priority, if provided.

In group transmit mode, if the mobile station has received a paging message with the own mobile station identity on the PCH or on the voice group call channel downlink, the RR entity shall provide an indication to the upper layers, together with the related priority, if applicable.

In group transmit mode, if the RR entity receives information on the voice group call channel of the existence of a paging message in its paging subgroup of the PCH, the RR entity shall pass this information to the upper layers together with the related priority if provided (see also section 3.3.2 and 3.3.3).

3.4.13 RR connection release procedure

3.4.13.1 Normal release procedure

The release of the RR connection can be requested by upper layers.

The purpose of this procedure is to deactivate all the dedicated channels in use. When the channels are released, the mobile station returns to the CCCH configuration, idle mode. The channel release procedure can be used in a variety of cases, including TCH release after a call release, and DCCH release when a dedicated channel allocated for signalling is released.

In dedicated mode and group transmit mode, the channel release procedure is always initiated by the network.

If the mobile station is IMSI attached for GPRS services (section 4) at release of the RR connection, the mobile station shall return to packet idle mode, or if a temporary block flow is established, continue in packet transfer mode.

3.4.13.1.1 Channel release procedure initiation in dedicated mode and in group transmit mode

The network initiates the channel release by sending a CHANNEL RELEASE message to the mobile station on the main DCCH, starts timer T3109 and deactivates the SACCH.

On receipt of a CHANNEL RELEASE message the mobile station starts timer T3110 and disconnects the main signalling link. When T3110 times out, or when the disconnection is confirmed, the mobile station deactivates all channels, considers the RR connection as released, and returns to CCCH idle mode.

NOTE: Data Links other than the main signalling link are disconnected by local end link release.

If case of dedicated mode, on the network side, when the main signalling link is disconnected, the network stops timer T3109 and starts timer T3111. When timer T3111 times out, the network deactivates the channels, they are then free to be allocated to another connection.

NOTE: The sole purpose of timer T3111 is to let some time to acknowledge the disconnection and to protect the channel in case of loss of the acknowledge frame.

If timer T3109 times out, the network deactivates the channels; they are then free to be allocated to another connection.

The CHANNEL RELEASE message will include an RR cause indication as follows:

#0 if it is a normal release, e.g. at the end of a call or at normal release of a DCCH.

#1 to indicate an unspecified abnormal release.

#2, #3 or #4 to indicate a specific release event.

#5 if the channel is to be assigned for servicing a higher priority call (e.g. an emergency call).

#65 if e.g. a handover procedure is stopped because the call has been cleared.

The CHANNEL RELEASE message may include the information element BA Range which may be used by a mobile station in its selection algorithm (see GSM 05.08 and GSM 03.22).

Mobile stations not supporting VGCS or VBS listening shall consider Group Channel Description and Group Cipher Key Number information elements as unnecessary in the message and perform the channel release procedure as normal.

For mobile stations supporting VGCS listening, the following procedures apply:

The CHANNEL RELEASE message may include the information element Group Channel Description. In this case, the mobile station shall release the layer 2 link, enter the group receive mode and give an indication to the upper layer. If a CHANNEL RELEASE message with no Group Channel Description is received, the normal behaviour applies.

If ciphering is applied on the VGCS or VBS channel, the network shall provide in the CHANNEL RELEASE message with the Group Cipher Key Number information element for the group cipher key to be used by the mobile station for reception of the VGCS or VBS channel. If this information element is not included, no ciphering is applied on the VGCS or VBS channel.

A mobile station not supporting the « GPRS » option shall consider the GPRS Resumption information element as an information element unknown in the message and continue the channel release procedure as normal.

For a mobile station supporting the « GPRS » option, the following additional procedures also apply:

The CHANNEL RELEASE message may include the information element GPRS Resumption. If the GPRS Resumption information element indicates that the network has resumed GPRS services, the RR sublayer of the mobile station shall indicate a RR GPRS resumption complete to the MM sublayer, see section 4. If the GPRS Resumption information element indicates that the network has not successfully resumed GPRS services, the RR sublayer of the mobile station shall indicate a RR GPRS resumption failure to the MM sublayer, see section 4.

If the mobile station has performed the GPRS suspension procedure (section 3.3.1.1.4.2) and the GPRS Resumption information element is not included in the message, the RR sublayer of the mobile station shall indicate a RR GPRS resumption failure to the MM sublayer, see section 4.

If the mobile station has not performed the GPRS suspension procedure and the GPRS Resumption information element is not included in the message, the mobile station shall continue the channel release procedure as normal.

3.4.13.1.2 Abnormal cases

Abnormal cases are taken into account in the main part of the description of the procedure.

3.4.13.2 Radio link failure in dedicated mode

The main part of these procedures concerns the "normal" cases, i.e. those without any occurrence of loss of communication means. A separate paragraph at the end of the description of each procedure treats the cases of loss of communication, called a radio link failure. In dedicated mode, in most of the cases the reaction of the mobile station or the network is the same. Those reactions are described in this section to avoid repetitions.

A radio link failure can be detected by several ways:

1) By analysis of reception at layer 1, as specified in GSM 05.08 and section 3.4.1.1.
2) By a data link layer failure as specified in GSM 04.06, on the main signalling link. A data link failure on any other data link shall not be considered as a radio link failure.
3) When a lower layer failure happens while the mobile station attempts to connect back to the old channels in a channel assignment procedure or handover procedure.
4) In some cases where timers are started to detect the lack of answer from the other party, as described in section 3.

The two first cases are known by the term "lower layer failure".

3.4.13.2.1 Mobile side

When a radio link failure is detected by the mobile station,

- the MS shall perform a local end release on all signalling links unless otherwise specified;
- the mobile station shall deactivate all channels;
- the RR sublayer of the mobile station shall indicate an RR connection failure to the MM sublayer unless otherwise specified.

NOTE: Upper layers may decide on a re-establishment (cf. section 5.5.4).

3.4.13.2.2 Network side

In dedicated mode, the reaction of the network to a lower layer failure depends on the context. Except when otherwise specified, it is to release the connection either with the channel release procedure as specified in section 3.5.1, or with the following procedure. The network starts timer T3109 and deactivates the SACCH (and hence to stop transmission on the SACCH).

When a radio link failure has been detected, an indication is passed to the upper Mobility Management sublayer on the network side.

When timer T3109 expires, the network can regard the channels as released and free for allocation.

This procedure relies on the fact that if a mobile station does not receive the SACCH for some time, it completely releases the channels (cf. GSM 05.08).

NOTE: The network should maintain for a while the transaction context in order to allow call re-establishment. The length of timer is for further study.

When a mobile station which has performed the GPRS suspension procedure (section 3.3.1.1.4.2) detects a radio link failure, the RR sublayer of the mobile station shall indicate a RR GPRS resumption failure to the MM sublayer, see section 4.

3.4.13.3 RR connection abortion in dedicated mode

The mobile station aborts the RR connection by initiating a normal release of the main signalling link, performing local end releases on all other signalling links and disconnecting all traffic channels, if any.

When a mobile station which has performed the GPRS suspension procedure (section 3.3.1.1.4.2) aborts the RR connection, the RR sublayer of the mobile station shall indicate a RR GPRS resumption failure to the MM sublayer, see section 4.

3.4.13.4 Uplink release procedure in group transmit mode

If the uplink release is requested by the upper layer the mobile station shall send an UPLINK RELEASE message on the voice group call channel uplink, perform a release of the main signalling link and go back to the group receive mode.

If the UPLINK RELEASE message is received from the network on the voice group call channel downlink, the MS shall perform a release of the main signalling link and go back to the group receive mode.

3.4.13.5 Radio link failure in group transmit mode

The main part of these procedures concerns the "normal" cases, i.e. those without any occurrence of loss of communication means. A separate paragraph at the end of the description of each procedure treats the cases of loss of communication, called a radio link failure. In group transmit mode, in most of the cases the reaction of the mobile station or the network is the same. Those reactions are described in this section to avoid repetitions.

A radio link failure can be detected by several ways:

1) By analysis of reception at layer 1, as specified in GSM 05.08 and section 3.4.1.1.

2) By a data link layer failure as specified in GSM 04.06, on the main signalling link. A data link failure on any other data link shall not be considered as a radio link failure.

3) When a lower layer failure happens while the mobile station attempts to connect back to the old channels in a channel assignment procedure or handover procedure.

4) In some cases where timers are started to detect the lack of answer from the other party, as described in section 3.

The two first cases are known by the term "lower layer failure".

3.4.13.5.1 Mobile side

When a radio link failure is detected by the mobile station,

- the MS shall perform a local end release on all signalling links;
- the mobile station shall go back to idle mode and, when possible, to group receive mode;
- the RR sublayer of the mobile station shall indicate an RR connection failure to the MM sublayer unless otherwise specified.

3.4.13.5.2 Network side

When the uplink has been allocated and the network detects a lower layer failure, the network shall set the uplink free and provide an UPLINK FREE message on the main signalling channel, when appropriate.

When a radio link failure has been detected, an indication is passed to the upper Mobility Management sublayer on the network side.

3.4.14 Receiving a RR STATUS message by a RR entity.

If the RR entity of the mobile station receives a RR STATUS message no transition and no specific action shall be taken as seen from the radio interface, i.e. local actions are possible.

The actions to be taken on receiving a RR STATUS message in the network are an implementation dependent option see also section 8.

3.4.15 Group receive mode procedures

Only applicable for support of VGCS listening or VBS listening.

3.4.15.1 Mobile station side

3.4.15.1.1 Reception of the VGCS or VBS channel

In group receive mode, the mobile station receives the downlink of the voice broadcast channel or voice group call channel for which the channel description was provided within the notification message or in the related command message. The mobile station should also listen to the CCCH of the serving cell. Moreover, it measures the received levels on the serving cell and on the neighbour cells to assess the need for a cell reselection as specified in GSM 05.08. The general cell reselection procedure for the mobile station in group receive mode is described in GSM 03.22.

Information on neighbour cells used for cell reselection and reception of the VGCS or VBS channel in the neighbour cells may be provided on the downlink messages (see section 3.4.15.1.2). If no such information is provided or information is missing, the mobile station shall try to read this information on the BCCH and NCH of the neighbour cells.

3.4.15.1.2 Monitoring of downlink messages and related procedures

Mobile stations in group receive mode shall monitor messages related to the following procedures on the VGCS or VBS channel downlink and act appropriately in order to be able to keep receiving the VGCS or VBS channel downlink.

All messages for mobile stations in group receive mode shall be sent in UI format on the VGCS or VBS channel downlink. Mobile stations in group receive mode shall ignore all messages which are not sent in UI format or which are not related to the following mentioned procedures.

The mobile should also monitor messages on the PCH or NCH of the current cell.

3.4.15.1.2.1 Spare

3.4.15.1.2.2 Spare

3.4.15.1.2.3 Channel mode modify procedure

The mobile station shall receive CHANNEL MODE MODIFY messages. The mobile station shall use the new channel mode but shall not transmit any response to the network.

3.4.15.1.2.4 Notification and paging information

The mobile station shall monitor messages related to notification and paging procedures.

The RR entity shall provide indications on all received notifications for voice group calls or voice broadcast calls to the upper layer. The indication shall include the notified group or broadcast call reference and, if provided, and if the mobile station supports eMLPP the related priority.

On request by the upper layer to join another voice broadcast call or voice group call for which a corresponding notification has been received on the VGCS or VBS channel downlink, the RR entity shall read the corresponding notification on the NCH.

If the mobile station has received a paging message with its own mobile station identity on the PCH or on the voice broadcast channel or voice group call channel downlink, the RR entity shall provide an indication to the upper layers, together with the related priority, if applicable.

3.4.15.1.2.4.1 Use of Reduced NCH monitoring

This section applies to mobile stations which are in group receive mode or group transmit mode of dedicated mode and which in addition want to receive notification messages for other voice broadcast calls or voice group calls and which aim at reducing the reception load.

If the reduced NCH monitoring mechanism is used on the NCH as defined in section 3.3.3.3, when the MS in group receive mode or group transmit mode enters a cell, it should read the NCH until it has received at least two messages on the NCH indicating NLN, with the two last received NLN being identical. Then it should stop reading the NCH until it receives on the SACCH an NLN(SACCH) different from the last previously received NLN.

For this, a parameter is provided on the SACCH in the SYSTEM INFORMATION TYPE 6 message:

- NLN(SACCH): Notification List Number (received on the SACCH).

If a mobile station receives on the SACCH an NLN(SACCH) different from the last received NLN it may read the NCH until it has received at least two messages on the NCH indicating NLN with the two last received NLN being identical.

If a message in the SACCH is not received correctly the MS may read the NCH until it has received at least two messages on the NCH indicating NLN, with the two last received NLN being identical.

NOTE: If the NLN(SACCH) is not provided on the SACCH, the mobile station, depending on its particular implementation, may either read the NCH while being in group receive mode or group transmit mode or may not be able to receive notifications for other voice group calls or voice broadcast calls other than those notifications provided on the FACCH.

3.4.15.1.2.5 Uplink status messages

Mobile stations supporting VGCS talking shall monitor the VGCS uplink control related messages UPLINK FREE and UPLINK BUSY.

3.4.15.1.2.6 Channel release message

The mobile station shall receive CHANNEL RELEASE messages. On receipt of a CHANNEL RELEASE message, the RR entity shall go to idle mode and give an indication to the upper layer. (See also section 3.4.15.1.4.1, 4th paragraph.)

3.4.15.1.2.7 Information on paging channel restructuring

On receipt of a SYSTEM INFORMATION TYPE 6 message indicating that paging channel restructuring has taken place, if the mobile station wants to be able to read its paging subchannel while in group receive mode or group transmit mode, the mobile station should read the related messages on the BCCH to know the position of its paging group.

3.4.15.1.3 Uplink reply procedure

Only applicable for mobile stations supporting « VGCS talking ».

On receipt of an UPLINK FREE message with an uplink access request indication from the network on the voice group call channel downlink, the mobile station shall send two UPLINK ACCESS messages on the voice group call channel with establishment cause "Reply on uplink access request" and then stop immediately transmitting on the uplink.

The first UPLINK ACCESS message shall be transmitted by the mobile station with a random delay between 0 and 20 ms. The second UPLINK ACCESS messages shall be repeated after a further period of 100 ms plus a random delay between 0 and 20 ms.

If an uplink identity code (UIC) of the current cell has been provided by the network in the UPLINK FREE message, the mobile station shall use this UIC for the coding of the UPLINK ACCESS messages. If no UIC is provided, the mobile station shall use the BSIC received of the serving cell, for instance as received from the initial synchronization.

3.4.15.1.4 Leaving the group receive mode

3.4.15.1.4.1 Returning to idle mode

If the mobile station enters a new cell in which:

- notifications for the current group or broadcast call are sent; but
- no VGCS or VBS channel description for the current group or broadcast call is provided;

the mobile station shall go to idle mode and give an indication to the upper (sub-)layers.

NOTE: Upper (sub-)layers then can request the establishment of an RR connection in order to be informed about the channel description by the network.

If the mobile station enters a cell in which notifications for the current group or broadcast call are not sent, the mobile station shall disconnect locally the TCH, go to idle mode and give an indication to the upper (sub-)layers.

On request by the upper layer in order to respond to a paging message the RR entity shall go to the idle mode in order to establish a dedicated RR connection.

On receipt of a CHANNEL RELEASE message in UI format from the network the RR entity shall go to idle mode and give an indication to the upper layer.

If the upper layer requests to abort the group receive mode, the mobile station shall go back to idle mode.

3.4.15.1.4.2 Going to group transmit mode

Only applicable for mobile stations supporting VGCS talking.

If the upper layer requests an uplink access, the mobile station shall perform the uplink investigation procedure as defined in section 3.3.1.2.1.1.

If the uplink investigation procedure is not successful, the mobile station shall give an indication to the upper layers and remain in group receive mode.

If the uplink investigation procedure is successful, the uplink access procedure is initiated as defined in section 3.3.1.2.1.2.

If the uplink access procedure is successful, the mobile station shall give an indication to the upper layers and enter the group transmit mode.

If the uplink access procedure is not successful, the mobile station shall give an indication to the upper layers and remain in group receive mode.

3.4.15.2 Network side

3.4.15.2.1 Provision of messages on the VGCS or VBS channel downlink

3.4.15.2.1.1 General

The network shall provide all messages directed to mobile stations in group receive mode (see section 3.4.15.1.2) in unacknowledged mode. Those messages which are also sent to the mobile station in group transmit mode in acknowledged mode have therefore to be repeated in addition as UI messages on the VGCS channel downlink if they shall also be received by mobile stations in group receive mode.

3.4.15.2.1.2 Provision of general information messages

In the case where the group call area exceeds one cell, the network should provide the SYSTEM INFORMATION TYPE 6 message on the SACCH related to the voice broadcast channel or voice group call channel.

In addition, if the group call area exceeds one cell, the network should provide SYSTEM INFORMATION TYPE 5 (possibly together with TYPE 5bis and 5ter) on the SACCH related to the voice broadcast channel or voice group call channel.

- The SYSTEM INFORMATION TYPE 5, TYPE 5bis and TYPE 5ter messages provide information on the BCCH frequency of the neighbour cells.
- The SYSTEM INFORMATION TYPE 6 message provides information on the location area of the current cell, possibly the status of the NCH, and an indication of whether paging channel restructuring has taken place.
- $(ASCI)$ Optional messages of the SYSTEM INFORMATION TYPE 10 message type provide information improving cell re-selection in group receive mode.

The network may also provide layer 3 messages for notification on the VGCS or VBS channel downlink FACCH.

3.4.15.2.1.3 Provision of messages related to the voice group call uplink channel

Only applicable for the support of VGCS talking.

The network shall provide UPLINK FREE messages on the main signalling link of all voice group call channels when the uplink is set free. The provision of UPLINK FREE messages shall be repeated as long as no uplink is granted to a mobile station.

The network shall provide an UPLINK BUSY message on the main signalling link of all voice group call when the uplink has been granted to a mobile station.

The network may send UPLINK FREE messages containing an uplink access request on the main signalling channel of the VGCS channels in order to obtain knowledge on whether any listening mobile is present in a cell or not. If there is no mobile station responding to the uplink access request, the network may decide to clear the VGCS channel in that cell.

3.4.15.2.2 Release of the VGCS or VBS Channels

If a release request for a voice group call is received from the upper layer, the network, after having released the RR connection with the mobile station in group transmit mode, shall stop the notification procedures for that voice group call and clear all related voice group call channels.

If a release request for a voice broadcast call is received from the upper layer, the network shall stop the notification procedures for that voice broadcast call and locally disconnect any channel related to the voice broadcast call.

3.4.15.3 Failure cases

If the mobile station looses the voice group call channel or voice broadcast channel, the mobile station shall search all possible channel positions on the current cell and the neighbour cells for which a channel description is known for that call.

3.4.16 Configuration change procedure

This is only applicable for multislot configuration.

The configuration change procedure is used by the network to change the number of timeslots used in a multislot configuration. The procedure can also be used to change the channel mode of one or several channels and change their allocation. The main signalling link however, cannot be changed by the configuration change procedure. If a change of the main signalling link is needed, the assignment or handover procedures shall be used.

The network shall not initiate a new configuration change procedure before a response to the previous CONFIGURATION CHANGE COMMAND message has been received from the mobile station.

3.4.16.1 Configuration change initiation

The procedure starts when the network sends a CONFIGURATION CHANGE COMMAND to the mobile station on the main DCCH. The message indicates:

- which timeslots to use in uplink;
- which timeslots to use in downlink; and
- which channel set each timeslot belongs to.

The message may also contain definitions of the channel mode to be applied for one or several channel sets. If a previously undefined channel set is defined by the CONFIGURATION CHANGE COMMAND a definition of the channel mode for the new channel set shall be included in the message.

3.4.16.2 Configuration change completion

When the mobile station receives the CONFIGURATION CHANGE COMMAND it changes its configuration in accordance with the message contents and returns a CONFIGURATION CHANGE ACKNOWLEDGE on the same channel as the command message was received, confirming the new channel configuration. This applies irrespective of whether the new configuration is different from the one already in use by the mobile station or if it is the same.

3.4.16.3 Abnormal cases

If the CONFIGURATION CHANGE COMMAND message instructs the mobile station to use a Channel Configuration or Mode(s) that it does not support, or if the channel mode to use is not defined for all channel sets, the mobile station shall return a CONFIGURATION CHANGE REJECT message with cause 'channel mode unacceptable', and the mobile station shall remain on the current channel(s) and use the old Channel Configuration and Channel Mode(s).

3.4.17 Mapping of user data substreams onto timeslots in a multislot configuration

For multislot configurations the following rules for mapping of the user data substreams onto timeslots shall apply for each channel set:

- at initial assignment (using assignment procedure), the lowest numbered user data substream shall be mapped to the lowest numbered timeslot etc. in ascending order (the user data substreams are numbered 0 to (n-1), where n is the number of substreams)
- at channel changes using handover procedure or assignment procedure (where none of the timeslots are present in both the old and the new configuration), the lowest numbered user data substream shall be mapped to the lowest numbered timeslot etc. in ascending order (the user data substreams are numbered 0 to (n-1), where n is the number of substreams)
- at channel changes using assignment procedure (where at least one of the timeslots is the same in both the old and the new configuration) or configuration change procedure:
  - user data substream(s) mapped to timeslot(s) that are present in both the old and the new configuration shall continue to be mapped to the same timeslot(s) as before the channel change; and

– possibly added timeslot(s) shall carry the lowest numbered available user data substream so that the lowest numbered data substream among the added is mapped to the lowest numbered added timeslot and so on in ascending order.

NOTE: The user data substream number is a number that need not be the same as the inband number used for transparent services. The user data substream number is only used as a point of reference to a specific user data substream.

3.4.18 Handling of classmark information at band change

The coding of some fields in the *Mobile Station Classmark 1* and in the *Mobile Station Classmark 2* information elements depends on the band in use as described in subclause 10.5.1.5 and subclause 10.5.1.6. When a command to change the frequency band (GSM 900, DCS 1800) has been received (by, e.g., an IMMEDIATE ASSIGNMENT message, an ASSIGNMENT COMMAND message, a HANDOVER COMMAND message or a FREQUENCY REDEFINITION message) the following applies:

- When an IMMEDIATE ASSIGNMENT message is received, "the band used" for the purpose of coding the classmark information in the service request message, see subclause 3.1.5, shall be understood as the band used for the CHANNEL REQUEST message or (one of) the band(s) indicated by the IMMEDIATE ASSIGNMENT message.

- For other cases "the band used" for the purpose of coding the classmark information shall be understood as one of the bands used or attempted to be used within the 2 seconds preceding the passing of the layer 3 message containing the classmark information to the layer 2 send queue as described in GSM 04.06.

NOTE: This definition means that when a band change is being done the network must take appropriate actions to handle possible ambiguities in the frequency band related information in the classmark.

3.4.19 Assignment to a Packet Data channel

This section is only applicable to mobile stations supporting the <<GPRS>> option.

When in dedicated mode or in group transmit mode, the network may wish to change the resources used by a mobile station that supports the <<GPRS option>>. This change may be performed through the assignment to a Packet Data Channel procedure.

The purpose of the assignment to PDCH channel procedure is to completely modify the physical channel configuration of the mobile station without frequency redefinition or change in synchronization while staying in the same cell.

The assignment to PDCH procedure only commences in dedicated mode or in group transmit mode. This procedure cannot be used in the idle mode.

The assignment to PDCH procedure includes:

- the suspension of normal operation.

- the release of the main signalling link, and of the other data links as defined in section 3.1.4, and the disconnection of TCHs if any.

- the deactivation of previously assigned channels (layer 1)

- The triggering of the establishment of a Temporary Block Flow .

The assignment to PDCH procedure is always initiated by the network.

3.4.19.1 Assignment to PDCH initiation

The network initiates the assignment to PDCH procedure by sending a PDCH ASSIGNMENT COMMAND message to the mobile station on the main signalling link. It then starts timer T3117.

NOTE: The network should take into account limitations of certain mobile stations to understand formats used in the Frequency List IE and Cell Channel Description IE used in the PDCH ASSIGNMENT COMMAND message, see section 10.5.2.13 and section 10.5.2.1b.

When sending this message on the network side, and when receiving it on the mobile station side, all transmission of signalling layer messages except for those RR messages needed for this procedure and for abnormal cases is suspended until resumption is indicated. These RR messages can be deduced from sections 3.4.3 and 8.8 Radio Resource management.

Upon receipt of the PDCH ASSIGNMENT COMMAND message, the mobile station initiates a local end release of dedicated mode link layer connections, disconnects the physical channels, commands the switching to the identified channels and obeys the procedures relevant to the establishment of the Temporary Block Flow. The mobile station starts timer T3132.

The PDCH ASSIGNMENT COMMAND message contains the description of either the uplink TBF or the downlink TBF.

The information on the power to be used on the target TBF shall not affect the power used on the old channel(s).

A PDCH ASSIGNMENT COMMAND message may indicate a frequency change in progress, with a starting time and possibly alternative channel descriptions.

In the case of the reception of a PDCH ASSIGNMENT COMMAND message which contains only the description of a TBF to be used after the starting time, the mobile station shall wait up to the starting time before using the TBF. If the starting time has already elapsed, the mobile shall use the TBF as an immediate reaction to the reception of the message (see GSM 05.10 for the timing constraints).

If the message contains both the description of a TBF to be used after the indicated time and of a TBF to be used before, the mobile station uses the TBF as an immediate reaction to the reception of the message. If the moment the mobile station is ready to access is before the indicated time, the mobile station uses the TBF described for before the starting time. The mobile station then changes to the TBF described for after the starting time at the indicated time. New parameters can be frequency list, MAIO and HSN. Other parameters describing the allocated channels shall be identical to the parameters described for before the starting time. If the moment the mobile station is ready to access is after the starting time, the mobile station uses the TBF described for after the starting time.

If frequency hopping is applied, the cell allocation if present in the message is used to decode the mobile allocation. If the cell allocation is not included, the mobile station uses its current cell allocation, the current CA is the last CA received on the BCCH. Afterward, the current CA may be changed by some messages sent on the main signalling link containing a CA (the possible messages are: ASSIGNMENT COMMAND, HANDOVER COMMAND and FREQUENCY REDEFINITION). Note that there are cases in which the current CA is undefined, see section 3.4.3.3.

The PDCH ASSIGNMENT COMMAND does not contain a cipher mode setting IE. Any RR layer ciphering that may have been applied in dedicated mode shall not be applied to the target TBF.

3.4.19.2 Completion of the Assignment to PDCH procedure

The network regards the procedure as successfully completed when RLC/MAC blocks are received from the mobile station on the target TBF. The network then stops timer T3117.

The mobile station regards the procedure as successfully completed when RLC/MAC blocks with any TFI are received on the new PDCH.

3.4.19.3 Abnormal cases

If the mobile station has no current CA and if it needs a CA to analyse the PDCH ASSIGNMENT COMMAND message, it stays on the current channel(s) and sends an ASSIGNMENT FAILURE message with cause "no cell allocation available".

If the PDCH ASSIGNMENT COMMAND message instructs the mobile station to use a Coding Scheme that it does not support then the mobile station shall return an ASSIGNMENT FAILURE message with cause "channel mode unacceptable", and the mobile station shall remain on the current channel(s) and uses the old Channel Description or Channel Mode(s).

If the PDCH ASSIGNMENT COMMAND message instructs the mobile station to use a frequency that it is not capable of, then the mobile station shall return an ASSIGNMENT FAILURE message with cause "frequency not implemented", and the mobile station shall remain on the current channel(s).

If the mobile station receives a PDCH ASSIGNMENT COMMAND message with a Frequency List IE indicating frequencies that are not all in one band, then the mobile station shall stay on the current channel(s) and send an ASSIGNMENT FAILURE message with cause "frequency not implemented". If the mobile station receives a PDCH ASSIGNMENT COMMAND message with a Mobile Allocation IE indexing frequencies that are not all in one band, then the mobile station shall stay on the current channel(s) and send an ASSIGNMENT FAILURE message with cause "frequency not implemented".

NOTE: A PDCH ASSIGNMENT COMMAND message sent to a multi band mobile station shall not be considered invalid because it indicates frequencies that are all in a different frequency band to that of the current channel.

On the mobile station side, if RLC/MAC blocks are not successfully received within T3132 seconds, the mobile station reactivates the old channels, reconnects the TCHs if any and triggers the establishment of the main signalling link. It then sends an ASSIGNMENT FAILURE message, cause "protocol error unspecified" on the main DCCH and resumes the normal operation, as if no assignment attempt had occurred. The operational parameters (e.g. ciphering mode) when returning on the old channel are those applied before the procedure.

When receiving the ASSIGNMENT FAILURE message, the network stops T3117.

If a lower layer failure happens while attempting to connect back to the old channels, the radio link failure procedure is applied (see section 3.4.13.2).

On the network side, if timer T3117 elapses before either the network receives an RLC/MAC block from the mobile station on the new channel, or, an ASSIGNMENT FAILURE message is received on the old channels, then the old channels and the new resources are released, except that, if the old channel was a VGCS channel, the old channel shall be maintained and the uplink shall be set free.

On the network side, lower layer failure occurring on the old channels after the sending of the PDCH ASSIGNMENT COMMAND message are ignored.

3.4.20 RR-Network Commanded Cell Change Order

This section is only applicable to mobiles supporting the <<GPRS>> option.

In dedicated mode or in group transmit mode, intracell or intercell change of channel(s) can be requested by the network RR sublayer. This change may be performed through the RR-network commanded cell change order procedure.

The purpose of the RR-network commanded cell change order procedure is to permit the complete modification of the channels allocated to the mobile station e.g. when the cell is changed. This procedure only commences while in dedicated mode or in group transmit mode.

The RR-network commanded cell change order procedure includes:

- The suspension of normal operation except for RR management (layer 3).
- The disconnection of the main signalling link, and of the other links via local end release (layer 2), and the disconnection of the TCH(s) if any.
- The disconnection and the deactivation of previously assigned channels and their release (layer 1).
- The triggering of the establishment of a Temporary Block Flow.

The RR-network controlled cell change order procedure is always initiated by the network.

3.4.20.1 RR-network commanded cell change order initiation

The network initiates the RR-network controlled cell change order procedure by sending a RR-CELL CHANGE ORDER message to the mobile station on the main DCCH. The network then starts timer T3119.

When sending this message on the network side, and when receiving it on the mobile station side, all transmission of signalling layer messages except for those RR messages needed for this procedure and for abnormal cases, is suspended

until resuming is indicated. These RR messages can be deduced from section 3.4.3 and 8.5.1 "Radio Resource management".

Upon receipt of the RR-CELL CHANGE ORDER message, the mobile station initiates, as described in section 3.1.4, the release of link layer connections, disconnects the physical channels, commands the switching to the identified cell and obeys the procedures relevant to the establishment of the Temporary Block Flow. The mobile station starts timer T3134. The mobile station shall obey the RR-CELL CHANGE ORDER irrespective of whether or not the mobile station has any knowledge of the relative synchronisation of the target cell to the serving cell.

The RR-CELL CHANGE ORDER message contains:

- The characteristics of the new cell that are necessary to identify it (i.e. BSIC + BCCH frequency);
- the NC mode to be initially applied on the new cell.

The RR-CELL CHANGE ORDER does not contain a cipher mode setting IE. Any RR layer ciphering that may have been applied in dedicated mode shall not be applied to the target TBF or with the target cell.

3.4.20.2 Network controlled cell reselection completion

The network regards the procedure as successfully completed when it knows that communication has been established with that mobile station via the new cell (e.g. the network has received a RLC/MAC Block containing the mobile station's identity). The network then stops timer T3119.

The mobile station regards the procedure as successfully completed when it has received a response to its CHANNEL REQUEST message on the new cell which allocates it a resource on the new cell.

3.4.20.3 Abnormal cases

If the RR-CELL CHANGE ORDER message instructs the mobile station to use a frequency that it is not capable of, then the mobile station shall return a HANDOVER FAILURE message with cause "frequency not implemented", and the mobile station shall remain on the current channel(s).

On the mobile station side, if timer T3134 times out before a response to the CHANNEL REQUEST message has been received, or, if an IMMEDIATE ASSIGNMENT REJECT message is received from the new cell, or, if the contention resolution procedure fails on the new cell then the mobile station shall reactivate the old channels, reconnect the TCHs if any and trigger the establishment of the main signalling link. It then sends a HANDOVER FAILURE message on the main signalling link and resumes normal operation as if no handover attempt had occurred. The operational parameters (e.g. ciphering mode) when returning on the old channel are those applied before the RR-CELL CHANGE ORDER message was received.

When the HANDOVER FAILURE message has been received, the network stops T3119.

If a lower layer failure happens while attempting to connect back to the old channels, the standard rules are applied (cf. section 3.4.13.2).

On the network side, if timer T3119 elapses before either the mobile station has been recognised on the new cell, or a HANDOVER FAILURE message is received on the old channels, then the old channels are released, except that, if the old channel was a VGCS channel, the old channel shall be maintained and the uplink shall be set free.

On the network side, lower layer failures occurring on the old channels after the sending of the RR-CELL CHANGE ORDER message are ignored.

3.5 RR procedures on CCCH related to temporary block flow establishment

The establishment of a temporary block flow (TBF) on a packet data physical channel is supported by procedures on CCCH when PCCCH is not provided in the cell. The procedures for temporary block flow establishment using CCCH are only applicable to a mobile station supporting GPRS. The procedures are optional for the network.

These procedures constitute a complement to the corresponding procedures for temporary block flow establishment using PCCCH, defined in GSM 04.60, and include the procedures using CCCH for *packet paging* (section 3.5.1), *packet access* (section 3.5.2) and *packet downlink assignment* (section 3.5.3).

3.5.1 Packet paging procedure using CCCH

The network can initiate the packet paging procedure in order to cause upper layers in the mobile station to respond, see section 4. The packet paging procedure can only be initiated by the network.

3.5.1.1 Packet paging initiation by the network

The packet paging procedure is initiated by the RR entity of the network side. It is triggered by a page request from the MM sublayer, see GSM 04.07.

The network initiates the paging procedure by sending a paging request message on an appropriate paging subchannel on CCCH or PCCCH. Paging initiation using a paging subchannel on CCCH is used when sending paging information to a mobile station and PCCCH is not present in the cell.

NOTE 1: There are three types of paging request messages that are applicable:

- PAGING REQUEST TYPE 1;
- PAGING REQUEST TYPE 2; and
- PAGING REQUEST TYPE 3.

In a PAGING REQUEST message used for the packet paging procedure, the mobile station shall be identified by the TMSI (GPRS TMSI) or its IMSI. If the mobile station is identified by the TMSI, it shall proceed as specified in section 3.5.1.2.

If the mobile station identified by its IMSI, it shall parse the message for a corresponding *Packet Page Indication* field:

- if the *Packet Page Indication* field indicates a paging procedure for RR connection establishment, or the field is not present in the message, the mobile station shall proceed as specified in section 3.3.2.2;
- if the *Packet Page Indication* field indicates a packet paging procedure, the mobile station shall proceed as specified in section 3.5.1.2.

A PAGING REQUEST message may include more than one mobile station identification.

The mobile station in packet idle mode is required to receive and analyse the paging messages and immediate assignment messages sent on the paging subchannels on CCCH corresponding to the paging groups determined for it in packet idle mode, as specified in GSM 05.02. These messages contain a page mode information element.

NOTE 2: The possible immediate assignment messages are: the IMMEDIATE ASSIGNMENT, the IMMEDIATE ASSIGNMENT EXTENDED and the IMMEDIATE ASSIGNMENT REJECT messages.

The treatment of page mode information, including the procedure when the mobile station selects a new PCH, and the procedure if a message in a paging subchannel is not received correctly are defined in section 3.3.2.1.1.

3.5.1.2 On receipt of a packet paging request

On the receipt of a paging request message, the RR sublayer of addressed mobile station indicates the receipt of a paging request to the MM sublayer, see GSM 04.07;

3.5.2 Packet access procedure using CCCH

The purpose of the packet access procedure is to establish a temporary block flow to support the transfer of LLC PDUs in the direction from the mobile station to the network.

3.5.2.1 Entering the packet transfer mode: packet access procedure

The packet access procedure is initiated by the RR entity of the mobile station. It is triggered by a request from upper layers to transfer a LLC PDU, see GSM 04.07. The request from upper layers specifies a *priority class* and an *RLC mode* associated with the packet transfer. Upon such a request,

- if access to the network is allowed (section 3.5.2.1.1), the RR entity of the mobile station initiates the packet access procedure as defined in section 3.5.2.1.2;
- otherwise, it rejects the request.

3.5.2.1.1 Permission to access the network

Access to the network is allowed:

- if the mobile station is a member of at least one authorized access class or special access class as defined in section 3.3.1.1.1, and
- if packet access is allowed in the cell for the *priority class* associated with the packet transfer, as indicated by the PRIORITY_ACCESS_THR parameter broadcast in SI 13 message.

During an uplink TBF, the mobile station is not allowed to transmit an LLC PDU belonging to a priority class lower than the priority class implicitly granted by the network in the *packet access* or the *resource reallocation for uplink* procedures, see GSM 04.60. In the packet access procedure using CCCH, the mobile station shall regard the priority class indicated by the PRIORITY_ACCESS_THR parameter as the priority class implicitly granted by the network.

3.5.2.1.2 Initiation of the packet access procedure: channel request

The mobile station initiates the packet access procedure by scheduling the sending of CHANNEL REQUEST messages on RACH and leaving the packet idle mode. In particular, the mobile station shall ignore PAGING REQUEST messages indicating a packet paging procedure.

A mobile station belonging to GPRS MS class A or B shall continue to monitor its paging subchannel on CCCH for PAGING REQUEST messages indicating an establishment of RR connection. A mobile station belonging to GPRS MS class B may abort the packet access procedure at the receipt of a PAGING REQUEST messages indicating an establishment of RR connection.

The mobile station schedules CHANNEL REQUEST messages on RACH as defined in section 3.3.1.1.2.

The CHANNEL REQUEST messages are sent on RACH and contain the parameters:

- an establishment cause which indicates packet access, and as applicable, a request for one phase packet access or single block packet access (section 9.1.8);
- a random reference which is drawn randomly from an uniform probability distribution for every new transmission.

If the requested RLC mode is *unacknowledged mode*, the mobile station shall request a single block packet access and attempt a two phase packet access.

After sending the first CHANNEL REQUEST message, the mobile station shall start listening to the BCCH; it shall also listen to the full downlink CCCH timeslot corresponding to its CCCH group.

Having sent the maximum number of CHANNEL REQUEST messages, the mobile station starts timer T3146. At expiry of timer T3146, the packet access procedure is aborted and a packet access failure is indicated to upper layers.

If the mobile station receives an IMMEDIATE ASSIGNMENT message during the packet access procedure indicating a packet downlink assignment procedure, the mobile station shall abort the packet access procedure and respond to the IMMEDIATE ASSIGNMENT message as specified in section 3.5.3.1.2. The mobile station shall then attempt an establishment of uplink TBF, using the procedure specified in GSM 04.60 which is applicable in packet transfer mode.

3.5.2.1.3 Packet immediate assignment

3.5.2.1.3.1 On receipt of a CHANNEL REQUEST message

On receipt of a CHANNEL REQUEST message indicating a packet access, the network may allocate a temporary flow identity and assign a packet uplink resource comprising one PDCH for an uplink temporary block flow.

If the establishment cause in the CHANNEL REQUEST message indicates a request for a single block packet access, the network shall grant only the single block period on the assigned packet uplink resource.

The packet uplink resource is assigned to the mobile station in an IMMEDIATE ASSIGNMENT message sent in unacknowledged mode on the same CCCH timeslot on which the network has received the CHANNEL REQUEST message. There is no further restriction on what part of the downlink CCCH timeslot the IMMEDIATE ASSIGNMENT message can be sent. Timer T3141 is started on the network side.

The IMMEDIATE ASSIGNMENT message contains:

- the packet response type;
- the information field of the CHANNEL REQUEST message and the frame number of the frame in which the CHANNEL REQUEST message was received;
- the packet channel description;
- the initial timing advance;
- the packet uplink assignment construction.

If frequency hopping is applied, the mobile station uses the information in the last consistent set of SI 14 messages received on BCCH to obtain the mobile allocation. If the *MA_CHANGE_MARK* information received with the packet channel description does not match the last consistent set of SI 14 messages, a TBF establishment failure has occurred and the mobile station proceed as specified in section 3.5.2.1.5.

As an option, frequency hopping may be applied using the information in SI 1 message to decode the IMMEDIATE ASSIGNMENT message, in which case the *Channel Description* and *Mobile Allocation* information elements are used in the IMMEDIATE ASSIGNMENT message to define the RF hopping channel.

On receipt of an IMMEDIATE ASSIGNMENT message corresponding to one of its 3 last CHANNEL REQUEST messages, the mobile station stops T3146 (if running), stops sending CHANNEL REQUEST messages, and switches to the assigned PDCH.

The packet uplink assignment construction contains the response indicator, giving indication of which type of packet access is granted: *one phase packet access* or *single block packet access*.

3.5.2.1.3.2 One phase packet access

In the case the one phase packet access is granted, the packet uplink assignment construction contains:

- the response indicator;
- the temporary flow identity;
- the USF value;
- the channel coding scheme for RLC data blocks;
- the power control parameters;
- optionally, the timing advance index (see GSM 05.10);
- optionally, the TBF starting time.

The medium access method is *dynamic allocation* and the RLC mode is *acknowledged mode*, see GSM 04.60.

The mobile station shall start timer T3164 and proceed with the contention resolution at one phase access defined in GSM 04.60.

If the timing advance index (TAI) is included in the packet uplink assignment construction, the mobile station shall use the continuous update timing advance mechanism, see GSM 05.10, using PTCCH in the same timeslot as the assigned PDCH. If a timing advance index (TAI) field is not included, the continuous update timing advance mechanism shall not be used.

In case the packet uplink assignment construction contains a TBF starting time and the mobile station receives the message before the TBF starting time has expired, it shall wait until the frame number indicated by the TBF starting time before accessing the channel. If the mobile station receives the message after the TBF starting time has expired, it shall ignore the TBF starting time.

3.5.2.1.3.3 Single block packet access

In the case the single block packet access is granted, the packet uplink resource description contains:

- the response indicator;
- the power control parameter setting;
- the TBF starting time.

The network shall use the TBF starting time to indicate the first frame number belonging to the single block period granted for packet access. The mobile station may use that block period to send a PACKET RESOURCE REQUEST message to initiate the two phase access defined in GSM 04.60, or to send a PACKET MEASUREMENT REPORT message, see GSM 04.60.

3.5.2.1.3.4 Packet access rejection

The network may send to the mobile station an IMMEDIATE ASSIGNMENT REJECT message in unacknowledged mode on the same CCCH timeslot on which the channel request message was received. There is no further restriction on what part of the downlink CCCH timeslot an IMMEDIATE ASSIGNMENT REJECT message can be sent. This message contains the request reference and a wait indication.

On receipt of an IMMEDIATE ASSIGNMENT REJECT message corresponding to one of its 3 last CHANNEL REQUEST messages, the mobile station stops sending CHANNEL REQUEST messages, starts timer T3142 with the indicated value, ("wait indication" information element), starts T3146 if it has not already been started, and listens to the downlink CCCH until T3146 expires. During this time, additional IMMEDIATE ASSIGNMENT REJECT messages are ignored, but any immediate assignment corresponding to any other of its 3 last CHANNEL REQUEST messages make the mobile station follow the procedure in section 3.5.2.1.3.1. If no such immediate assignment is received, the mobile station returns to packet idle mode.

If the mobile station has received responses from the network on all, or in case more than 3 were sent the last 3, of its CHANNEL REQUEST messages, it shall immediately return to packet idle mode.

The mobile station is not allowed to make a new attempt for packet access in the same cell until T3142 expires, but may attempt packet access in an other cell after successful cell reselection. The value of the wait indication (i.e. T3142) relates to the cell from which it was received.

The mobile station may initiate RR connection establishment in the same cell before T3142 has expired, see section 3.3.1.1.3.2.

3.5.2.1.4 Packet access completion

The one phase packet access procedure is completed at a successful contention resolution. The mobile station has entered the packet transfer mode. Timer T3141 is stopped on the network side. Timer T3164 is stopped on the mobile station side.

3.5.2.1.5 Abnormal cases

If a failure occurs on the mobile station side before a successful contention resolution procedure is completed, the allocated temporary block flow is released; the mobile station returns to packet idle mode, upper layers are notified (TBF establishment failure), transactions in progress are aborted and cell reselection continues:

- If a TLLI mismatch has occurred during the contention resolution procedure, and the repetition of the packet access has been repeated the maximum number of times as defined in GSM 04.60, a TBF establishment failure has occurred.
- If the information available in the mobile station, after the reception of an IMMEDIATE ASSIGNMENT message does not satisfactorily define a PDCH, a TBF establishment failure has occurred.
- If the mobile allocation indexes frequencies in more than one frequency band then a TBF establishment failure has occurred.
- If an IMMEDIATE ASSIGNMENT message indicates a PDCH in a non-supported frequency band then a TBF establishment failure has occurred.

On the network side, if timer T3141 elapses before a successful contention resolution procedure is completed, the newly allocated temporary block flow is released as specified in GSM 04.60 and the packet access is forgotten.

3.5.3 Packet downlink assignment procedure using CCCH

The purpose of the packet downlink assignment procedure using CCCH is to establish a temporary block flow to support the transfer of LLC PDUs in the direction from the network to the mobile station.

3.5.3.1 Entering the packet transfer mode: packet downlink assignment procedure

The packet downlink assignment procedure is initiated by the RR entity on the network side. It is triggered by a request from upper layers to transfer a LLC PDU, see GSM 04.07. The request from upper layers specifies a *priority class*, an *RLC mode*, *DRX parameters* and a *MS classmark* associated with the packet transfer.

Upon such a request, the network shall determine whether the mobile station is in packet idle mode or packet transfer mode. The packet downlink assignment procedure using CCCH is applicable when the mobile station is in packet idle mode and when there is no PCCCH present in the cell.

The network may allocate a temporary flow identity and assign a packet downlink resource comprising one PDCH for a downlink temporary block flow. The medium access method is *dynamic allocation*, see GSM 04.60.

3.5.3.1.2 Initiation of the packet downlink assignment procedure

The network initiates the packet downlink assignment procedure by sending an IMMEDIATE ASSIGNMENT message in unacknowledged mode on the CCCH timeslot corresponding to CCCH group the mobile station belongs to. If the mobile station does not apply DRX, there is no further restriction on what part of the downlink CCCH timeslot an IMMEDIATE ASSIGNMENT message can be sent. If the mobile station applies DRX, the message shall be sent in a CCCH block corresponding to a paging group determined for the mobile station in packet idle mode, see GSM 05.02.

The IMMEDIATE ASSIGNMENT message contains:

- the packet response type;
- the packet channel description;
- the initial timing advance;
- the packet downlink construction, comprising:
  - TLLI;
  - the temporary flow identity;
  - the RLC mode;

- the power control parameters;
- optionally, the timing advance index (see GSM 05.10);
- optionally, the TBF starting time.

The medium access method is *dynamic allocation*, see GSM 04.60.

If frequency hopping is applied, the mobile station uses the information in the last consistent set of SI 14 messages received on BCCH to obtain the mobile allocation. If the *MA_CHANGE_MARK* information received with the packet channel description does not match the last consistent set of SI 14 messages, a TBF establishment failure has occurred and the mobile station shall proceed as specified in section 3.5.3.1.4.

As an option, frequency hopping may be applied using the information in SI 1 message to decode the IMMEDIATE ASSIGNMENT message, in which case the *Channel Description* and *Mobile Allocation* information elements are used in the IMMEDIATE ASSIGNMENT message to define the RF hopping channel.

On receipt of an IMMEDIATE ASSIGNMENT message stops monitoring downlink CCCH and switches to the assigned PDCH and starts listening for downlink RLC/MAC blocks identified by the assigned TFI; it starts timer T3190.

The IMMEDIATE ASSIGNMENT message may indicate a TBF starting time. If the mobile station receives the message before the TBF starting time has expired, it continues to monitor downlink CCCH; it then stops monitoring downlink CCCH, starts timer T3190 and switches to the assigned PDCH at the frame number indicated by the TBF starting time. If the mobile station receives the message after the TBF starting time has expired, it shall ignore the indicated TBF starting time.

An IMMEDIATE ASSIGNMENT message may indicate a timing advance index (TAI) in the packet timing advance IE. The mobile station shall then use the continuous update timing advance mechanism, see GSM 05.10, using PTCCH in the same timeslot as the assigned PDCH. If there is no indication of a timing advance index, the continuous update timing advance mechanism shall not be used.

If the network does not have a valid timing advance value for the mobile station to include in the IMMEDIATE ASSIGNMENT message, the network shall use the procedures defined in GSM 04.60 on the assigned TBF, to obtain a timing advance value and to update the initially assigned timing advance value before the mobile station is required to transmit other than access burst on the newly assigned channel.

3.5.3.1.3 Packet downlink assignment completion

After having sent the packet downlink assignment, the network starts sending downlink RLC/MAC blocks on the assigned packet downlink resource and the packet downlink assignment procedure is terminated at the network side.

On the mobile station side, the procedure is terminated when the mobile station receives an RLC/MAC block identified by the assigned temporary flow identity. The mobile station stops timer T3190. The mobile station has entered packet transfer mode.

3.5.3.1.4 Abnormal cases

If a failure occurs on the mobile station side before the packet downlink assignment procedure is completed (TBF establishment failure), the temporary block flow is released; the mobile station returns to packet idle mode and cell reselection continues:

- If the mobile station does not receive a RLC/MAC block on the assigned PDCHs before timer T3190 expires, then a TBF establishment failure has occurred.
- If the information available in the mobile station, after the reception of an IMMEDIATE ASSIGNMENT message does not satisfactorily define a PDCH, then a TBF establishment failure has occurred.
- If the mobile allocation in the frequency parameters indexes frequencies in more than one frequency band, then a TBF establishment failure has occurred.
- If an IMMEDIATE ASSIGNMENT message indicates a PDCH in a non-supported frequency band, then a TBF establishment failure has occurred.

4 Elementary procedures for Mobility Management

4.1 General

This section describes the procedures used for mobility management for non-GPRS services and for GPRS-services at the radio interface (Reference Point Um).

The main function of the Mobility Management sublayer is to support the mobility of user terminals, such as informing the network of its present location and providing user identity confidentiality.

A further function of the MM sublayer is to provide connection management services to the different entities of the upper Connection Management (CM) sublayer (see GSM 04.07).

There are two sets of procedures defined in this chapter:

- MM procedures for non-GPRS services (performed by the MM entity of the MM sublayer); and
- GMM procedures for GPRS services (performed by the GMM entity and GMM-AA entity of the MM sublayer), see GSM 04.07 [20].

All the MM procedures described in this section can only be performed if a RR connection has been established between the MS and the network. Else, the MM sublayer has to initiate the establishment of a RR connection according to the procedures specified in section 3.3. The GMM procedures described in this section, use services provided by the RR sublayer without prior RR connection establishment.

GMM procedures are mandatory and applicable only for GPRS MSs and networks supporting those MSs. For GPRS MSs which are IMSI attached for both GPRS and non-GPRS services, some MM procedures are replaced by GMM combined procedures provided that the network operates in network operation mode I, i.e. is supporting combined GMM procedures. GMM combined procedures are not applicable for the GPRS MS operation mode C but are mandatory for the GPRS MS operation modes A and B and networks supporting network operation mode I, see GSM 03.60.

4.1.1 Type of MM and GMM procedures

Depending on how they can be initiated, three types of MM procedures can be distinguished:

1) MM common procedures:

   A MM common procedure can always be initiated whilst a RR connection exists. The procedures belonging to this type are:

   Initiated by the network:

   - TMSI reallocation procedure;
   - authentication procedure;
   - identification procedure;
   - MM information procedure;
   - abort procedure.

     However, abort procedure is used only if an MM connection is being established or has already been established i.e. not during MM specific procedures or during IMSI detach procedure, see section 4.3.5.

   Initiated by the mobile station:

   - IMSI detach procedure (with the exceptions specified in section 4.3.4).

ii) MM specific procedures:

A MM specific procedure can only be initiated if no other MM specific procedure is running or no MM connection exists. The procedures belonging to this type are:

- normal location updating procedure;
- periodic updating procedure;
- IMSI attach procedure.

iii) MM connection management procedures:

These procedures are used to establish, maintain and release a MM connection between the mobile station and the network, over which an entity of the upper CM layer can exchange information with its peer. A MM connection establishment can only be performed if no MM specific procedure is running. More than one MM connection may be active at the same time. Depending on how they can be initiated, two types of GMM procedures can be distinguished:

i) GMM common procedures:

Initiated by the network when a GMM context has been established:

- P-TMSI (re-) allocation;
- GPRS authentication and ciphering;
- GPRS identification;
- GPRS information.

ii) GMM specific procedures:

Initiated by the network and used to detach the IMSI in the network for GPRS services and/or non-GPRS services and to release a GMM context:

- GPRS detach.

Initiated by the MS and used to attach or detach the IMSI in the network for GPRS services and/or non-GPRS services and to establish or release a GMM context:

- GPRS attach and combined GPRS attach;
- GPRS detach and combined GPRS detach.

Initiated by the MS when a GMM context has been established:

- normal routing area updating and combined routing area updating;
- periodic routing area updating.

4.1.2 MM sublayer states

The description of the states for the MM sublayer is organized as follows. The main states for the MS side, related to the procedures, are described in section 4.1.2.1.1. The MM IDLE state is subdivided in substates for the description of the behaviour in idle mode (section 4.1.2.1.2). This behaviour depends on an update status, described in 4.1.2.2. The states for the network side are described in 4.1.2.3.

4.1.2.1 MM sublayer states in the mobile station

In this section, the possible states for the MM sublayer in the mobile station is described. In figure 4.1/GSM 04.08 an overview of the MM sublayer protocol is given.

4.1.2.1.1 Main states

0 NULL

The mobile station is inactive (e.g. power down). Important parameters are stored. Only manual action by the user may transfer the MM sublayer to another state.

3 LOCATION UPDATING INITIATED

A location updating procedure has been started and the MM awaits a response from the network. The timer T3210 is running.

5 WAIT FOR OUTGOING MM CONNECTION

The MM connection establishment has been started, and the MM awaits a response from the network. The timer T3230 is running.

6 MM CONNECTION ACTIVE

The MM sublayer has a RR connection to its peer entity on the network side. One or more MM connections are active.

7 IMSI DETACH INITIATED

The IMSI detach procedure has been started. The timer T3220 is running.

8 PROCESS CM SERVICE PROMPT

The MM sublayer has an RR connection to its peer entity on the network side. The Mobile Station has received a CM SERVICE PROMPT message but has not yet responded $(CCBS)$.

9 WAIT FOR NETWORK COMMAND

The MM sublayer has a RR connection to its peer entity in the network, but no MM connection is established. The mobile station is passive, awaiting further commands from the network. The timer T3240 may be running.

10 LOCATION UPDATE REJECTED

A location updating procedure has been rejected and RR connection release is awaited. The timer T3240 is running.

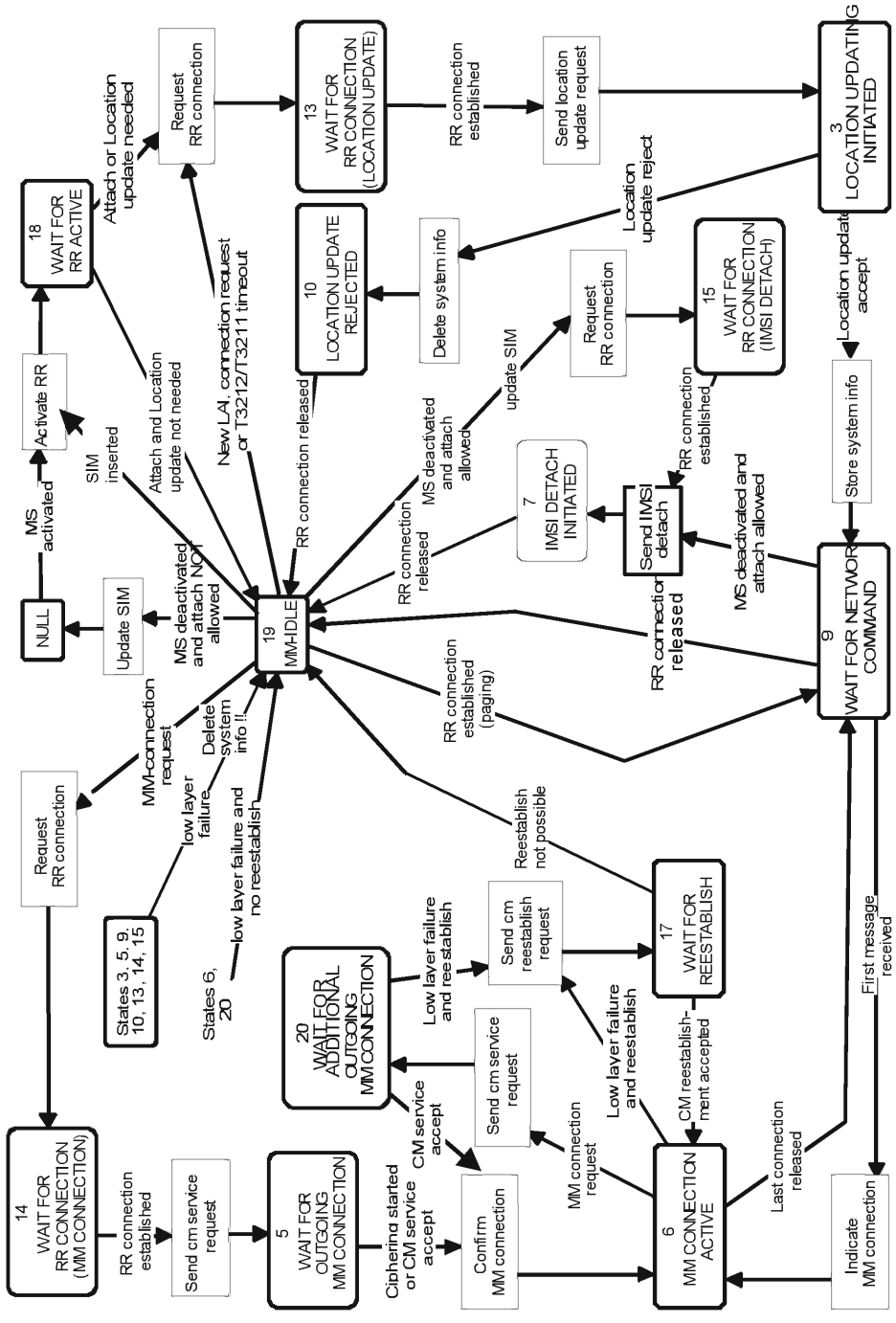
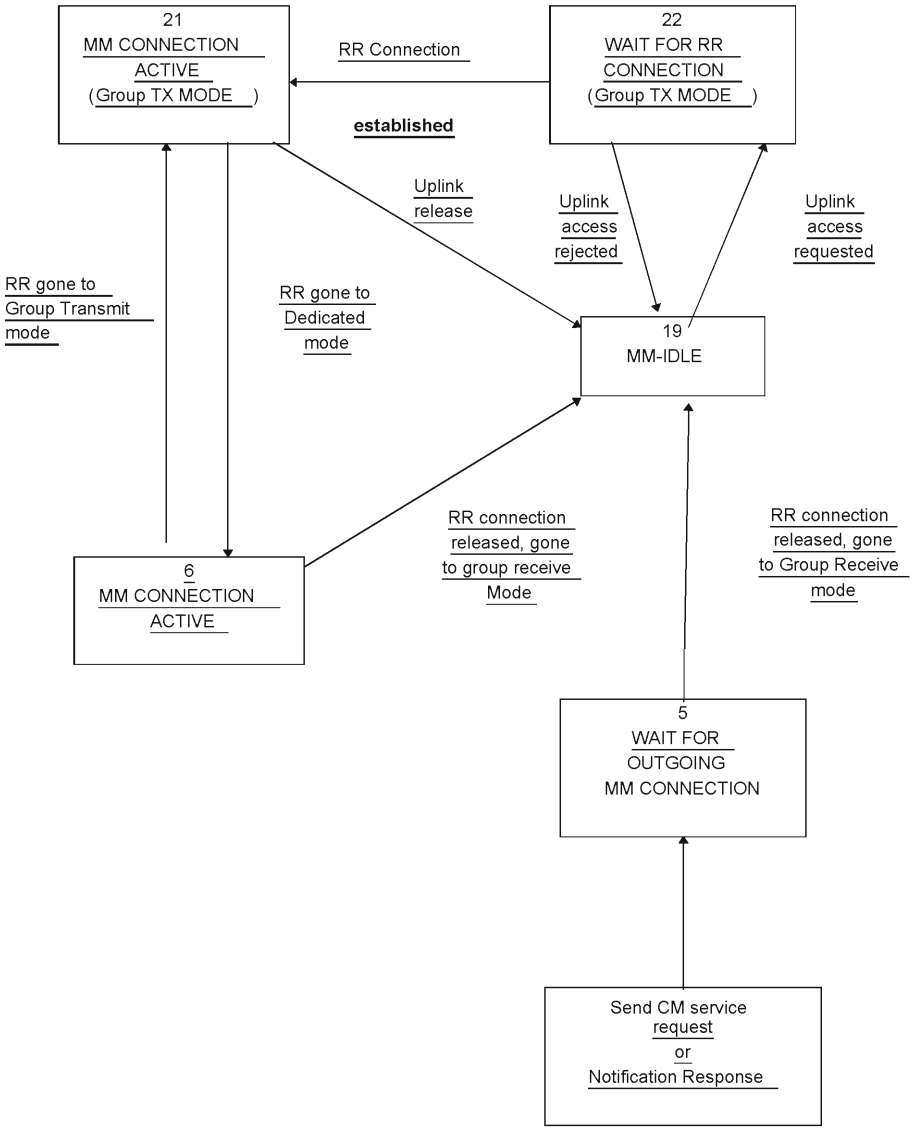


Figure 4.1a / GSM 04.08: Overview mobility management protocol / MS Side



Additions to Figure 4.1.a/GSM 04.08

13. WAIT FOR RR CONNECTION (LOCATION UPDATING)

The MM sublayer has requested RR connection establishment for starting the location updating procedure.

14. WAIT FOR RR CONNECTION (MM CONNECTION)

The MM sublayer has requested RR connection establishment for dedicated mode for starting the MM connection establishment.

15. WAIT FOR RR CONNECTION (IMSI DETACH)

The MM sublayer has requested RR connection establishment for starting the IMSI detach procedure.

17. WAIT FOR REESTABLISH

A lower layer failure has occurred and re-establishment may be performed from the disturbed CM layer entities.

18. WAIT FOR RR ACTIVE

The MM sublayer has requested activation of the RR sublayer.

19. MM IDLE

There is no MM procedure running and no RR connection exists except that a local MM context may exist when the RR sublayer is in Group Receive mode. This is a compound state, and the actual behaviour of the mobile station to Connection Management requests is determined by the actual substate as described hereafter.

20. WAIT FOR ADDITIONAL OUTGOING MM CONNECTION.

The MM connection establishment for an additional MM connection has been started, and the MM awaits response from the network.

21. MM CONNECTION ACTIVE (GROUP TRANSMIT MODE)

(Only applicable for mobile stations supporting VGCS talking:) The MM sublayer has an RR connection on the VGCS channel to its peer entity on the network side. Only one MM connection is active.

22. WAIT FOR RR CONNECTION (GROUP TRANSMIT MODE)

(Only applicable for mobile stations supporting VGCS talking:) The MM sublayer has requested to perform an uplink access on the VGCS channel.

23. LOCATION UPDATING PENDING

(Only applicable for GPRS MS operation modes A and B; not shown in figure 4.1a) A location updating has been started using the combined GPRS routing area updating procedure.

24. IMSI DETACH PENDING

(Only applicable for GPRS MS operation modes A and B; not shown in figure 4.1a) An IMSI detach for non-GPRS services has been started using the combined GPRS detach procedure at not switching off.

4.1.2.1.2 Substates of the MM IDLE state

For the description of the behaviour of the MS the MM IDLE state is subdivided in several substates, also called the service states. The service state pertains to the whole MS (ME alone if no SIM is inserted, or ME plus SIM.). The service state depends on the update status (see 4.1.2.2) and on the selected cell.

19.1 NORMAL SERVICE

Valid subscriber data are available, update status is U1, a cell is selected that belongs to the LA where the subscriber is registered.

In this state, all requests from the CM layers are treated normally.

19.2 ATTEMPTING TO UPDATE

Valid subscriber data are available, update status is U2 and a cell is selected. Requests from upper layers are accepted. Emergency call requests are treated normally, otherwise the request triggers first a location updating attempt in the selected cell, and then triggers the needed procedure only in case of successful location updating, otherwise the request is rejected.

19.3 LIMITED SERVICE

Valid subscriber data are available, update status is U3, and a cell is selected, which is known not to be able to provide normal service. Only emergency services are offered.

19.4 NO IMSI

No valid subscriber data (no SIM, or the SIM is not considered valid by the ME), and a cell is selected. Only emergency services are offered.

19.5 NO CELL AVAILABLE

No cell can be selected. This state is entered after a first intensive search failed (state 19.7). Cells are searched at a low rhythm. No services are offered.

19.6 LOCATION UPDATE NEEDED

Valid subscriber data are available, and for some reason a location updating must be done as soon as possible (for instance update status is U1 but the selected cell is not in the registered LA, or the timer has expired, ...). This state is usually of no duration, but can last, e.g., in the case of access class blocking.

19.7 PLMN SEARCH

The mobile station is searching for PLMNs, and the conditions for state 19.8 are not met. This state is ended when either a cell is selected (the new state is 19.1, 19.3 or 19.6), or when it is concluded that no cell is available for the moment (the new state is 19.5).

19.8 PLMN SEARCH, NORMAL SERVICE

Valid subscriber data are available, update status is U1, a cell is selected which belongs to the LA where the subscriber is registered, and the mobile station is searching for PLMNs. This state is ended when either a cell is selected (the new state is 19.1, 19.3 or 19.6), or when it is concluded that no cell is available for the moment (the new state is 19.5).

19.9 RECEIVING GROUP CALL (NORMAL SERVICE)

Only applicable for mobile stations supporting VGCS listening or VBS listening. Valid subscriber data are available, update status is U1, a VGCS channel or VBS channel is received in a cell that belongs to the LA where the subscriber is registered.

In this state, only requests from the GCC or BCC layers are treated.

19.10 RECEIVING GROUP CALL (LIMITED SERVICE)

Only applicable for mobile stations supporting VGCS listening or VBS listening. Valid subscriber data are available, update status is U3, a VGCS channel or VBS channel is received in a cell which is known not to be able to provide normal service.

In this state, only requests from the GCC or BCC layers for the reception of VGCS or VBS calls are treated and group call emergency services are offered.

4.1.2.2 The update Status

In parallel with the sublayer states described in section 4.1.2.1 and which control the MM sublayer protocol, an update status exists.

The update status pertains to a specific subscriber embodied by a SIM. This status is defined even when the subscriber is not activated (SIM removed or connected to a switched-off ME). It is stored in a non volatile memory in the SIM. The update status is changed only as a result of a location updating procedure attempt (with the exception of an authentication failure and of some cases of CM service rejection).

U1 UPDATED

The last location updating attempt was successful (correct procedure outcome, and the answer was acceptance from the network). With this status, the SIM contains also the LAI of the LA where the subscriber is registered, and possibly valid TMSI, ciphering key and ciphering key sequence number. The "Location update status" stored on the SIM shall be "updated".

U2 NOT UPDATED

The last location updating attempt made failed procedurally (no significant answer was received from the network, including the cases of failures or congestion inside the network).

For this status, the SIM does not contain any valid LAI, TMSI, ciphering key or ciphering key sequence number. For compatibility reasons, all these fields must be set to the "deleted" value at the moment the status is set to NOT UPDATED. However the presence of other values shall not be considered an error by the mobile station. The "Location update status" stored on the SIM shall be "not updated".

U3 ROAMING NOT ALLOWED

The last location updating attempt run correctly, but the answer from the network was negative (because of roaming or subscription restrictions).

For this status, the SIM does not contain any valid LAI, TMSI, ciphering key or ciphering key sequence number. For compatibility reasons, all these fields must be set to the "deleted" value at the moment the status is set to ROAMING NOT ALLOWED. However the presence of other values shall not be considered an error by the mobile station. The "Location update status" stored on the SIM shall be "Location Area not allowed".

4.1.2.3 MM sublayer states on the network side

1. IDLE

The MM sublayer is not active except possibly when the RR sublayer is in Group Receive mode.

2. WAIT FOR RR CONNECTION

The MM sublayer has received a request for MM connection establishment from the CM layer. A RR connection to the mobile station is requested from the RR sublayer (i.e. paging is performed).

3. MM CONNECTION ACTIVE

The MM sublayer has a RR connection to a mobile station. One or more MM connections are active.

4. IDENTIFICATION INITIATED

The identification procedure has been started by the network. The timer T3270 is running.

5. AUTHENTICATION INITIATED

The authentication procedure has been started by the network. The timer T3260 is running.

6. TMSI REALLOCATION INITIATED

The TMSI reallocation procedure has been started by the network. The timer T3250 is running.

7. CIPHERING MODE INITIATED

The cipher mode setting procedure has been requested to the RR sublayer.

8a. WAIT FOR MOBILE ORIGINATED MM CONNECTION

A CM SERVICE REQUEST message is received and processed, and the MM sublayer awaits the "opening message" of the MM connection.

8b. WAIT FOR NETWORK ORIGINATED MM CONNECTION

A CM SERVICE PROMPT message has been sent by the network and the MM sublayer awaits the “opening message” of the MM connection $(CCBS)$.

9. WAIT FOR REESTABLISHMENT

The RR connection to a mobile station with one or more active MM connection has been lost. The network awaits a possible re-establishment request from the mobile station.

10. WAIT OF A GROUP CALL

Only applicable in case for mobile station supporting VGCS talking. The MM sublayer has received a request for establishing a VGCS from the GCC sublayer. The request for establishing a VGCS channels is given to the RR sublayer.

11. GROUP CALL ACTIVE

Only applicable in case of mobile station supporting VGCS talking. A VGCS channel is established by the RR sublayer. An RR connection to the talking mobile station can be established by the RR sublayer on the VGCS channel. The MM sublayer is active but no sending of MM message between the network and the mobile station has occured.

12. MM CONNECTION ACTIVE (GROUP CALL)

Only applicable in case of mobile station supporting VGCS talking. The MM sublayer has a RR connection to the talking mobile station on the VGCS channel. Only one MM connection is active.

13. WAIT FOR BROADCAST CALL

Only applicable in case of VBS. The MM sublayer has received a request for a VBS establishment from the BCC sublayer. The request for establishment of VBS channels is given to the RR sublayer.

14. BROADCAST CALL ACTIVE

Only applicable in case of VBS. A VBS channel is established by the RR sublayer. The MM sublayer is active but no explicit MM establishment between the Network and the mobile station has occurred.

4.1.3 GPRS mobility management (GMM) sublayer states

In this section, the GMM protocol of the MS and the network are described by means of two different state machines. In section 4.1.3.1, the states of the GMM entity in the MS are introduced. The behaviour of the MS depends on a GPRS update status that is described in section 4.1.3.2. The states for the network side are described in section 4.1.3.3.

4.1.3.1 GMM states in the MS

In this section, the possible GMM states are described of a GMM entity in the mobile station. Section 4.1.3.1.1 summarises the main states of a GMM entity, see figure 4.1b/GSM 04.08. The substates that have been defined are described in section 4.1.3.1.2 and section 4.1.3.1.3.

However, it should be noted that this section does not include a description of the detailed behaviour of the MS in the single states and does not cover abnormal cases. Thus, figure 4.1b/GSM 04.08 is rather intended to give an overview of the state transitions than to be a complete state transition diagram. A detailed description of the behaviour of the MS is given in section 4.2. Especially, with respect to the behaviour of the MS in abnormal cases it is referred to section 4.7.

4.1.3.1.1 Main states

4.1.3.1.1.1 GMM-NULL

The GPRS capability is disabled in the MS. No GPRS mobility management function shall be performed in this state.

4.1.3.1.1.2 GMM-DEREGISTERED

The GPRS capability has been enabled in the MS, but no GMM context has been established. In this state, the MS may establish a GMM context by starting the GPRS attach or combined GPRS attach procedure.

4.1.3.1.1.3 GMM-REGISTERED-INITIATED

A GPRS attach or combined GPRS attach procedure has been started and the MS is awaiting a response from the network.

4.1.3.1.1.4 GMM-REGISTERED

A GMM context has been established, i.e. the GPRS attach or combined GPRS attach procedure has been successfully performed. In this state, the MS may activate PDP contexts, may send and receive user data and signalling information and may reply to a page request. Furthermore, cell and routing area updating are performed.

4.1.3.1.1.5 GMM-DEREGISTERED-INITIATED

The MS has requested release of the GMM context by starting the GPRS detach or combined GPRS detach procedure. This state is only entered if the MS is not being switched off at detach request.

4.1.3.1.1.6 GMM-ROUTING-AREA-UPDATING-INITIATED

A routing area updating procedure has been started and the MS is awaiting a response from the network.

4.1.3.1.2 Substates of state GMM-DEREGISTERED

The GMM-DEREGISTERED state is subdivided into several substates as explained below. The substates pertain to the whole MS (ME alone if no SIM is inserted, or ME plus SIM). The selection of the appropriate substate depends on the GPRS update status, see section 4.1.3.2, and on the selected cell.

4.1.3.1.2.1 GMM-DEREGISTERED.NORMAL-SERVICE

Valid subscriber data is available, the GPRS update status is GU1 or GU2, a cell has been selected. In this state, a request for GPRS attach is performed using the stored temporary mobile subscriber identity for GPRS (P-TMSI), routing area identification (RAI) and GPRS ciphering key sequence number in case of GU1. If the GPRS update status is GU2, the IMSI shall be used to attach for GPRS services.

4.1.3.1.2.2 GMM-DEREGISTERED.LIMITED-SERVICE

Valid subscriber data is available, GPRS update status is GU3, and a cell is selected, which is known not to be able to provide normal service.

4.1.3.1.2.3 GMM-DEREGISTERED.ATTACH-NEEDED

Valid subscriber data is available and for some reason a GPRS attach must be performed as soon as possible. This state is usually of no duration, but can last, e.g. if the access class is blocked.

4.1.3.1.2.4 GMM-DEREGISTERED.ATTEMPTING-TO-ATTACH

The GPRS update status is GU2, a cell is selected, a previous GPRS attach was rejected. The execution of further attach procedures depends on the GPRS attach attempt counter. No GMM procedure except GPRS attach shall be initiated by the MS in this substate.

4.1.3.1.2.5 GMM-DEREGISTERED.NO-IMSI

No valid subscriber data is available (no SIM, or the SIM is not considered valid by the ME) and a cell has been selected.

4.1.3.1.2.6 GMM-DEREGISTERED.NO-CELL-AVAILABLE

No cell can be selected. This substate is entered after a first intensive search failed (substate PLMN SEARCH). Cells are searched for at a low rhythm. No services are offered.

4.1.3.1.2.7 GMM-DEREGISTERED.PLMN-SEARCH

The mobile station is searching for PLMNs. This substate is left either when a cell has been selected (the new substate is NORMAL-SERVICE or LIMITED-SERVICE) or when it has been concluded that no cell is available at the moment (the new substate is NO-CELL-AVAILABLE).

4.1.3.1.3 Substates of state GMM-REGISTERED

The state GMM-REGISTERED is subdivided into several substate as explained below. The substates pertain to the whole MS (ME alone if no SIM is inserted, or ME plus SIM.).

4.1.3.1.3.1 GMM-REGISTERED.NORMAL-SERVICE

User data and signalling information may be sent and received.

4.1.3.1.3.2 GMM-REGISTERED.SUSPENDED

. The MS shall enter this substate when entering dedicated mode and when the MS limitations makes it unable to communicate on GPRS channels... In this substate, no user data should be sent and no signalling information shall be sent. The MS shall leave this substate when leaving dedicated mode.

4.1.3.1.3.3 GMM-REGISTERED.UPDATE-NEEDED

The MS has to perform a routing area updating procedure, but its access class is not allowed in the cell. The procedure will be initiated as soon as access is granted (this might be due to a cell-reselection or due to change of the access class of the current cell). No GMM procedure except routing area updating shall be initiated by the MS in this substate. In this substate, no user data and no signalling information shall be sent.

4.1.3.1.3.4 GMM-REGISTERED.ATTEMPTING-TO-UPDATE

A routing area updating procedure failed due to a missing response from the network. The MS retries the procedure controlled by timers and a GPRS attempt counter. No GMM procedure except routing area updating shall be initiated by the MS in this substate. No data shall be sent or received.

4.1.3.1.3.5 GMM-REGISTERED.NO-CELL-AVAILABLE

GPRS coverage has been lost. In this substate, the MS shall not initiate any GMM procedures except of cell (and PLMN) reselection.

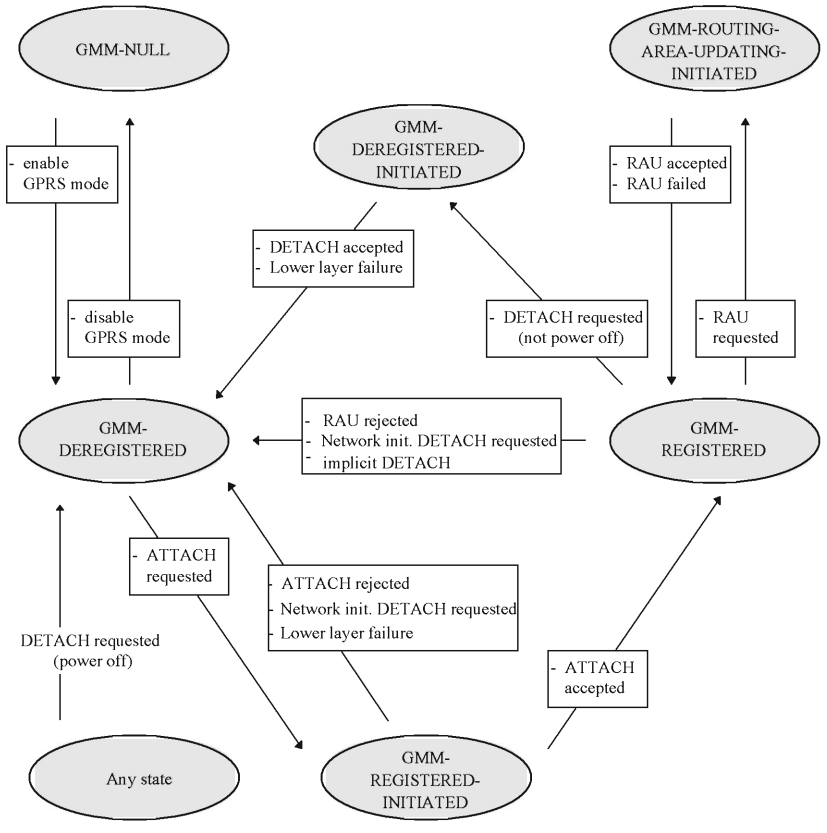


Figure 4.1b/GSM 04.08:GMM main states in the MS

4.1.3.2 GPRS update status

In addition to the GMM sublayer states described so far, a GPRS update status exists.

The GPRS update status pertains to a specific subscriber embodied by a SIM. This status is defined even when the subscriber is not activated (SIM removed or connected to a switched off ME). It is stored in a non volatile memory in the SIM. The GPRS update status is changed only after execution of a GPRS attach or routing area updating procedure.

GU1: UPDATED

The last GPRS attach or routing area updating attempt was successful (correct procedure outcome, and the answer was accepted by the network). The SIM contains the RAI of the routing area (RA) to which the subscriber was attached, and possibly a valid P-TMSI, GPRS ciphering key and GPRS ciphering key sequence number.

GU2: NOT UPDATED

The last GPRS attach or routing area updating attempt failed procedurally, i.e. no response was received from the network. This includes the cases of failures or congestion inside the network.

In this case, the SIM does not contain any valid RAI, P-TMSI, GPRS ciphering key or GPRS ciphering key sequence number. For compatibility reasons, all these fields shall be set to the "deleted" value at the moment the status is set to NOT UPDATED. However, the presence of other values shall not be considered an error by the MS.

GU3: ROAMING NOT ALLOWED

The last GPRS attach or routing area updating attempt was correctly performed, but the answer from the network was negative (because of roaming or subscription restrictions).

For this status, the SIM does not contain any valid RAI, P-TMSI, GPRS ciphering key or GPRS ciphering key sequence number. For compatibility reasons, all these fields must be set to the value "deleted" at the moment the status is set to ROAMING NOT ALLOWED. However, the presence of other values shall not be considered an error by the MS.

4.1.3.3 GMM mobility management states on the network side

In this subsection, the possible states are described for the GMM on the network side. Section 4.1.3.3.1 summarises the main states. The corresponding substates are described in section 4.1.3.3.2.

However, it should be noted that this section does not include a description of the detailed behaviour of the network in the single states and does not cover abnormal cases. Thus, figure 4.1c/GSM 04.08 is rather intended to give an overview of the state transitions than to be a complete state transition diagram. A detailed description of the behaviour of the MS is given in section 4.2. Especially, with respect to the behaviour of the MS in abnormal cases it is referred to section 4.7.

4.1.3.3.1 Main States

4.1.3.3.1.1 GMM-DEREGISTERED

The network has no GMM context or the GMM context is marked as detached, the MS is detached. In this state, the network may answer to a GPRS attach or combined GPRS attach procedure initiated by the MS.

4.1.3.3.1.2 GMM-COMMON-PROCEDURE-INITIATED

A common GMM procedure, as defined in section 4.1.1, has been started. The network is awaiting the answer from the MS.

4.1.3.3.1.3 GMM-REGISTERED

The GMM context has been established and the GPRS attach procedure has been successfully performed.

4.1.3.3.1.4 GMM-DEREGISTERED-INITIATED

The network has started a GPRS detach procedure and is awaiting the answer from the MS.

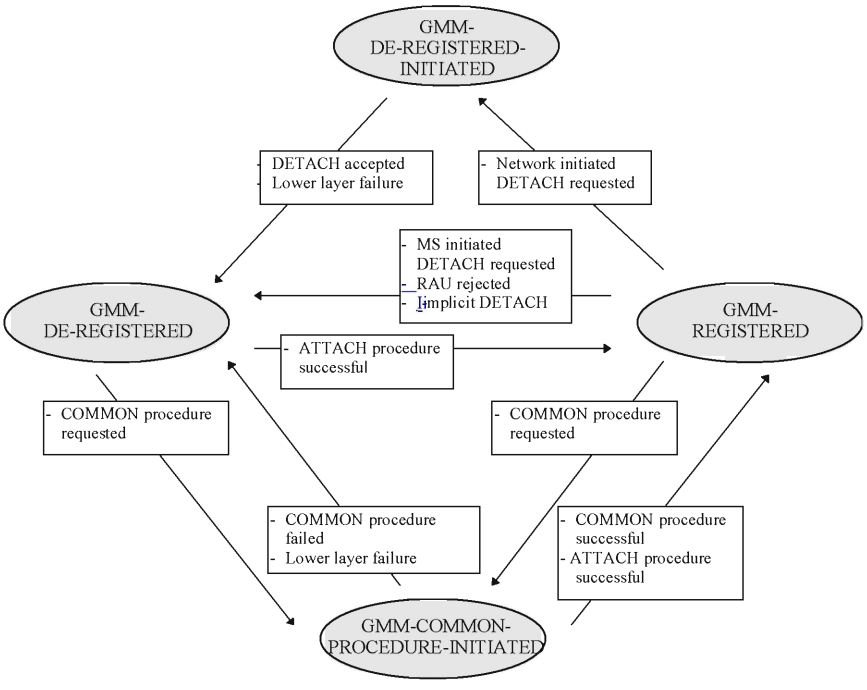


Figure 4.1c/GSM 04.08: GMM main states on the network side

4.1.3.3.2 Substates of state GMM-REGISTERED

The state GMM-REGISTERED is subdivided into two substates as explained below.

4.1.3.3.2.1 GMM-REGISTERED.NORMAL-SERVICE

User data and signalling information may be sent and received.

4.1.3.3.2.2 GMM-REGISTERED.SUSPENDED

In this substate, the lower layers shall be prevented of sending user data or signalling information.

4.2 Behaviour of the MS in MM Idle state, GMM-DEREGISTERED state and GMM-REGISTERED state

In this section, the detailed behaviour of the MS in the main states MM IDLE, GMM-DEREGISTERED and GMM-REGISTERED is described. Sections 4.2.1 to 4.2.3 refer to the state MM IDLE, whereas section 4.2.4 and section 4.2.5 refer to the states GMM-DEREGISTERED and GMM-REGISTERED, respectively.

The MM IDLE state is entered when none of the MM procedures are running and no RR connection exists. It is left when one of the MM procedures are triggered or an RR connection is established.

The specific behaviour in the MM IDLE state depends on the service state of the mobile station as described in section 4.1.2.1.2. The service state depends in particular on the update status which is defined in section 4.1.2.2.

How an appropriate service state is chosen after power on is described in section 4.2.1, and the specific behaviour of the mobile station in MM IDLE state is described in section 4.2.2. The service state chosen when the MM IDLE state is returned to from any state except NULL state is described in 4.2.3.

It should be noted that transitions between the various MM idle states are caused by (e.g.):

- results of procedures on RR connected mode (see section 4.2.3);
- insertion or removal of the SIM;
- cell selection/reselection (see also GSM 03.22);
- PLMN search;
- loss of coverage.

How various MM procedures affects the service state and the update status is described in the detailed descriptions of the procedures in sections 4.3 to 4.5.

4.2.1 Primary Service State selection

4.2.1.1 Selection of the Service State after Power On.

When mobility management is activated after power-on, the service state is 19.7 PLMN SEARCH. The detailed processing in this state is described in detail in GSM 03.22 and 05.08, where procedures for power on and selection of PLMN is described in detail. If the "Location update status" stored on the SIM is different from "updated", then the mobile shall act as if the "Location update status" stored on the SIM is "not updated".

The service state when the PLMN SEARCH state is left depends on the outcome of the search and on the presence of the SIM:

- if no cell has been found, the state is NO CELL AVAILABLE, until a cell is found;
- if no SIM is present the state is NO IMSI;
- if the mobile station has been continuously activated since loosing coverage and then returns to coverage, and if the selected cell is in the location area where the mobile station is registered and the timer T3212 has not expired, then the state is NORMAL SERVICE;
- if the selected cell is in the location area where the mobile station is registered and IMSI ATTACH is not required and timer T3212 has not expired, then the state is NORMAL SERVICE;
- if the mobile station is in automatic network selection mode and the selected cell is in a forbidden PLMN or a forbidden LA, then the mobile station enters the LIMITED SERVICE state;
- if the mobile station is in manual network selection mode and no cell of the selected PLMN has been found, then the mobile station enters the LIMITED SERVICE state;
- otherwise, the mobile station enters the LOCATION UPDATE NEEDED state.

4.2.1.2 Other Cases

The state PLMN SEARCH is also entered in the following cases:

- In state NO IMSI, a SIM is inserted;
- In any state except NO IMSI, NO CELL AVAILABLE, NORMAL SERVICE and RECEIVING GROUP CALL (NORMAL SERVICE) after the user has asked for a PLMN selection;
- In any state except NO IMSI and NO CELL AVAILABLE, coverage is lost;
- Roaming is denied;
- optionally, when the mobile station is in the ATTEMPTING TO UPDATE state and is in Automatic Network Selection mode and location update attempt counter is greater than or equal to 4.

The service state when the PLMN SEARCH is left depends on the outcome of the search and on the presence of the SIM as specified in paragraph 4.2.1.1.

4.2.2 Detailed Description of the MS behaviour in MM IDLE State.

In the MM IDLE state the mobile station shall behave according to the service state. In the following sections the behaviour is described for the non transient service states. It should be noted that after procedures in RR connected mode, e.g. location updating procedures, section 4.2.3 applies which specifies the selection of the MM idle state. Furthermore when in sub-state NORMAL SERVICE, if a PLMN selection is requested, the MS enters sub-state SEARCH FOR PLMN, NORMAL SERVICE.

4.2.2.1 Service State, NORMAL SERVICE

When in state MM IDLE and service state NORMAL SERVICE, the mobile station shall:

- perform normal location updating when a new location area is entered;
- perform location updating procedure at expiry of timer T3211 or T3213;
- perform periodic updating at expiration of timer T3212;
- perform IMSI detach;
- support requests from the CM layer;
- respond to paging.

In addition, mobile stations supporting VGCS listening or VBS listening shall:

- indicate notifications to the GCC or BCC sublayer;
- respond to notification if the GCC or BCC sublayer requests the reception of a voice group or broadcast call for which no channel description has been received in the notification by the RR sublayer;
- request the RR sublayer to receive a voice group or broadcast call if the GCC or BCC sublayer requests the reception of a voice group or broadcast call for which a channel description has been received in the notification by the RR sublayer and then go to the service state RECEIVING GROUP CALL (NORMAL SERVICE).

4.2.2.2 Service State, ATTEMPTING TO UPDATE

When in state MM IDLE and service state ATTEMPTING TO UPDATE the mobile station shall:

- perform location updating procedure at expiry of timer T3211 or T3213;
- perform normal location updating when the location area identification of the serving cell changes;
- if entry into this state was caused by c) or d) or f) (with cause different from "abnormal release, unspecified") or g) (with cause "retry upon entry into a new cell") of section 4.4.4.9, then location updating shall be performed when a new cell is entered;
- if entry into this state was caused by e) or f) (with cause "abnormal release, unspecified") or g) (with cause different from "retry upon entry into a new cell") of section 4.4.4.9, then location updating shall not be performed because a new cell is entered;
- perform normal location updating at expiry of timer T3212;
- not perform IMSI detach;
- support request for emergency calls;
- use other request from CM layer as triggering of normal location updating procedure (if the location updating procedure is successful, then the request for MM connection is accepted, see section 4.5.1);
- respond to paging (with IMSI).

In addition, mobile stations supporting VGCS listening or VBS listening shall:

- indicate notifications to the GCC or BCC sublayer for which a channel description has been received in the notification by the RR sublayer;
- reject requests of the GCC or BCC sublayer to respond to notifications for which no channel description has been received in the notification by the RR sublayer;
- request the RR sublayer to receive a voice group or broadcast call if the GCC or BCC sublayer requests the reception of a voice group or broadcast call for which a channel description has been received in the notification by the RR sublayer and then go to the service state RECEIVING GROUP CALL (LIMITED SERVICE).

4.2.2.3 Service State, LIMITED SERVICE

When in state MM IDLE and service state LIMITED SERVICE the mobile station shall:

- not perform periodic updating;
- not perform IMSI detach;
- reject any requests from CM entities for MM connections except for emergency calls;
- perform normal location updating when a cell is entered which may provide normal service (e.g. location area not in one of the forbidden LAI lists.);
- it may respond to paging (with IMSI).

In addition, mobile stations supporting VGCS listening or VBS listening shall:

- indicate notifications to the GCC or BCC sublayer for which a channel description has been received in the notification by the RR sublayer;
- reject requests of the GCC or BCC sublayer to respond to notifications for which no channel description has been received in the notification by the RR sublayer;
- request the RR sublayer to receive a voice group or broadcast call if the GCC or BCC sublayer requests the reception of a voice group or broadcast call for which a channel description has been received in the notification by the RR sublayer and then go to the service state RECEIVING GROUP CALL (LIMITED SERVICE).

4.2.2.4 Service State, NO IMSI

When in state MM IDLE and service state NO IMSI the mobile station shall (see section 3.2, GSM 03.22 and GSM 05.08):

- not start any normal location updating attempt;
- not perform periodic updating;
- not perform IMSI detach if powered down;
- reject any request from CM entities for MM connections except for emergency calls;
- not respond to paging;
- only perform default cell selection.

In addition, mobile stations supporting VGCS listening or VBS listening shall:

- not indicate notifications to the GCC or BCC layer.

4.2.2.5 Service State, SEARCH FOR PLMN, NORMAL SERVICE

When in state MM IDLE and service state SEARCH FOR PLMN, NORMAL SERVICE the mobile station shall:

- if timer T3211 or T3213 expires in this state perform a location updating procedure at the latest if and when back to NORMAL SERVICE state and if the cell is not changed;

- if timer T3212 expires in this state perform a periodic location updating procedure at the latest if and when back to NORMAL SERVICE state;
- perform IMSI detach;
- support requests from the CM layer;
- listen as far as possible to paging, and respond.

In addition, mobile stations supporting VGCS listening or VBS listening shall:

- listen as far as possible to notifications and indicate notifications to the GCC or BCC layer;
- respond to notification if the GCC or BCC sublayer requests the reception of a voice group or broadcast call for which no channel description has been received in the notification by the RR sublayer;
- request the RR sublayer to receive a voice group or broadcast call if the GCC or BCC sublayer requests the reception of a voice group or broadcast call for which a channel description has been received in the notification by the RR sublayer.

4.2.2.6 Service State, SEARCH FOR PLMN

When in state MM IDLE and service state SEARCH FOR PLMN the mobile station shall:

- not start any normal location updating attempt;
- not perform periodic updating;
- not perform IMSI detach if powered down;
- reject any request from CM entities for MM connections except emergency calls;
- not respond to paging.

4.2.2.7 Service State, RECEIVING GROUP CALL (NORMAL SERVICE)

Only applicable for mobile stations supporting VGCS listening or VBS listening:

When in state MM IDLE and service state RECEIVING GROUP CALL (NORMAL SERVICE), the mobile station shall:

- perform normal location updating when a new location area is entered;
- perform location updating procedure at expiry of timer T3211 or T3213;
- perform periodic updating at expiration of timer T3212;
- perform IMSI detach;
- support requests from the GCC or BCC layers;
- indicate notifications or paging informations to the GCC or BCC layer;
- respond to notification if the GCC or BCC sublayer requests the reception of a voice group or broadcast call for which no channel description has been received in the notification by the RR sublayer;
- request the RR sublayer to receive another voice group or broadcast call if the GCC or BCC sublayer requests the reception of a voice group or broadcast call for which a channel description has been received in the notification by the RR sublayer.

4.2.2.8 Service State, RECEIVING GROUP CALL (LIMITED SERVICE)

Only applicable for mobile stations supporting VGCS listening or VBS listening:

When in state MM IDLE and service state RECEIVING GROUP CALL (LIMITED SERVICE), the mobile station shall:

- not perform periodic updating;
- not perform IMSI detach;
- reject any requests from CM entities for MM connections except for emergency calls;
- perform normal location updating when a cell is entered which may provide normal service (e.g. location area not in one of the forbidden LAI lists.);
- it may respond to paging (with IMSI);
- indicate notifications to the GCC or BCC sublayer for which a channel description has been received in the notification by the RR sublayer;
- reject requests of the GCC or BCC sublayer to respond to notifications for which no channel description has been received in the notification by the RR sublayer;
- request the RR sublayer to receive a voice group or broadcast call if the GCC or BCC sublayer requests the reception of a voice group or broadcast call for which a channel description has been received in the notification by the RR sublayer and then go to the service state RECEIVING GROUP CALL (LIMITED SERVICE).

4.2.3 Service state when back to state MM IDLE from another state

When returning to MM IDLE, e.g., after a location updating procedure, the mobile station selects the cell as specified in GSM 03.22. With one exception, this is a normal cell selection.

If this return to idle state is not subsequent to a location updating procedure terminated with reception of cause "Roaming not allowed in this location area" the service state depends on the result of the cell selection procedure, on the update status of the mobile station, on the location data stored in the mobile station and on the presence of the SIM:

- if no cell has been found, the state is NO CELL AVAILABLE, until a cell is found;
- if no SIM is present, or if the inserted SIM is considered invalid by the MS, the state is NO IMSI;
- if the selected cell is in the location area where the MS is registered, then the state is NORMAL SERVICE; it shall be noted that this also includes an abnormal case described in paragraph 4.4.4.9;
- (Only applicable for mobile stations supporting VGCS listening or VBS listening.) if the mobile stations was in the service state RECEIVING GROUP CALL (NORMAL SERVICE) or RECEIVING GROUP CALL (LIMITED SERVICE) before the location updating procedure and the selected cell is in the location area where the mobile station is registered, then the state is RECEIVING GROUP CALL (NORMAL SERVICE);
- if the selected cell is in a location area where the mobile station is not registered but in which the MS is allowed to attempt a location update, then the state is LOCATION UPDATE NEEDED;
- if the selected cell is in a location area where the mobile station is not allowed to attempt a location update, then the state is LIMITED SERVICE;
- (Only applicable for MSs supporting VGCS listening or VBS listening.) if the MSs was in the service state RECEIVING GROUP CALL (NORMAL SERVICE) or RECEIVING GROUP CALL (LIMITED SERVICE) before the location updating procedure and the selected cell is in the location area where the MS is not allowed to attempt a location update, then the state is RECEIVING GROUP CALL (LIMITED SERVICE);
- after some abnormal cases occurring during an unsuccessful location updating procedure, as described in paragraph 4.4.4.9, the state is ATTEMPTING TO UPDATE.

In case of a return from a location updating procedure to which was answered "Roaming not allowed in this location area", the service state PLMN SEARCH is entered as specified in section 4.2.1.2.

4.2.4 Behaviour in state GMM-DEREGISTERED

The state GMM-DEREGISTERED is entered when:

- the MS is switched on;
- the GPRS capability has been enabled in the MS;
- a GPRS detach or combined GPRS detach procedure has been performed; or
- a GMM procedure has failed (except routing area updating, see 4.7.5).

The selection of the appropriate substate of GMM-DEREGISTERED after switching on is described in section 4.2.4.1. The specific behaviour of the MS in state GMM-DEREGISTERED is described in section 4.2.4.2. The substate chosen when the GMM-DEREGISTERED state is returned to from another state except state GMM-NULL is described in section 4.2.4.3.

It should be noted that transitions between the various substates of GMM-DEREGISTERED are caused by (e.g.):

- insertion or removal of the SIM;
- cell selection/reselection (see also GSM 03.22 [14]);
- PLMN search;
- loss/regain of coverage; or
- change of RA.

How various GMM procedures affect the GMM-DEREGISTERED substates and the GPRS update status is described in the detailed description of the GMM procedures in section 4.7.

4.2.4.1 Primary substate selection

4.2.4.1.1 Selection of the substate after power on or enabling the MS's GPRS capability

When the MS is switched on, the substate shall be PLMN-SEARCH in case the SIM is inserted and valid. See GSM 03.22 [14] and 05.08 [34] for further details.

When the GPRS capability in an activated MS has been enabled, the selection of the GMM-DEREGISTERED substate depends on the MM state and the GPRS update status.

The substate chosen after PLMN-SEARCH, in case of power on or after enabling of the GPRS capability is:

- if the cell is not supporting GPRS, the substate shall be NO-CELL-AVAILABLE;
- if no SIM is present the substate shall be NO-IMSI;
- if a cell supporting GPRS has been found and the PLMN or LA is not in the forbidden list, then the substate shall be NORMAL-SERVICE;
- if the MS is in automatic network selection mode and the selected cell supporting GPRS is in a forbidden PLMN or a forbidden LA, then the MS shall enter the substate LIMITED-SERVICE;
- if the MS is in manual network selection mode and no cell supporting GPRS of the selected PLMN has been found, the MS shall enter the substate NO-CELL-AVAILABLE.

4.2.4.1.2 Other Cases

When the MM state is IDLE, the state PLMN-SEARCH shall also be entered in the following cases:

- when a SIM is inserted in substate NO-IMSI;
- when the user has asked for a PLMN selection in substate LIMITED-SERVICE;

- when coverage is lost in substate NORMAL-SERVICE or substate LIMITED-SERVICE;
- when the MS is in automatic network selection mode and the GPRS attempt counter is greater than or equal to 4.

4.2.4.2 Detailed description of the MS behaviour in state GMM-DEREGISTERED

In state GMM-DEREGISTERED, the MS shall behave according to the substate. In the following sections, the behaviour is described for the non transient substates.

4.2.4.2.1 Substate, NORMAL-SERVICE

The MS shall:

- perform GPRS attach.

4.2.4.2.2 Substate, ATTEMPTING-TO-ATTACH

The MS shall:

- perform GPRS attach on the expiry of timers T3311 or T3302;
- perform GPRS attach when the routing area of the serving cell changes and is not in the forbidden lists;
- if entry into this state was caused by d in 4.7.3.1.5 with cause "Retry upon entry into a new cell", GPRS attach shall be performed when a new cell is entered.
- perform cell updates when the MS enters a new cell in the same RA.

4.2.4.2.3 Substate, LIMITED-SERVICE

The MS shall:

- perform GPRS attach when a cell is entered which may provide normal service (e.g. location area is not in one of the forbidden lists);

4.2.4.2.4 Substate, NO-IMSI

The MS shall:

- only perform default cell selection;

4.2.4.2.5 Substate, NO-CELL

The MS shall:

- perform cell selection according to GSM 03.22 [14] and shall choose an appropriate substate.

4.2.4.2.6 Substate, PLMN-SEARCH

No specific action is required in this substate.

4.2.4.2.7 Substate, ATTACH-NEEDED

The MS shall start a GPRS attach procedure if still needed as soon as the access class allows network contact in the selected cell.

4.2.4.3 Substate when back to state GMM-DEREGISTERED from another GMM state

When returning to state GMM-DEREGISTERED, the MS shall select a cell as specified in GSM 03.22 [14].

If this transition back to state GMM-DEREGISTERED is not subsequent to a GPRS attach or routing area updating procedure terminated with cause "Roaming not allowed in this location area", the substate depends on the result of the cell selection procedure, on the GPRS update status of the MS, on the location area data stored in the MS and on the presence of the SIM:

- if no cell has been found, the substate is NO-CELL-AVAILABLE, until a cell is found;
- if no SIM is present or if the inserted SIM is considered invalid by the MS, the substate shall be NO-IMSI;
- if the selected cell is in a location area where the MS is allowed to roam, the substate shall be NORMAL-SERVICE;
- if the selected cell is in a location area where the MS is not allowed to roam, the state shall be LIMITED-SERVICE.

If the state GMM-DEREGISTERED is entered after execution of a GPRS attach or routing area updating procedure with result "Roaming not allowed in this location area", the substate PLMN-SEARCH shall be entered if the MM state is IDLE, otherwise the substate entered is LIMITED-SERVICE.

4.2.5 Behaviour in state GMM-REGISTERED

The state GMM-REGISTERED is entered when:

- a GMM context is established, i.e. the MS is IMSI attached for GPRS services only or for GPRS and non-GPRS services.

The specific behaviour of the MS in state GMM-REGISTERED is described in section 4.2.5.1. The primary substate when entering the state GMM-REGISTERED is always NORMAL-SERVICE.

It should be noted that transitions between the various substates of GMM-REGISTERED are caused by (e.g.):

- cell selection/reselection (see also GSM 03.22);
- change of RA;
- loss/regain of coverage.

How various GMM procedures affect the GMM-REGISTERED substates is described in the detailed description of the procedures in section 4.7.

4.2.5.1 Detailed description of the MS behaviour in state GMM-REGISTERED

In state GMM-REGISTERED, the MS shall behave according to the substate as explained below.

4.2.5.1.1 Substate, NORMAL-SERVICE

The MS shall:

- perform cell selection/reselection according to GSM 03.22 [14];
- perform normal and periodic routing area updating; and
- receive and transmit user data and signalling information.

GPRS MSs in operation modes C or A shall answer to paging requests.

GPRS MS in operation mode B may answer to paging requests.

4.2.5.1.2 Substate, SUSPENDED

The MS:

- should not send any user data ; and

- shall not send any signalling information.

4.2.5.1.3 Substate, UPDATE-NEEDED

The MS shall:

- perform cell selection/reselection according to GSM 03.22 [14];
- perform a routing area updating procedure as soon as the access class allows network contact in the selected cell.

4.2.5.1.4 Substate, ATTEMPTING-TO-UPDATE

The MS shall:

- perform routing area update on the expiry of timers T3311 or T3302;
- perform routing area update when the routing area of the serving cell has changed and the location area this cell is belonging to is not in the list of forbidden LAs;
- if entry into this state was caused by d in 4.7.5.1.5 with cause "Retry upon entry into a new cell", routing area updating shall be performed when a new cell is entered.

4.2.5.1.5 Substate, NO-CELL-AVAILABLE

The MS shall perform cell selection/reselection according to GSM 03.22 [14].

4.3 MM common procedures

As described in section 4.1.1, a MM common procedure can be initiated at any time whilst a RR connection exists between the network and the mobile station.

4.3.1 TMSI reallocation procedure

The purpose of the TMSI reallocation procedure is to provide identity confidentiality , i.e. to protect a user against being identified and located by an intruder (see GSM 02.09 and 03.20).

If the identity confidentiality service is applied for an IMSI, a Temporary Mobile Subscriber Identity (TMSI) is used for identification within the radio interface signalling procedures.

The structure of the TMSI is specified in GSM 03.03. The TMSI has significance only within a location area. Outside the location area it has to be combined with the Location Area Identifier (LAI) to provide for an unambiguous identity.

Usually the TMSI reallocation is performed at least at each change of a location area. (Such choices are left to the network operator).

The reallocation of a TMSI can be performed either by a unique procedure defined in this section or implicitly by a location updating procedure using the TMSI. The implicit reallocation of a TMSI is described together with that procedure.

If a TMSI provided by a mobile station is unknown in the network e.g. due to a data base failure, the network may require the mobile station to provide its International Mobile Subscriber Identity (IMSI). In this case the identification procedure (see section 4.3.3) should be used before the TMSI reallocation procedure may be initiated.

The TMSI reallocation can be initiated by the network at any time whilst a RR connection exists between the network and the mobile station.

NOTE 1: Usually the TMSI reallocation is performed in ciphered mode.

NOTE 2: Normally the TMSI reallocation will take place in conjunction with another procedure, e.g. at location updating or at call setup (see GSM 09.02).

4.3.1.1 TMSI reallocation initiation by the network

The network initiates the TMSI reallocation procedure by sending a TMSI REALLOCATION COMMAND message to the mobile station and starts the timer T3250.

The TMSI REALLOCATION COMMAND message contains a new combination of TMSI and LAI allocated by the network or a LAI and the IMSI if the used TMSI shall be deleted. Usually the TMSI-REALLOCATION COMMAND message is sent to the mobile station using a RR connection in ciphered mode (see GSM 03.20).

4.3.1.2 TMSI reallocation completion by the mobile station

Upon receipt of the TMSI REALLOCATION COMMAND message the mobile station stores the Location Area Identifier (LAI) in the SIM. If the received identity is the IMSI of the relevant mobile station, the mobile station deletes any TMSI. If the received identity is a TMSI the mobile station stores the TMSI in the SIM. In both cases the mobile station sends a TMSI REALLOCATION COMPLETE message to the network.

4.3.1.3 TMSI reallocation completion in the network.

Upon receipt of the TMSI REALLOCATION COMPLETE message, the network stops the timer T3250 and either considers the new TMSI as valid or, if an IMSI was sent to the mobile station, considers the old TMSI as deleted.

If the RR connection is no more needed, then the network will request the RR sublayer to release it (see section 3.5).

4.3.1.4 Abnormal cases

Mobile station side:

The mobile station shall consider the new TMSI and new LAI, if any, as valid and the old TMSI and old LAI as deleted as soon as a TMSI REALLOCATION COMMAND or another message containing a new TMSI (e.g. LOCATION UPDATING ACCEPT) is correctly received. Any RR connection failure at a later stage shall not have any impact on the TMSI and LAI storage.

Network side:

(a) RR connection failure:

If the RR connection is lost before the TMSI REALLOCATION COMPLETE message is received, all MM connections (if any) shall be released and both the old and the new TMSIs should be considered as occupied for a certain recovery time.

During this period the network may:

- use the IMSI for paging in the case of network originated transactions on the CM layer. Upon response from the mobile station the TMSI reallocation is restarted;
- consider the new TMSI as valid if it is used by the mobile station in mobile originated requests for RR connection;
- use the Identification procedure followed by a new TMSI reallocation if the mobile station uses the old TMSI.

Other implementations are possible.

(b) Expiry of timer T3250:

The TMSI reallocation is supervised by the timer T3250 in the network. At the first expiry of timer T3250 the network may release the RR connection. In this case, the network shall abort the reallocation procedure release all MM connections if any, and follow the rules described for RR connection failure above.

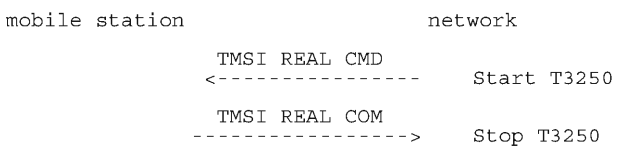


Figure 4.1/GSM 04.08: TMSI reallocation sequence

4.3.2 Authentication procedure

The purpose of the authentication procedure is twofold:

First to permit the network to check whether the identity provided by the mobile station is acceptable or not (see GSM 03.20);

Second to provide parameters enabling the mobile station to calculate a new ciphering key.

The cases where the authentication procedure should be used are defined in GSM 02.09.

The authentication procedure is always initiated and controlled by the network.

4.3.2.1 Authentication request by the network

The network initiates the authentication procedure by transferring an AUTHENTICATION REQUEST message across the radio interface and starts the timer T3260. The AUTHENTICATION REQUEST message contains the parameters necessary to calculate the response parameters (see GSM 03.20). It also contains the ciphering key sequence number allocated to the key which may be computed from the given parameters.

4.3.2.2 Authentication response by the mobile station

The mobile station shall be ready to respond upon an AUTHENTICATION REQUEST message at any time whilst a RR connection exists. It shall process the challenge information and send back an AUTHENTICATION RESPONSE message to the network. The new ciphering key calculated from the challenge information shall overwrite the previous one and be stored on the SIM before the AUTHENTICATION RESPONSE message is transmitted. The ciphering key stored in the SIM shall be loaded in to the ME when any valid CIPHERING MODE COMMAND is received during an RR connection (the definition of a valid CIPHERING MODE COMMAND message is given in section 3.4.7.2). The ciphering key sequence number shall be stored together with the calculated key.

4.3.2.3 Authentication processing in the network

Upon receipt of the AUTHENTICATION RESPONSE message, the network stops the timer T3260 and checks the validity of the response (see GSM 03.20).

4.3.2.4 Ciphering key sequence number

The security parameters for authentication and ciphering are tied together in sets, i.e. from a challenge parameter RAND both the authentication response SRES and the ciphering key can be computed given the secret key associated to the IMSI.

In order to allow start of ciphering on a RR connection without authentication, the ciphering key sequence numbers are introduced. The sequence number is managed by the network in the way that the AUTHENTICATION REQUEST message contains the sequence number allocated to the key which may be computed from the RAND parameter carried in that message.

The mobile station stores this number with the key, and indicates to the network in the first message (LOCATION UPDATING REQUEST, CM SERVICE REQUEST, PAGING RESPONSE, CM RE-ESTABLISHMENT REQUEST) which sequence number the stored key has. When the deletion of the sequence number is described this also means that the associated key shall be considered as invalid.

The network may choose to start ciphering with the stored key (under the restrictions given in GSM 02.09) if the stored sequence number and the one given from the mobile station are equal.

4.3.2.5 Unsuccessful authentication

If authentication fails, i.e. if the response is not valid, the network may distinguish between the two different ways of identification used by the mobile station:

- the TMSI was used;
- the IMSI was used.

If the TMSI has been used, the network may decide to initiate the identification procedure. If the IMSI given by the mobile station then differs from the one the network had associated with the TMSI, the authentication should be restarted with the correct parameters. If the IMSI provided by the MS is the expected one (i.e. authentication has really failed), the network should proceed as described below.

If the IMSI has been used, or the network decides not to try the identification procedure, an AUTHENTICATION REJECT message should be transferred to the mobile station.

After having sent this message, all MM connections in progress (if any) are released and the network should initiate the RR connection release procedure described in section 3.5.

Upon receipt of an AUTHENTICATION REJECT message, the mobile station shall set the update status in the SIM to ROAMING NOT ALLOWED, delete from the SIM the stored TMSI, LAI and ciphering key sequence number, and consider the SIM invalid until switched-off or the SIM is removed.

If the AUTHENTICATION REJECT message is received in the state IMSI DETACH INITIATED the mobile station shall follow section 4.3.4.3.

If the AUTHENTICATION REJECT message is received in any other state the mobile station shall abort any MM specific, MM connection establishment or call re-establishment procedure, stop any of the timers T3210 or T3230 (if running), release all MM connections (if any), set timer T3240 and enter the state WAIT FOR NETWORK COMMAND, expecting the release of the RR connection. start timer T3240 and enter the state WAIT FOR NETWORK COMMAND, expecting the release of the RR connection. If the RR connection is not released within a given time controlled by the timer T3240, the mobile station shall abort the RR connection. In both cases, either after a RR connection release triggered from the network side or after a RR connection abort requested by the MS-side, the MS enters state MM IDLE, substate NO IMSI.

4.3.2.6 Abnormal cases

(a) RR connection failure:

Upon detection of a RR connection failure before the AUTHENTICATION RESPONSE is received, the network shall release all MM connections (if any) and abort any ongoing MM specific procedure.

(b) Expiry of timer T3260:

The authentication procedure is supervised on the network side by the timer T3260. At expiry of this timer the network may release the RR connection. In this case the network shall abort the authentication procedure and any ongoing MM specific procedure, release all MM connections if any, and initiate the RR connection release procedure described in section 3.5.

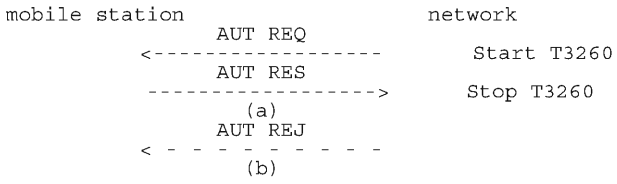


Figure 4.2/GSM 04.08: Authentication sequence: (a) authentication; (b) authentication rejection.

4.3.3 Identification procedure

The identification procedure is used by the network to request a mobile station to provide specific identification parameters to the network e.g. International Mobile Subscriber Identity, International Mobile Equipment Identity (cf. GSM 03.03). For the presentation of the IMEI, the requirements of GSM 02.09 apply.

4.3.3.1 Identity request by the network

The network initiates the identification procedure by transferring an IDENTITY REQUEST message to the mobile station and starts the timer T3270. The IDENTITY REQUEST message specifies the requested identification parameters in the identity type information element.

4.3.3.2 Identification response by the mobile station

The mobile station shall be ready to respond to an IDENTITY REQUEST message at any time whilst a RR connection exists.

Upon receipt of the IDENTITY REQUEST message the mobile station sends back an IDENTITY RESPONSE message. The IDENTITY RESPONSE message contains the identification parameters as requested by the network.

Upon receipt of the IDENTITY RESPONSE the network shall stop timer T3270.

4.3.3.3 Abnormal cases

(a) RR connection failure:

Upon detection of a RR connection failure before the IDENTITY RESPONSE is received, the network shall release all MM connections (if any) and abort any ongoing MM specific procedure.

(b) Expiry of timer T3270:

The identification procedure is supervised by the network by the timer T3270. At expiry of the timer T3270 the network may release the RR connection. In this case, the network shall abort the identification procedure and any ongoing MM specific procedure, release all MM connections if any, and initiate the RR connection release procedure as described in section 3.5.

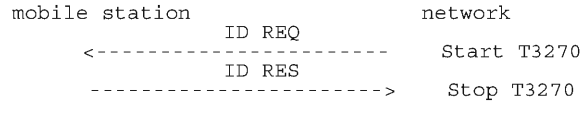


Figure 4.3/GSM 04.08: Identification sequence

4.3.4 IMSI detach procedure

The IMSI detach procedure may be invoked by a mobile station if the mobile station is deactivated or if the Subscriber Identity Module (see GSM 02.17) is detached from the mobile station. A flag (ATT) broadcast in the SYSTEM

INFORMATION TYPE 3 message on the BCCH is used by the network to indicate whether the detach procedure is required. The value of the ATT flag to be taken into account shall be the one broadcast when the mobile station was in MM idle.

The procedure causes the mobile station to be indicated as inactive in the network.

4.3.4.1 IMSI detach initiation by the mobile station

The IMSI detach procedure consists only of the IMSI DETACH INDICATION message sent from the mobile station to the network. The mobile station then starts timer T3220 and enters the MM sublayer state IMSI DETACH INITIATED.

If no RR connection exists, the MM sublayer within the mobile station will request the RR sublayer to establish a RR connection. If establishment of the RR connection is not possible because a suitable cell is not (or not yet) available then, the mobile station shall try for a period of at least 5 seconds and for not more than a period of 20 seconds to find a suitable cell. If a suitable cell is found during this time then, the mobile station shall request the RR sublayer to establish an RR connection, otherwise the IMSI detach is aborted.

If a RR connection exists, the MM sublayer will release locally any ongoing MM connections before the IMSI DETACH INDICATION message is sent.

The IMSI detach procedure may not be started if a MM specific procedure is active. If possible, the IMSI detach procedure is then delayed until the MM specific procedure is finished, else the IMSI detach is omitted.

4.3.4.2 IMSI detach procedure in the network

When receiving an IMSI DETACH INDICATION message, the network may set an inactive indication for the IMSI. No response is returned to the mobile station. After reception of the IMSI DETACH INDICATION message the network shall release locally any ongoing MM connections, and start the normal RR connection release procedure (see section 3.5).

Only applicable for a network supporting VGCS: If an IMSI DETACH INDICATION message is received from the talking mobile station in a group call while the network is in service state MM CONNECTION ACTIVE (GROUP TRANSMIT MODE), the network shall release locally the ongoing MM connection and then go to the service state GROUP CALL ACTIVE.

4.3.4.3 IMSI detach completion by the mobile station

Timer T3220 is stopped when the RR connection is released. The mobile station should, if possible, delay the local release of the channel to allow a normal release from the network side until T3220 timeout. If this is not possible (e.g. detach at power down) the RR sublayer on the mobile station side should be aborted.

4.3.4.4 Abnormal cases

If the establishment of an RR connection is unsuccessful, or the RR connection is lost, the IMSI detach is aborted by the mobile station.

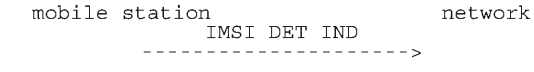


Figure 4.4/GSM 04.08: IMSI detach sequence

4.3.5 Abort procedure

The abort procedure may be invoked by the network to abort any on-going MM connection establishment or already established MM connection. The mobile station shall treat ABORT message as compatible with current protocol state only if it is received when at least one MM connection exists or an MM connection is being established.

4.3.5.1 Abort procedure initiation by the network

The abort procedure consists only of the ABORT message sent from the network to the mobile station. Before the sending of the ABORT message the network shall locally release any ongoing MM connection. After the sending the network may start the normal RR connection release procedure.

The Cause information element indicates the reason for the abortion. The following cause values may apply:

6: Illegal ME

#17: Network failure

4.3.5.2 Abort procedure in the mobile station

At the receipt of the ABORT message the mobile station shall abort any MM connection establishment or call re-establishment procedure and release all MM connections (if any). If cause value #6 is received the mobile station shall delete any TMSI, LAI and ciphering key sequence number stored in the SIM, set the update status to ROAMING NOT ALLOWED (and store it in the SIM according to section 4.1.2.2) and consider the SIM invalid until switch off or the SIM is removed. As a consequence the mobile station enters state MM IDLE, substate NO IMSI after the release of the RR connection.

The mobile station shall then wait for the network to release the RR connection - see section 4.5.3.1.

4.3.6 MM information procedure

The MM information message support is optional in the network.

The MM information procedure may be invoked by the network at any time during an RR connection.

4.3.6.1 MM information procedure initiation by the network

The MM information procedure consists only of the MM INFORMATION message sent from the network to the mobile station. During an RR connection, the network shall send none, one, or more MM INFORMATION messages to the mobile station. If more than one MM INFORMATION message is sent, the messages need not have the same content.

NOTE: The network may be able to select particular instants where it can send the MM INFORMATION message without adding delay to, or interrupting, any CM layer transaction, e.g. immediately after the AUTHENTICATION REQUEST message.

4.3.6.2 MM information procedure in the mobile station

When the mobile station (supporting the MM information message) receives an MM INFORMATION message, it shall accept the message and optionally use the contents to update appropriate information stored within the mobile station.

If the mobile station does not support the MM information message the mobile station shall ignore the contents of the message and return an MM STATUS message with cause #97.

4.4 MM specific procedures

A MM specific procedure can only be started if no other MM specific procedure is running or no MM connection exists between the network and the mobile station. The end of the running MM specific procedure or the release of all MM connections have to be awaited before a new MM specific procedure can be started.

During the lifetime of a MM specific procedure, if a MM connection establishment is requested by a CM entity, this request will either be rejected or be delayed until the running MM specific procedure is terminated (this depends on the implementation).

Any MM common procedure (except IMSI detach) may be initiated during a MM specific procedure.

Unless it has specific permission from the network (follow-on proceed) the mobile station side should await the release of the RR connection used for a MM specific procedure before a new MM specific procedure or MM connection establishment is started.

NOTE: The network side may use the same RR connection for MM connection management.

If the network operates in network operation mode I, GPRS MSs that operate in MS operation modes A or B and wish to be or are simultaneously IMSI attached for GPRS and non-GPRS services, shall use the combined GPRS attach and combined, normal, and periodic routing area updating procedures instead of the corresponding MM specific procedures IMSI attach and normal and periodic location area updating.

If the network operates in network operation mode II or III, GPRS MSs that operate in MS operation modes A or B shall use the MM specific procedures. The applicability of periodic updating is further specified in section 4.4.2.

4.4.1 Location updating procedure

The location updating procedure is a general procedure which is used for the following purposes:

- normal location updating (described in this section);
- periodic updating (see section 4.4.2);
- IMSI attach for non-GPRS services (see section 4.4.3).

The normal location updating procedure is used to update the registration of the actual Location Area of a mobile station in the network. The location updating type information element in the LOCATION UPDATING REQUEST message shall indicate normal location updating. The conditions under which the normal location updating procedure is used by a mobile station in the MM IDLE state are defined for each service state in section 4.2.2.

Only applicable for mobile stations supporting VGCS listening or VBS listening: A mobile station in RR group receive mode is in the MM IDLE state, substate RECEIVING GROUP CALL (NORMAL SERVICE) or RECEIVING GROUP CALL (LIMITED SERVICE). To perform a location updating, the MS in RR group receive mode shall leave the group receive mode, establish an independent dedicated RR connection to perform the location updating as described above and return to the RR group receive mode afterwards.

The normal location updating procedure shall also be started if the network indicates that the mobile station is unknown in the VLR as a response to MM connection establishment request.

To limit the number of location updating attempts made, where location updating is unsuccessful, an attempt counter is used. The attempt counter is reset when a mobile station is switched on or a SIM card is inserted.

Upon successful location updating the mobile station sets the update status to UPDATED in the SIM, and stores the received Location Area Identification in the SIM. The attempt counter shall be reset.

The detailed handling of the attempt counter is described in 4.4.4.6 to 4.4.4.9.

The Mobile Equipment shall contain a list of "forbidden location areas for roaming", as well as a list of "forbidden location areas for regional provision of service". These lists shall be erased when the MS is switched off or when the SIM is removed, and periodically (with period in the range 12 to 24 hours). The location area identification received on the BCCH that triggered the location updating request shall be added to the suitable list whenever a location update reject message is received with the cause "Roaming not allowed in this location area" or with the cause "Location Area not allowed". The lists shall accommodate each 10 or more location area identifications. When the list is full and a new entry has to be inserted, the oldest entry shall be deleted.

The cell selection processes in the different states are described in GSM 03.22 and GSM 05.08.

The location updating procedure is always initiated by the mobile station.

4.4.2 Periodic updating

Periodic updating may be used to notify periodically the availability of the mobile station to the network. Periodic updating is performed by using the location updating procedure or the routing area updating procedure (see section

4.7.5.1). The location updating type information element in the LOCATION UPDATING REQUEST message shall indicate periodic updating.

The procedure is controlled by the timer T3212 in the mobile station. If the timer is not already started, the timer is started each time the mobile station enters the MM IDLE substate NORMAL SERVICE or ATTEMPTing TO UPDATE. When the MS leaves the MM Idle State the timer T3212 shall continue running until explicitly stopped.

The timer is stopped (shall be set to its initial value for the next start) when:

- a LOCATION UPDATING ACCEPT or LOCATION UPDATING REJECT message is received;
- an AUTHENTICATION REJECT message is received;
- the first MM message is received, or ciphering mode setting is completed in the case of MM connection establishment, except when the most recent service state is LIMITED SERVICE;
- the mobile station has responded to paging and thereafter has received the first correct layer 3 message except RR message;
- the mobile station is deactivated (i.e. equipment powered down or SIM removed).

When the timer T3212 expires, the location updating procedure is started and the timer shall be set to its initial value for the next start. If the mobile station is in other state than MM Idle when the timer expires the location updating procedure is delayed until the MM Idle State is entered.

The conditions under which the periodic location updating procedure is used by a mobile station in the MM IDLE state are defined for each service state in section 4.2.2.

If the mobile station is in service state NO CELL AVAILABLE, LIMITED SERVICE, PLMN SEARCH or PLMN SEARCH-NORMAL SERVICE when the timer expires the location updating procedure is delayed until this service state is left. The (periodic) location updating procedure is not started if the BCCH information at the time the procedure is triggered indicates that periodic location shall not be used. The timeout value is broadcasted in the SYSTEM INFORMATION TYPE 3 message on the BCCH, in the Control channel description IE, see section 10.5.2.11.

The T3212 timeout value shall not be changed in the NO CELL AVAILABLE, LIMITED SERVICE, PLMN SEARCH and PLMN SEARCH-NORMAL SERVICE states.

When a change of the T3212 timeout value has to be taken into account and the timer is running (at change of the serving cell or, change of the broadcast value of T3212), the MS shall behave as follows:

> Let t1 be the new T3212 timeout value and let t be the current timer value at the moment of the change to the new T3212 timeout value; then the timer shall be restarted with the value t modulo t1.

When the mobile station is activated, or when a change of the T3212 timeout value has to be taken into account and the timer is not running, the mobile station shall behave as follows:

> Let t1 be the new T3212 timeout value, the new timer shall be started at a value randomly, uniformly drawn between 0 and t1.

4.4.3 IMSI attach procedure

The IMSI attach procedure is the complement of the IMSI detach procedure (see section 4.3.4). It is used to indicate the IMSI as active in the network. A flag (ATT) is broadcast in the SYSTEM INFORMATION TYPE 3 message. It indicates whether the attach and detach procedures are required to be used or not.

The IMSI attach procedure is invoked if the detach/attach procedures are required by the network and an IMSI is activated in a mobile station (i.e. activation of a mobile station with plug-in SIM, insertion of a card in a card-operated mobile station etc.) within coverage area from the network or a mobile station with an IMSI activated outside the coverage area enters the coverage area. The IMSI attach procedure is used only if the update status is UPDATED and if the stored Location Area Identification is the same as the one which is actually broadcasted on the BCCH of the current serving cell. Otherwise a normal location updating procedure (see section 4.4.1) is invoked independently of the ATT flag indication.

IMSI attach is performed by using the location updating procedure. The location updating type information element in the LOCATION UPDATING REQUEST message shall in this case indicate IMSI attach.

4.4.4 Generic Location Updating procedure

4.4.4.1 Location updating initiation by the mobile station

Any timer used for triggering the location updating procedure (e.g. T3211, T3212) is stopped if running.

As no RR connection exists at the time when the location updating procedure has to be started, the MM sublayer within the mobile station will request the RR sublayer to establish a RR connection and enter state WAIT FOR RR CONNECTION (LOCATION UPDATE). The procedure for establishing an RR connection is described in section 3.3.

The mobile station initiates the location updating procedure by sending a LOCATION UPDATING REQUEST message to the network, starts the timer T3210 and enters state LOCATION UPDATING INITIATED. The location updating type information element shall indicate what kind of updating is requested.

4.4.4.1a Network Request for Additional mobile station Capability Information

The network may initiate the classmark interrogation procedure, for example, to obtain further information on the mobile station's encryption capabilities.

4.4.4.2 Identification request from the network

The network may initiate the identification procedure, e.g. if the network is unable to get the IMSI based on the TMSI and LAI used as identification by the mobile station (see section 4.3.3).

4.4.4.3 Authentication by the network

The authentication procedure (see section 4.3.2) may be initiated by the network upon receipt of the LOCATION UPDATING REQUEST message from the mobile station. (See the cases defined in GSM 02.09).

4.4.4.4 Ciphering mode setting by the network

The ciphering mode setting procedure (see section 3.4.7) may be initiated by the network, e.g., if a new TMSI has to be allocated.

4.4.4.5 Attempt Counter

To limit the number of location updating attempts made, where location updating is unsuccessful, an attempt counter is used. It counts the number of consecutive unsuccessful location update attempts.

The attempt counter is incremented when a location update procedure fails. The specific situations is specified in section 4.4.4.9.

The attempt counter is reset when:

- the mobile station is powered on;
- a SIM is inserted;
- location update is successfully completed;
- location update completed with cause #11, #12 or #13 (see section 4.4.4.7).

and in case of service state ATTEMPTING to UPDATE:

- a new location area is entered;
- expiry of timer T3212;

- location update is triggered by CM sublayer requests.

The attempt counter is used when deciding whether to re-attempt a location update after timeout of timer T3211.

4.4.4.6 Location updating accepted by the network

If the location updating is accepted by the network a LOCATION UPDATING ACCEPT message is transferred to the mobile station.

In case the identity confidentiality service is active (see section 4.3.1 and 4.4.4.4), the TMSI reallocation may be part of the location updating procedure. The TMSI allocated is then contained in the LOCATION UPDATING ACCEPT message together with the location area identifier LAI. The network shall in this case start the supervision timer T3250 as described in section 4.3.1.

If the network wishes to prolong the RR connection to allow the mobile station to initiate MM connection establishment (for example if the mobile station has indicated in the LOCATION UPDATING REQUEST that it has a follow-on request pending) the network shall send "follow on proceed" in the LOCATION UPDATING ACCEPT and start timer T3255.

The mobile station receiving a LOCATION UPDATING ACCEPT message shall store the received location area identification LAI, stop timer T3210, reset the attempt counter and set the update status in the SIM to UPDATED. If the message contains an IMSI, the mobile station is not allocated any TMSI, and shall delete any TMSI in the SIM accordingly. If the message contains a TMSI, the mobile station is allocated this TMSI, and shall store this TMSI in the SIM and a TMSI REALLOCATION COMPLETE shall be returned to the network. If neither IMSI nor TMSI is received in the LOCATION UPDATING ACCEPT message, the old TMSI if any available shall be kept.

If the LAI or PLMN identity contained in the LOCATION UPDATING ACCEPT message is a member of any of the "forbidden lists" then any such entries shall be deleted.

After that, the mobile station shall act according to the presence of the "Follow-on proceed" information element in the LOCATION UPDATING ACCEPT; if this element is present and the mobile station has a CM application request pending, it shall send a CM SERVICE REQUEST to the network and proceed as in section 4.5.1.1. Otherwise, it shall start timer T3240 and enter state WAIT FOR NETWORK COMMAND.

4.4.4.7 Location updating not accepted by the network

If the location updating cannot be accepted the network sends a LOCATION UPDATING REJECT message to the mobile station. The mobile station receiving a LOCATION UPDATING REJECT message shall stop the timer T3210, store the reject cause, start T3240, enter state LOCATION UPDATING REJECTED await the release of the RR connection triggered by the network. Upon the release of the RR connection the mobile station shall take the following actions depending on the stored reject cause:

2: IMSI unknown in HLR;

3: Illegal MS; or

6: Illegal ME.

The mobile station shall set the update status to ROAMING NOT ALLOWED (and store it in the SIM according to section 4.1.2.2), and delete any TMSI, stored LAI and ciphering key sequence number and shall consider the SIM as invalid until switch-off or the SIM is removed.

11: PLMN not allowed;

12: Location Area not allowed; or

13: Roaming not allowed in this location area.

The mobile station shall delete any LAI, TMSI and ciphering key sequence number stored in the SIM, reset the attempt counter, set the update status to ROAMING NOT ALLOWED (and store it in the SIM according to section 4.1.2.2). The mobile station shall store the LAI or the PLMN identity in the suitable forbidden list, i.e. in the "forbidden PLMN list" for cause #11, in the list of "forbidden location areas for regional provision of service" for cause #12, and in the list of "forbidden location areas for roaming" for cause #13. In addition, the

MS will memorize if cause #13 was received, so to perform a PLMN selection instead of a cell selection when back to the MM IDLE state.

Other values are considered as abnormal cases and the specification of the mobile station behaviour in those cases is given in section 4.4.4.9.

4.4.4.8 Release of RR connection after location updating

When the Location updating procedure is finished (see sections 4.4.4.6 and 4.4.4.7) the mobile station shall (except in the case where the mobile has a follow-on CM application request pending and has received the follow-on proceed indication, see 4.4.4.6) set timer T3240 and enter the state WAIT FOR NETWORK COMMAND, expecting the release of the RR connection. The network may decide to keep the RR connection for network initiated establishment of a MM connection, or to allow for mobile initiated MM connection establishment.

Any release of the RR connection shall be initiated by the network according to section 3.5. If the RR connection is not released within a given time controlled by the timer T3240, the mobile station shall abort the RR connection. In both cases, either after a RR connection release triggered from the network side or after a RR connection abort requested by the MS-side, the MS shall return to state MM IDLE.

At transition to state MM IDLE, substates NORMAL SERVICE or RECEIVING GROUP CALL (NORMAL SERVICE) or ATTEMPTING TO UPDATE either timer T3212 or timer T3211 is started as described in section 4.4.4.9.

4.4.4.9 Abnormal cases on the mobile station side

The different abnormal cases that can be identified are the following:

a) Access barred because of access class control

   The location updating procedure is not started. The mobile station stays in the current serving cell and applies normal cell reselection process. The procedure is started as soon as possible and if still necessary (when the barred state is ended or because of a cell change)

b) The answer to random access is an IMMEDIATE ASSIGNMENT REJECT message

   The location updating is not started. The mobile station stays in the chosen cell and applies normal cell selection process. The waiting timer T3122 is reset when a cell change occurs. The procedure is started as soon as possible after T3122 timeout if still necessary.

c) Random access failure

   Timer T3213 is started. When it expires the procedure is attempted again if still necessary.

NOTE: As specified in GSM 05.08, a cell reselection then takes place, with return to the cell inhibited for 5 seconds if there is at least one other suitable cell. Typically the selection process will take the mobile station back to the cell where the random access failed after 5 seconds.

   If at the expiry of timer T3213 a new cell has not been selected due to the lack of valid information (see GSM 05.08), the mobile station may as an option delay the repeated attempt for up to 8 seconds to allow cell re-selection to take place. In this case the procedure is attempted as soon as a new cell has been selected or the mobile station has concluded that no other cell can be selected.

   If random access failure occurs for two successive random access attempts for location updating the mobile station proceeds as specified below.

d) RR connection failure

   The procedure is aborted and the mobile station proceeds as specified below.

e) T3210 timeout

   The procedure is aborted, the RR connection is aborted and the MS proceeds as specified below.

f) RR release before the normal end of procedure

The procedure is aborted and the mobile station proceeds as specified below.

g) Location updating reject, other causes than those treated in section 4.4.4.7

The MS waits for release of the RR connection as specified in section 4.4.4.8, and then proceeds as specified below.

In cases d) to g) above and for repeated failures as defined in c) above the mobile station proceeds as follows. Timer T3210 is stopped if still running. The RR Connection is aborted in case of timer T3210 timeout. The attempt counter is incremented. The next actions depend on the Location Area Identities (stored and received from the BCCH of the current serving cell) and the value of the attempt counter.

– the update status is UPDATED, and the stored LAI is equal to the one received on the BCCH from the current serving cell and the attempt counter is smaller than 4:

The mobile station shall keep the update status to UPDATED, the MM IDLE sub-state after the RR connection release is NORMAL SERVICE. The mobile station shall memorize the location updating type used in the location updating procedure. It shall start timer T3211 when the RR connection is released. When timer T3211 expires the location updating procedure is triggered again with the memorized location updating type;

– either the update status is different from UPDATED, or the stored LAI is different from the one received on the BCCH from the current serving cell, or the attempt counter is greater or equal to 4:

The mobile station shall delete any LAI, TMSI, ciphering key sequence number stored in the SIM, set the update status to NOT UPDATED and enter the MM IDLE sub-state ATTEMPTING TO UPDATE when the RR connection is released (See section 4.2.2.2 for the subsequent actions). If the attempt counter is smaller than 4, the mobile station shall memorize that timer T3211 is to be started when the RR connection is released, otherwise it shall memorize that timer T3212 is to be started when the RR connection is released.

4.4.4.10 Abnormal cases on the network side

a) RR connection failure

If a RR connection failure occurs during a common procedure integrated with the location updating procedure, the behaviour of the network should be according to the description of that common procedure.

If a RR connection failure occurs when a common procedure does not exist, the location updating procedure towards the mobile station should be aborted.

b) protocol error

If the LOCATION UPDATING REQUEST message is received with a protocol error, the network should, if possible, return a LOCATION UPDATING REJECT message with one of the following Reject causes:

#96: Mandatory information element error

#99: Information element non-existent or not implemented

#100: Conditional IE error

#111: Protocol error, unspecified

Having sent the response, the network should start the channel release procedure (see section 3.5).

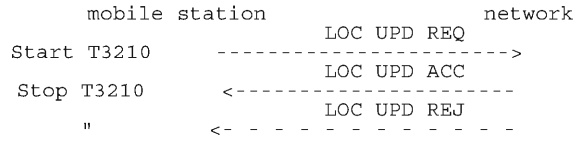


Figure 4.5/GSM 04.08: Location updating sequence

4.5 Connection management sublayer service provision

The concept of MM connection is introduced in this section. This concept is mainly a descriptive tool: The establishment of an MM connection by the network can be local (ie. it is achieved by the transmission of the first CM layer message and without the transmission of any MM layer messages) or can be achieved by the transmission of a CM SERVICE PROMPT message (eg. in the case of certain ring back services). The the release of an MM connection by the network or by the mobile station is always local, i.e. these purposes can be achieved without sending any MM messages over the radio interface. (On the contrary, establishment of an MM connection by the mobile station requires the sending of MM messages over the radio interface. An exception is VGCS, where an MM connection will be established as result of an uplink access procedure (see section 3.7.2.1.1).)

The Mobility Management (MM) sublayer is providing connection management services to the different entities of the upper Connection management (CM) sublayer (see GSM 04.07). It offers to a CM entity the possibility to use an MM connection for the exchange of information with its peer entity. An MM connection is established and released on request from a CM entity. Different CM entities communicate with their peer entity using different MM connections. Several MM connections may be active at the same time.

An MM connection requires an RR connection. All simultaneous MM connections for a given mobile station use the same RR connection.

In the following sections, the procedures for establishing, re-establishing, maintaining, and releasing an MM connection are described, usually separately for the mobile station and the network side.

4.5.1 MM connection establishment

4.5.1.1 MM connection establishment initiated by the mobile station

Upon request of a CM entity to establish an MM connection the MM sublayer first decides whether to accept, delay, or reject this request:

- An MM connection establishment may only be initiated by the mobile station when the following conditions are fulfilled:

  - Its update status is UPDATED.

  - The MM sublayer is in one of the states MM IDLE or MM connection active but not in MM connection active (Group call).

  An exception from this general rule exists for emergency calls (see section 4.5.1.5). A further exception is defined in the following clause.

- If an MM specific procedure is running at the time the request from the CM sublayer is received, and the LOCATION UPDATING REQUEST message has been sent, the request will either be rejected or delayed, depending on implementation, until the MM specific procedure is finished and, provided that the network has not sent a "follow-on proceed" indication, the RR connection is released. If the LOCATION UPDATING REQUEST message has not been sent, the mobile station may include a "follow-on request" indicator in the message. The mobile station shall then delay the request until the MM specific procedure is completed, when it may be given the opportunity by the network to use the RR connection: see section 4.4.4.6.

In order to establish an MM connection, the mobile station proceeds as follows:

a) If no RR connection exists, the MM sublayer requests the RR sublayer to establish an RR connection and enters MM sublayer state WAIT FOR RR CONNECTION (MM CONNECTION). This request contains an establishment cause and a CM SERVICE REQUEST or NOTIFICATION RESPONSE message. When the establishment of an RR connection is indicated by the RR sublayer (this indication implies that the CM SERVICE REQUEST or NOTIFICATION RESPONSE message has been successfully transferred via the radio interface, see section 2.2), the MM sublayer of the mobile station starts timer T3230, gives an indication to the CM entity that requested the MM connection establishment, and enters MM sublayer state WAIT FOR OUTGOING MM CONNECTION.

b) If an RR connection is available, the MM sublayer of the mobile station sends a CM SERVICE REQUEST or NOTIFICATION RESPONSE message to the network, starts timer T3230, gives an indication to the CM entity that requested the MM connection establishment, and enters:

- MM sublayer state WAIT FOR OUTGOING MM CONNECTION, if no MM connection is active;
- MM sublayer state WAIT FOR ADDITIONAL OUTGOING MM CONNECTION, if at least one MM connection is active;
- If an RR connection exists but the mobile station is in the state WAIT FOR NETWORK COMMAND then any requests from the CM layer that are received will either be rejected or delayed until this state is left.

c) Only applicable for mobile stations supporting VGCS talking:

If a mobile station which is in the MM sublayer state MM IDLE, service state RECEIVING GROUP CALL (NORMAL SERVICE), receives a request from the GCC sublayer to perform an uplink access, the MM sublayer requests the RR sublayer to perform an uplink access procedure and enters MM sublayer state WAIT FOR RR CONNECTION (GROUP TRANSMIT MODE).

When a successful uplink access is indicated by the RR sublayer, the MM sublayer of the mobile station gives an indication to the GCC sublayer and enters MM sublayer state MM CONNECTION ACTIVE (GROUP TRANSMIT MODE).

When an uplink access reject is indicated by the RR sublayer, the MM sublayer of the mobile station gives an indication to the GCC sublayer and enters the MM sublayer state MM IDLE, service state RECEIVING GROUP CALL (NORMAL SERVICE).

In the network, if an uplink access procedure is performed, the RR sublayer in the network provides an indication to the MM sublayer together with the mobile subscriber identity received in the TALKER INDICATION message. The network shall then enter the MM sublayer state MM CONNECTION ACTIVE (GROUP TRANSMIT MODE).

The CM SERVICE REQUEST message contains the

- mobile identity according to section 10.5.1.4;
- mobile station classmark 2;
- ciphering key sequence number; and
- CM service type identifying the requested type of transaction (e.g. mobile originating call establishment, emergency call establishment, short message service, supplementary service activation).

A MS supporting eMLPP may optionally include a priority level in the CM SERVICE REQUEST message.

Only applicable for mobile stations supporting VGCS listening or VBS listening:

The NOTIFICATION RESPONSE message is used if a mobile station has received a notification message on the NCH for a VGCS or VBS call without a description of the respective VGCS or VBS channel. The mobile station therefore establishes an MM connection with a NOTIFICATION RESPONSE in order to obtain the necessary details from the network. The NOTIFICATION RESPONSE message contains the

- mobile identity according to section 10.5.1.4;
- mobile station classmark 2; and
- notified voice group or broadcast call reference according to section 10.5.1.9.

A collision may occur when a CM layer message is received by the mobile station in MM sublayer state WAIT FOR OUTGOING MM CONNECTION or in WAIT FOR ADDITIONAL OUTGOING MM CONNECTION. In this case the MM sublayer in the MS shall establish a new MM connection for the incoming CM message as specified in 4.5.1.3.

Upon receiving a CM SERVICE REQUEST or NOTIFICATION RESPONSE message, the network shall analyse its content. The type of semantic analysis may depend on other on going MM connection(s). Depending on the type of

request and the current status of the RR connection, the network may start any of the MM common procedures and RR procedures.

The network may initiate the classmark interrogation procedure, for example, to obtain further information on the mobile station's encryption capabilities.

The identification procedure (see section 4.3.3) may be invoked for instance if a TMSI provided by the mobile station is not recognized.

The network may invoke the authentication procedure (see section 4.3.2) depending on the CM service type.

The network decides also if the ciphering mode setting procedure shall be invoked (see section 3.4.7).

NOTE: If the CM_SERVICE_REQUEST message contains a priority level the network may use this to perform queuing and pre-emption as defined in GSM 03.67.

An indication from the RR sublayer that the ciphering mode setting procedure is completed, or reception of a CM SERVICE ACCEPT message, shall be treated as a service acceptance indication by the mobile station. The MM connection establishment is completed, timer T3230 shall be stopped, the CM entity that requested the MM connection shall be informed, and MM sublayer state MM CONNECTION ACTIVE is entered. The MM connection is considered to be active.

If the service request cannot be accepted, the network returns a CM SERVICE REJECT message to the mobile station.

The reject cause information element (see 10.5.3.6 and Annex G) indicates the reason for rejection. The following cause values may apply:

#4 : IMSI unknown in VLR

#6 : Illegal ME

#17 : Network failure

#22 : Congestion

#32 : Service option not supported

#33 : Requested service option not subscribed

#34 : Service option temporarily out of order

If no other MM connection is active, the network may start the RR connection release (see section 3.5) when the CM SERVICE REJECT message is sent.

If a CM SERVICE REJECT message is received by the mobile station, timer T3230 shall be stopped, the requesting CM sublayer entity informed. Then the mobile station shall proceed as follows:

- If the cause value is not #4 or #6 the MM sublayer returns to the previous state (the state where the request was received). Other MM connections shall not be affected by the CM SERVICE REJECT message.
- If cause value #4 is received, the mobile station aborts any MM connection, deletes any TMSI, LAI and ciphering key sequence number in the SIM, changes the update status to NOT UPDATED (and stores it in the SIM according to section 4.1.2.2), and enters the MM sublayer state WAIT FOR NETWORK COMMAND. If subsequently the RR connection is released or aborted, this will force the mobile station to initiate a normal location updating). Whether the CM request shall be memorized during the location updating procedure, is a choice of implementation.
- If cause value #6 is received, the mobile station aborts any MM connection, deletes any TMSI, LAI and ciphering key sequence number in the SIM, changes the update status to ROAMING NOT ALLOWED (and stores it in the SIM according to section 4.1.2.2), and enters the MM sublayer state WAIT FOR NETWORK COMMAND. The mobile station shall consider the SIM as invalid until switch-off or the SIM is removed.

4.5.1.2 Abnormal cases

Mobile station side:

a) RR connection failure or IMSI deactivation

If an RR connection failure occurs or the IMSI is deactivated during the establishment of an MM connection, the MM connection establishment is aborted, timers T3230 is stopped, and an indication is given to the CM entity that requested the MM connection establishment. This shall be treated as a rejection for establishment of the new MM connection, and the MM sublayer shall release all active MM connections.

b) T3230 expiry

If T3230 expires (i.e. no response is given but a RR connection is available) the MM connection establishment is aborted and the requesting CM sublayer is informed. If no other MM connection exists then the mobile station shall proceed as described in section 4.5.3.1 for release of the RR connection. Otherwise the mobile station shall return to the MM sublayer state where the request of an MM connection was received, i.e. to MM sublayer state MM connection active. Other ongoing MM connections (if any) shall not be affected.

c) Reject cause values #95, #96, #97, #99, #100, #111 received

The same actions as on timer expiry shall be taken by the mobile station.

d) Random access failure or RR connection establishment failure

If the mobile station detects a random access failure or RR connection establishment failure during the establishment of an MM connection, it aborts the MM connection establishment and gives an indication to the CM entity that requested the MM connection establishment.

NOTE: Further actions of the mobile station depend on the RR procedures and MM specific procedures during which the abnormal situation has occurred and are described together with those procedures.

Network side:

a) RR connection failure

The actions to be taken upon RR connection failure within a MM common procedure are described together with that procedure. A RR connection failure occurring outside such MM common procedures, shall trigger the release of all active MM connections if any.

b) Invalid message or message content

Upon reception of an invalid initial message or a CM SERVICE REQUEST message with invalid content, a CM SERVICE REJECT message shall be returned with one of the following appropriate Reject cause indications:

95: Semantically incorrect message

96: Mandatory information element error

97: Message type non-existent or not implemented

99: Information element non-existent or not implemented

100: Conditional IE error

111: Protocol error, unspecified

When the CM SERVICE REJECT message has been sent, the network may start RR connection release if no other MM connections exist or if the abnormal condition also has influence on the other MM connections.

4.5.1.3 MM connection establishment initiated by the network

4.5.1.3.1 Mobile Terminating CM Activity

When a CM sublayer entity in the network requests the MM sublayer to establish a MM connection, the MM sublayer will request the establishment of an RR connection to the RR sublayer if no RR connection to the desired mobile station exists. The MM sublayer is informed when the paging procedure is finished (see section 3.3.2) and the mobile station shall enter the MM state WAIT FOR NETWORK COMMAND.

(* editor's note: this does not appear to be stated any where other than in fig 4.1a. Without this statement, there does not seem to be anything to stop the mobile sending a CM SERVICE REQUEST message which might cross (ambiguously) with a CIPHERING MODE COMMAND message. *)

When an RR connection is established (or if it already exists at the time the request is received), the MM sublayer may initiate any of the MM common procedures (except IMSI detach); it may request the RR sublayer to perform the RR classmark interrogation procedure, and/or the ciphering mode setting procedure.

When all MM and RR procedures are successfully completed which the network considers necessary, the MM sublayer will inform the requesting mobile terminating CM sublayer entity on the success of the MM connection establishment.

If an RR connection already exists and no MM specific procedure is running, the network may also establish a new mobile terminating MM connection by sending a CM message with a new PD/TI combination.

If the establishment of an RR connection is unsuccessful, or if any of the MM common procedures or the ciphering mode setting fail, this is indicated to the CM layer with an appropriate error cause.

If an RR connection used for a MM specific procedure exists to the mobile station, the CM request may be rejected or delayed depending on implementation. When the MM specific procedure has been completed, the network may use the same RR connection for the delayed CM request.

Only applicable in case of VGCS talking:

In the MM CONNECTION ACTIVE (GROUP TRANSMIT MODE) the mobile station is in RR Group transmit mode. There shall be only one MM connection active.

When in MM CONNECTION ACTIVE (GROUP TRANSMIT MODE) state, the MM sublayer in the network shall reject the request for the establishment of another MM connection by any CM layer.

If the RR sublayer in the network indicates a request to perform a transfer of the mobile station from RR connected mode to RR Group transmit mode which will result in a transition from MM CONNECTION ACTIVE state to MM CONNECTION ACTIVE (GROUP TRANSMIT MODE) state in the MM sublayer, the MM sublayer shall not allow the transition if more than one MM connection is active with the mobile station.

4.5.1.3.2 Mobile Originating CM Activity $(CCBS)$

When a CM sublayer entity in the network requests the MM sublayer to establish a MM connection, the MM sublayer will request the establishment of an RR connection to the RR sublayer if no RR connection to the desired mobile station exists. The MM sublayer is informed when the paging procedure is finished (see section 3.3.2) and the mobile station shall enter the MM state WAIT FOR NETWORK COMMAND.

When an RR connection is established (or if it already exists at the time the request is received), the MM sublayer may initiate any of the MM common procedures (except IMSI detach), it may request the RR sublayer to perform the RR classmark interrogation procedure and/or the ciphering mode setting procedure.

The network should use the information contained in *the Mobile Station Classmark Type* 2 IE on the mobile station's support for "Network Initiated MO CM Connection Request" to determine whether to:

not start this procedure (eg if an RR connection already exists), or,

to continue this procedure, or,

to release the newly established RR connection.

In the case of a "Network Initiated MO CM Connection Request" the network shall use the established RR connection to send a CM SERVICE PROMPT message to the mobile station.

For a mobile station which supports "Network Initiated MO CM Connection Request", the CM SERVICE PROMPT message identifies the CM entity in the mobile station which shall be informed of the completion of the MM connection. A mobile that does not support "Network Initiated MO CM Connection Request" shall return an MM STATUS message with cause #97 "message type non-existent or not implemented" to the network.

If the mobile station supports "Network Initiated MO CM Connection Request" but the identified CM entity in the mobile station does not provide the associated support, then the mobile station shall send an MM STATUS message

with cause "Service option not supported". In the case of a temporary CM problem (eg lack of transaction identifiers) then the mobile station shall send an MM STATUS message with cause "Service option temporarily out of order".

If an RR connection already exists and no MM specific procedure is running, the network may use it to send the CM SERVICE PROMPT message.

If the establishment of an RR connection is unsuccessful, or if any of the MM common procedures or the ciphering mode setting fail, this is indicated to the CM layer in the network with an appropriate error cause.

If an RR connection used for a MM specific procedure exists to the mobile station, the "Network Initiated MO CM Connection Request" may be rejected or delayed depending on implementation. When the MM specific procedure has been completed, the network may use the same RR connection for the delayed "Network Initiated MO CM Connection Request".

4.5.1.4 Abnormal cases

The behaviour upon abnormal events is described together with the relevant RR procedure or MM common procedure.

4.5.1.5 MM connection establishment for emergency calls

A MM connection for an emergency call may be established in all states of the mobility management sublayer which allow MM connection establishment for a normal originating call. In addition, establishment may be attempted in all service states where a cell is selected (see 4.2.2) but not in the MM CONNECTION ACTIVE state (GROUP TRANSMIT MODE) state. However, as a network dependent option, a MM connection establishment for emergency call may be rejected in some of the states.

When a user requests an emergency call establishment the mobile station will send a CM SERVICE REQUEST message to the network with a CM service type information element indicating emergency call establishment. If the network does not accept the emergency call request, e.g., because IMEI was used as identification and this capability is not supported by the network, the network will reject the request by returning a CM SERVICE REJECT message to the mobile station.

The reject cause information element indicates the reason for rejection. The following cause values may apply:

#3 "Illegal MS"

#4 "IMSI unknown in VLR"

#5 "IMEI not accepted"

#6 "Illegal ME"

#17 "Network failure"

#22 "Congestion"

#32 "Service option not supported"

#34 "Service option temporarily out of order"

With the above defined exceptions, the procedures described for MM connection establishment in 4.5.1.1 and 4.5.1.2 shall be followed.

NOTE: Normally, the mobile station will be identified by an IMSI or a TMSI. However, if none of these identifiers is available in the mobile station, then the mobile station shall use the IMEI for identification purposes. The network may in that case reject the request by returning a CM SERVICE REJECT message with reject cause:

#5 "IMEI not accepted".

4.5.1.6 Call re-establishment

The re-establishment procedure allows a MS to resume a connection in progress after a radio link failure, possibly in a new cell and possibly in a new location area. The conditions in which to attempt call re-establishment or not depend on

the call control state, see section 5.5.4 and, whether or not a cell allowing call re-establishment has been found (as described in GSM 05.08). MM connections are identified by their protocol discriminators and transaction identifiers: these shall not be changed during call re-establishment.

The re-establishment takes place when a lower layer failure occurs and at least one MM connection is active (i.e.. the mobile station's MM sublayer is either in state 6 "MM CONNECTION ACTIVE" or state 20 "WAIT FOR ADDITIONAL OUTGOING MM CONNECTION").

NOTE: During a re-establishment attempt the mobile station does not return to the MM IDLE state; thus no location updating is performed even if the mobile is not updated in the location area of the selected cell.

No call re-establishment shall be performed for voice group and broadcast calls.

4.5.1.6.1 Call re-establishment, initiation by the mobile station

NOTE: The network is unable to initiate call re-establishment.

If at least one request to re-establish an MM connection is received from a CM entity as a response to the indication that the MM connection is interrupted (see 4.5.2.3.) the mobile station initiates the call re-establishment procedure. If several CM entities request re-establishment only one re-establishment procedure is initiated. If any CM entity requests re-establishment, then re-establishment of all transactions belonging to all Protocol Discriminators that permit Call Re-establishment shall be attempted.

Upon request of a CM entity to re-establish an MM connection the MM sublayer requests the RR sublayer to establish an RR connection and enters MM sublayer state WAIT FOR REESTABLISH. This request contains an establishment cause and a CM RE-ESTABLISHMENT REQUEST message. When the establishment of an RR connection is indicated by the RR sublayer (this indication implies that the CM RE-ESTABLISHMENT REQUEST message has been successfully transferred via the radio interface, see section 2.2), the MM sublayer of the mobile station starts timer T3230, gives an indication to all CM entities that are being re-established, and remains in the MM sublayer state WAIT FOR REESTABLISH.

The CM RE-ESTABLISHMENT REQUEST message contains the

- mobile identity according to section 10.5.1.4;
- mobile station classmark 2;
- ciphering key sequence number.

NOTE: Whether or not a CM entity can request re-establishment depends upon the Protocol Discriminator. The specifications for Short Message Service (GSM 04.11) and Call Independent Supplementary Services (GSM 04.10) do not currently specify any re-establishment procedures.

Upon receiving a CM RE-ESTABLISHMENT REQUEST message, the network shall analyse its content. Depending on the type of request, the network may start any of the MM common procedures and RR procedures.

The network may initiate the classmark interrogation procedure, for example, to obtain further information on the mobile station's encryption capabilities.

The identification procedure (see section 4.3.3) may be invoked.

The network may invoke the authentication procedure (see section 4.3.2).

The network decides if the ciphering mode setting procedure shall be invoked (see section 3.4.7).

An indication from the RR sublayer that the ciphering mode setting procedure is completed, or reception of a CM SERVICE ACCEPT message, shall be treated as a service acceptance indication by the mobile station. The MM connection re-establishment is completed, timer T3230 shall be stopped, all CM entities associated with the re-establishment shall be informed, and MM sublayer state MM CONNECTION ACTIVE is re-entered. All the MM connections are considered to be active.

If the network cannot associate the re-establishment request with any existing call for that mobile station, a CM SERVICE REJECT message is returned with the reject cause:

#38 "call cannot be identified"

If call re-establishment cannot be performed for other reasons, a CM SERVICE REJECT is returned, the appropriate reject cause may be any of the following (see annex G):

4 "IMSI unknown in VLR";

6 "illegal ME";

#17 "network failure";

#22 "congestion";

#32 "service option not supported";

#34 "service option temporarily out of order".

Whatever the reject cause a mobile station receiving a CM SERVICE REJECT as a response to the CM RE-ESTABLISHMENT REQUEST shall stop T3230, release all MM connections and proceed as described in section 4.5.3.1. In addition:

- if cause value #4 is received, the mobile station deletes any TMSI, LAI and ciphering key sequence number in the SIM, changes the update status to NOT UPDATED (and stores it in the SIM according to section 4.1.2.2), and enters the MM sublayer state WAIT FOR NETWORK COMMAND. If subsequently the RR connection is released or aborted, this will force the mobile station to initiate a normal location updating). The CM re-establishment request shall not be memorized during the location updating procedure.
- if cause value #6 is received, the mobile station deletes any TMSI, LAI and ciphering key sequence number in the SIM, changes the update status to ROAMING NOT ALLOWED (and stores it in the SIM according to section 4.1.2.2), and enters the MM sublayer state WAIT FOR NETWORK COMMAND. The MS shall consider the SIM as invalid until switch-off or the SIM is removed.

4.5.1.6.2 Abnormal cases

Mobile station side:

a) Random access failure or RR connection establishment failure

If the mobile station detects a random access failure or RR connection establishment failure during the re-establishment of an MM connection, the re-establishment is aborted and all MM connections are released.

b) RR connection failure

If a RR connection failure occurs, timer T3230 is stopped, the re-establishment is aborted and all active MM connections are released.

c) IMSI deactivation

If the IMSI deactivated during the re-establishment attempt then timer T3230 is stopped, the re-establishment is aborted and all MM connections are released.

d) T3230 expires

If T3230 expires (i.e. no response is given but a RR connection is available) the re-establishment is aborted, all active MM connections are released and the mobile station proceeds as described in section 4.5.3.1.

e) Reject causes #96, #97, #99, #100, #111 received

The mobile station shall perform the same actions as if timer T3230 had expired.

Network side:

a) RR connection failure

If a RR connection failure occurs after receipt of the CM RE-ESTABLISHMENT REQUEST the network shall release all MM connections.

b) Invalid message content

Upon reception an invalid initial of message or a CM RE-ESTABLISHMENT REQUEST message with invalid content, a CM SERVICE REJECT message shall be returned with one of the following appropriate Reject cause indications:

#96: Mandatory information element error

#99: Information element non-existent or not implemented

#100: Conditional IE error

#111: Protocol error, unspecified

When the CM SERVICE REJECT message has been sent, the network shall release the RR connection.

4.5.1.7 Forced release during MO MM connection establishment

If the mobile station's CM layer initiated the MM connection establishment but the CM layer wishes to abort the establishment prior to the completion of the establishment phase, the mobile station shall send a CM SERVICE ABORT message any time after the completion of the RR connection and not after the first CM message (e.g. SETUP) is sent.

If the first CM message has already been sent, the normal release procedure defined by the appropriate CM protocol applies and the CM SERVICE ABORT shall not be sent.

Sending of the CM SERVICE ABORT message is only allowed during the establishment of the first MM connection, where no other MM connection exists in parallel. If parallel MM connections exist already, a new connection establishment cannot be aborted and normal MM connection release according to 4.5.3 applies after MM connection establishment.

Upon transmission of the CM SERVICE ABORT message the mobile station shall set timer T3240 and enter the state WAIT FOR NETWORK COMMAND, expecting the release of the RR connection.

Upon receipt of the CM SERVICE ABORT message the network shall abort ongoing processes, release the appropriate resources, and unless another MM connection establishment is pending, initiate a normal release of the RR connection.

If the RR connection is not released within a given time controlled by timer T3240, the mobile station shall abort the RR connection. In both cases, either after a RR connection release triggered from the network side or after a RR connection abort requested by the mobile station side the mobile station shall return to state MM IDLE; the service state depending upon the current update status as specified in section 4.2.3.

4.5.2 MM connection information transfer phase

After the MM connection has been established, it can be used by the CM sublayer entity for information transfer. According to the protocol architecture described in GSM 04.07, each CM entity will have its own MM connection. These different MM connections are identified by the protocol discriminator PD and, additionally, by the transaction identifier TI.

All MM common procedures may be initiated at any time while MM connections are active. Except for Short Message Control which uses a separate layer 2 low priority data link, no priority mechanism is defined between the CM, MM and RR sublayer messages.

4.5.2.1 Sending CM messages

A CM sublayer entity, after having been advised that a MM connection has been established, can request the transfer of CM messages. The CM messages passed to the MM sublayer are then sent to the other side of the interface with the PD and TI set according to the source entity.

4.5.2.2 Receiving CM messages

Upon receiving a CM message, the MM sublayer will distribute it to the relevant CM entity according to the PD value and TI value. However, if the received CM message is the first for the MM connection (identified by PD and TI), the MM sublayer will in addition indicate to the CM entity that a new MM connection has been established.

4.5.2.3 Abnormal cases

RR connection failure:

If the RR connection failure occurs during a RR or MM common procedure, the consequent actions are described together with that procedure.

In other cases, the following applies:

Mobile station:

The MM sublayer shall indicate to all CM entities associated with active MM connections that the MM connection is interrupted, the subsequent action of the MM sublayer (call re-establishment, see 4.5.1.6, or local release) will then depend on the decisions by the CM entities.

Network:

The MM sublayer shall locally release all active MM connections. As an option the network may delay the release of all or some of the MM connections to allow the mobile station to initiate call re-establishment

4.5.3 MM connection release

An established MM connection can be released by the local CM entity. The release of the CM connection will then be done locally in the MM sublayer, i.e. no MM message are sent over the radio interface for this purpose.

4.5.3.1 Release of associated RR connection

If all MM connections are released by their CM entities, the mobile station shall set timer T3240 and enter the state WAIT FOR NETWORK COMMAND, expecting the release of the RR connection.

In the network, if the last MM connection is released by its user, the MM sublayer may decide to release the RR connection by requesting the RR sublayer according to section 3.5. The RR connection may be maintained by the network, e.g. in order to establish another MM connection.

If the RR connection is not released within a given time controlled by the timer T3240, the mobile station shall abort the RR connection. In both cases, either after a RR connection release triggered from the network side or after a RR connection abort requested by the MS-side, the MS shall return to MM IDLE state; the service state depending upon the current update status as specified in section 4.2.3.

4.5.3.2 Uplink release in a voice group call

(Only applicable for mobile stations supporting VGCS talking:)

If a mobile station which is in the MM sublayer state MM CONNECTION ACTIVE (GROUP TRANSMIT MODE) receives a request from the GCC sublayer to perform an uplink release, the MM sublayer requests the RR sublayer to perform an uplink release procedure and enters the MM sublayer state RECEIVING GROUP CALL (NORMAL SERVICE).

4.6 Receiving a MM STATUS message by a MM entity.

If the MM entity of the mobile station receives a MM STATUS message no state transition and no specific action shall be taken as seen from the radio interface, i.e. local actions are possible.

With the exceptions described for the responses to the CM SERVICE PROMPT message, the actions to be taken on receiving a MM STATUS message in the network are an implementation dependent option.

4.7 Elementary mobility management procedures for GPRS services

4.7.1 General

This section describes the basic functions offered by the mobility management (GMM) sublayer at the radio interface (reference point U_m). The functionality is described in terms of timers and procedures. During GMM procedures, session management procedures, see chapter 6, are suspended.

4.7.1.1 Lower layer failure

The LLC sublayer shall indicate a logical link failure or an RR sublayer failure to the GMM sublayer. The failure indicates an error that cannot be corrected by the lower layers.

4.7.1.2 Ciphering of messages

If ciphering is to be applied on a GMM context, all GMM messages shall be ciphered except the following messages:

-- ATTACH REQUEST;

-- ATTACH REJECT;

-- AUTHENTICATION AND CIPHERING REQUEST;

-- AUTHENTICATION AND CIPHERING RESPONSE;

-- AUTHENTICATION AND CIPHERING REJECT;

-- IDENTITY REQUEST;

-- IDENTITY RESPONSE;

-- ROUTING AREA UPDATE REQUEST; and

-- ROUTING AREA UPDATE REJECT.

4.7.1.3 Radio resource sublayer address handling

While a packet TMSI (P-TMSI) is used in the GMM sublayer for identification of an MS, a temporary logical link identity (TLLI) is used for addressing purposes at the RR sublayer. This section describes how the RR addressing is managed by GMM. For the detailed coding of the different TLLI types and how a TLLI can be derived from a P-TMSI, see GSM 03.03 [10].

Two cases can be distinguished:

- a valid P-TMSI is available in the MS; or
- no valid P-TMSI is available in the MS

NOTE: For anonymous access, the RR address assignment is handled by the SM sublayer as described in section 6.1.1.1.

i) valid P-TMSI available

If the MS has stored a valid P-TMSI, the MS shall derive a foreign TLLI from that P-TMSI and shall use it for transmission of the:

- ATTACH REQUEST message of any GPRS combined/non-combined attach procedure; and
- ROUTING AREA UPDATE REQUEST message of a combined/non-combined RAU procedure if the MS has entered a new routing area.

Any other GMM message is transmitted using a local TLLI derived from the stored P-TMSI. This includes a ROUTING AREA UPDATE REQUEST message that is sent within a periodic routing area update procedure.

ii) no valid P-TMSI available

When the MS has not stored a valid P-TMSI, i.e. the MS is not attached to GPRS, the MS shall use a randomly selected random TLLI for transmission of the:

- ATTACH REQUEST message of any combined/non-combined GPRS attach procedure.

Upon receipt of an ATTACH REQUEST message, the network assigns a P-TMSI to the MS, derives a local TLLI from the assigned P-TMSI, and transmits the assigned P-TMSI to the MS.

Upon receipt of the assigned P-TMSI, the MS shall derive the local TLLI from this P-TMSI and shall use it for addressing at lower layers.

In both cases, the MS shall acknowledge the reception of the assigned P-TMSI to the network. After receipt of the acknowledgement, the network shall use the local TLLI for addressing at lower layers.

4.7.2 GPRS Mobility management timers

4.7.2.1 READY and STANDBY timer behaviour

The READY timer, T3314, and the STANDBY timer, T3315, are used in the MS and in the network per each assigned P-TMSI to control the cell updating and paging procedure.

When the READY timer is running the MS shall perform cell update each time a new cell is selected (see GSM 03.22 [14]). If a routing area border is crossed, a routing area updating procedure shall be performed instead of a cell update.

When the STANDBY timer is running the MS shall:

- perform the routing area updating procedure when a routing area border is crossed;
- not perform a cell update when a new cell is selected.

When the STANDBY timer is running in the network and the Mobile Reachable timer has not expired, paging shall be initiated when GMM signalling messages or user data are pending to be sent to the MS. Only GPRS MSs in GMM-REGISTERED state shall be paged; in case of error recovery GPRS MSs may also be paged in any GMM state.

All other GMM procedures are not affected by the READY and STANDBY timers.

The READY timer is started:

- in the MS when the GMM entity receives an indication from lower layers that user data or GMM or SM signalling messages have been transmitted; and
- in the network when the GMM entity receives an indication from lower layers that user data or GMM or SM signalling messages have been received by the network.

The STANDBY timer is started in the network and in the MS when:

- the READY timer expires; or
- force to standby is indicated in a signalling message
(the timer is started after successful completion of the signalling procedure); or
- a lower layer failure occurs.

Within GMM signalling procedures the network or the MS may include a 'force to standby'-request. Upon receipt of such a request, the acceptance may be indicated in the corresponding GMM response message. Upon successful completion of the GMM procedure, the READY timer shall be stopped and the STANDBY timer shall be started in the MS and in the network.

When the STANDBY timer is started, the READY timer is stopped (if running) and vice versa. Additionally, the READY timer shall be stopped when the GPRS detach procedure is completed.

When the STANDBY timer expires the state GMM-DEREGISTERED is entered - the GMM context is implicitly released.

However, if the network operates in network operation mode I and if a GPRS MS operates in MS operation mode B and the MS and the network enter the state GMM-REGISTERD.SUSPENDED, the STANDBY timer shall be prevented to trigger this implicit detach as long as the MS and the network are in state GMM-REGISTERED.SUSPENDED. When this state is left, the STANDBY timer shall be restarted in the MS and on the network side. The READY timer is not affected by state transitions to and from the GMM-REGISTERED.SUSPENDED substate.

The value of the READY and STANDBY timers may be negotiated between the MS and the network using the GPRS attach or GPRS routing area updating procedure.

- If the MS wishes to negotiate READY and/or STANDBY timer values different than the default values it shall include the preferred values into the ATTACH REQUEST and/or ROUTING AREA UPDATE REQUEST messages. The preferred values may be smaller or greater than the default values or may indicate that either the READY or STANDBY timer function shall be deactivated.

- When the network receives timer values in the ATTACH REQUEST or ROUTING AREA UPDATE REQUEST messages, it shall include the negotiated timer values into the ATTACH ACCEPT or ROUTING AREA UPDATE ACCEPT messages, respectively. These timer values shall be applied for the GMM context by the network and by the MS.

- When no timer values have been received by the network in the ATTACH REQUEST or ROUTING AREA UPDATE REQUEST messages, the network may include timer values for the READY and/or STANDBY timers different than the default values into the ATTACH ACCEPT or ROUTING AREA UPDATE ACCEPT messages, respectively. These timer values shall be applied for the GMM context by the network and by the MS.

If the negotiated READY timer value indicates that the ready timer function is deactivated, the READY timer shall always run without expiry. If the negotiated STANDBY timer value indicates that the standby timer function is deactivated, the STANDBY timer shall always run without expiry. If the STANDBY timer is negotiated to zero, the MS is implicitly detached when the READY timer expires.

4.7.2.2 Periodic routing area updating

Periodic routing area updating is used to periodically notify the availability of the MS to the network. The procedure is controlled in the MS by the periodic RA update timer, T3312. The value of timer T3312 is sent by the network to the MS in the messages ATTACH ACCEPT and ROUTING AREA UPDATE ACCEPT. The value of the timer T3312 shall be unique within a RA.

The timer T3312 shall be started, reset and restarted together with the STANDBY timer. When timer T3312 expires, the periodic routing area updating procedure shall be started.

The network supervises the periodic routing area updating procedure by means of the Mobile Reachable timer. When the Mobile Reachable timer expires, typically the network stops sending paging messages to the mobile and may take other appropriate actions.

If the MS is both IMSI attached for GPRS and non-GPRS services in a network that operates in network operation mode I, and if the MS lost coverage of the selected PLMN and timer T3312 expires, then:

a) if the MS returns to coverage in a cell that supports GPRS and that indicates that the network is in network operation mode I, then, depending upon the RA of the cell, the MS shall either perform the periodic routing area update procedure or the normal RA update procedure; or

b) if the MS returns to coverage in a cell that supports GPRS and that indicates that the network is in network operation mode II or III, then the MS shall act as if a new routing area with a different network operation mode has been entered; or

c) if the MS returns to coverage in a cell that does not support GPRS, then, depending upon the LA of the cell, the MS shall either perform the periodic location updating procedure or a normal location updating procedure. In addition, the MS shall perform a combined GPRS attach procedure when the MS enters a cell that supports GPRS and that indicates that the network is in network operation mode I.

If the MS is both IMSI attached for GPRS and non-GPRS services in a network that operates in network operation mode I, and if the MS has camped on a cell that does not support GPRS, and timer T3312 expires, then the MS shall start an MM location updating procedure. In addition, the MS shall perform a combined GPRS attach procedure when the MS enters a cell that supports GPRS and indicates that the network is in operation mode I.

Timer T3312 shall be stopped when a GPRS MS in MS operation mode B enters state GMM-REGISTERED.SUSPENDED. When this state is left, the timer T3312 shall be restarted by the MS with its initial value.

4.7.3 GPRS attach procedure

The GPRS attach procedure is used for two purposes:

- normal GPRS attach, performed by the MS to IMSI attach for GPRS services only. The normal GPRS attach procedure shall be used by GPRS MSs in MS operation mode C and by GPRS and B MSs in MS operation modes A or B when attaching for GPRS services only.
- combined GPRS attach procedure, used by GPRS MSs in MS operation modes A or B to attach the IMSI for GPRS and non-GPRS services provided that the network operates in network operation mode I.

With a successful GPRS attach procedure a GMM context is established.

Section 4.7.3.1 describes the GPRS attach procedure to attach the IMSI only for GPRS services. The combined GPRS attach procedure used to attach the IMSI for both GPRS and non-GPRS services is described in section 4.7.3.2.

If an IMSI attach for non-GPRS services is requested and a GMM context exists, the routing area updating procedure shall be used as described in section 4.7.5.2.

To limit the number of subsequently rejected attach attempts, a GPRS attach attempt counter is introduced. The GPRS attach attempt counter shall be incremented as specified in section 4.7.3.1.5. Depending on the value of the GPRS attempt counter, specific actions shall be performed. The GPRS attach attempt counter shall be reset when:

- the MS is powered on;
- a SIM is inserted;
- a GPRS attach procedure is successfully completed; or
- a GPRS attach procedure is completed with cause #8, #9, #11, #12, #13, or #16;

and additionally when the MS is in substate ATTEMPTING-TO-ATTACH:

- a new routing area is entered; or
- an attach is triggered by CM sublayer requests.

The mobile equipment shall contain a list of "forbidden location areas for roaming", as well as a list of "forbidden location areas for regional provision of service". The handling of these lists is described in section 4.4.1; the same lists are used by GMM and MM procedures.

4.7.3.1 GPRS attach procedure for GPRS services

The GPRS attach procedure is a GMM procedure used by GPRS MSs to IMSI attach for GPRS services only.

The attach type information element shall indicate "GPRS attach".

4.7.3.1.1 GPRS attach procedure initiation

In state GMM-DEREGISTERED, the MS initiates the GPRS attach procedure by sending an ATTACH REQUEST message to the network, starts timer T3310 and enters state GMM-REGISTERED-INITIATED.

The MS shall include a valid P-TMSI, if any is available, the P-TMSI signature associated with the P-TMSI and the routing area identity associated with the P-TMSI in the ATTACH REQUEST message. If there is no valid P-TMSI available, the IMSI shall be included instead of the P-TMSI, P-TMSI signature and RAI.