
**3rd Generation Partnership Project;
Technical Specification Group Radio Access Network;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Physical layer procedures
(Release 10)**



The present document has been developed within the 3rd Generation Partnership Project (3GPPTM) and may be further elaborated for the purposes of 3GPP.

The present document has not been subject to any approval process by the 3GPP Organisational Partners and shall not be implemented. This Specification is provided for future development work within 3GPP only. The Organisational Partners accept no liability for any use of this Specification. Specifications and reports for implementation of the 3GPPTM system should be obtained via the 3GPP Organisational Partners' Publications Offices.

IPR2022-00464

Keywords

UMTS, radio, layer 1

3GPP

Postal address

3GPP support office address

650 Route des Lucioles – Sophia Antipolis
Vauban – France
Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Internet

<http://www.3gpp.org>

Copyright Notification

No part may be reproduced except as authorized by written permission.
The copyright and the foregoing restriction extend to reproduction in all media.

© 2011, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TTA, TTC).
All rights reserved.

UMTS™ is a Trade Mark of ETSI registered for the benefit of its members
3GPP™ is a Trade Mark of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners
LTE™ is a Trade Mark of ETSI currently being registered for the benefit of its Members and of the 3GPP Organizational Partners
GSM® and the GSM logo are registered and owned by the GSM Association

3GPP

IPR2022-00464

Contents

Foreword.....	5
1 Scope	6
2 References	6
3 Definitions, symbols, and abbreviations	7
3.1 Symbols.....	7
3.2 Abbreviations	7
4 Synchronisation procedures	8
4.1 Cell search.....	8
4.2 Timing synchronisation.....	8
4.2.1 Radio link monitoring	8
4.2.2 Inter-cell synchronisation.....	8
4.2.3 Transmission timing adjustments.....	8
4.3 Timing for Secondary Cell Activation / Deactivation	9
5 Power control	9
5.1 Uplink power control	9
5.1.1 Physical uplink shared channel	9
5.1.1.1 UE behaviour.....	9
5.1.1.2 Power headroom	14
5.1.2 Physical uplink control channel	15
5.1.2.1 UE behaviour.....	15
5.1.3 Sounding Reference Symbol.....	18
5.1.3.1 UE behaviour.....	18
5.2 Downlink power allocation.....	18
5.2.1 eNodeB Relative Narrowband TX Power restrictions	20
6 Random access procedure	20
6.1 Physical non-synchronized random access procedure.....	21
6.1.1 Timing.....	21
6.2 Random Access Response Grant	22
7 Physical downlink shared channel related procedures	23
7.1 UE procedure for receiving the physical downlink shared channel.....	23
7.1.1 Single-antenna port scheme.....	27
7.1.2 Transmit diversity scheme	28
7.1.3 Large delay CDD scheme	28
7.1.4 Closed-loop spatial multiplexing scheme	28
7.1.5 Multi-user MIMO scheme	28
7.1.5A Dual layer scheme.....	28
7.1.5B Up to 8 layer transmission scheme	28
7.1.6 Resource allocation.....	28
7.1.6.1 Resource allocation type 0.....	28
7.1.6.2 Resource allocation type 1.....	29
7.1.6.3 Resource allocation type 2.....	30
7.1.6.4 PDSCH starting position.....	31
7.1.6.5 PRB bundling.....	31
7.1.7 Modulation order and transport block size determination.....	31
7.1.7.1 Modulation order determination.....	32
7.1.7.2 Transport block size determination	33
7.1.7.2.1 Transport blocks not mapped to two or more layer spatial multiplexing	34
7.1.7.2.2 Transport blocks mapped to two-layer spatial multiplexing.....	40
7.1.7.2.3 Transport blocks mapped for DCI Format 1C	40
7.1.7.2.4 Transport blocks mapped to three-layer spatial multiplexing.....	40
7.1.7.2.5 Transport blocks mapped to four-layer spatial multiplexing	41
7.1.7.3 Redundancy Version determination for Format 1C.....	42
7.2 UE procedure for reporting Channel State Information (CSI).....	42

3GPP

IPR2022-00464

7.2.1	Aperiodic CSI Reporting using PUSCH	46
7.2.2	Periodic CSI Reporting using PUCCH	51
7.2.3	Channel quality indicator (CQI) definition	61
7.2.4	Precoding Matrix Indicator (PMI) definition	63
7.2.5	Channel-State Information – Reference Symbol (CSI-RS) definition	64
7.3	UE procedure for reporting HARQ-ACK	64
8	Physical uplink shared channel related procedures	68
8.0	UE procedure for transmitting the physical uplink shared channel	68
8.0.1	Single-antenna port scheme	71
8.0.2	Closed-loop spatial multiplexing scheme	71
8.1	Resource Allocation for PDCCH with uplink DCI Format	72
8.1.1	Uplink Resource allocation type 0	72
8.1.2	Uplink Resource allocation type 1	72
8.2	UE sounding procedure	72
8.3	UE HARQ-ACK procedure	76
8.4	UE PUSCH Hopping procedure	77
8.4.1	Type 1 PUSCH Hopping	78
8.4.2	Type 2 PUSCH Hopping	78
8.5	UE Reference Symbol procedure	79
8.6	Modulation order, redundancy version and transport block size determination	79
8.6.1	Modulation order and redundancy version determination	79
8.6.2	Transport block size determination	81
8.6.3	Control information MCS offset determination	82
8.7	UE Transmit Antenna Selection	84
9	Physical downlink control channel procedures	84
9.1	UE procedure for determining physical downlink control channel assignment	84
9.1.1	PDCCH Assignment Procedure	84
9.1.2	PHICH Assignment Procedure	86
9.1.3	Control Format Indicator assignment procedure	87
9.2	PDCCH validation for semi-persistent scheduling	87
9.3	PDCCH control information procedure	89
10	Physical uplink control channel procedures	89
10.1	UE procedure for determining physical uplink control channel assignment	89
10.1.1	PUCCH format information	90
10.1.2	FDD HARQ-ACK feedback procedures	91
10.1.2.1	FDD HARQ-ACK procedure for one configured serving cell	91
10.1.2.2	FDD HARQ-ACK procedures for more than one configured serving cell	92
10.1.2.2.1	PUCCH format 1b with channel selection HARQ-ACK procedure	92
10.1.2.2.2	PUCCH format 3 HARQ-ACK procedure	95
10.1.3	TDD HARQ-ACK feedback procedures	96
10.1.3.1	TDD HARQ-ACK procedure for one configured serving cell	97
10.1.3.2	TDD HARQ-ACK procedure for more than one configured serving cell	101
10.1.3.2.1	PUCCH format 1b with channel selection HARQ-ACK procedure	102
10.1.3.2.2	PUCCH format 3 HARQ-ACK procedure	108
10.1.4	HARQ-ACK Repetition procedure	109
10.1.5	Scheduling Request (SR) procedure	109
10.2	Uplink HARQ-ACK timing	110
11	Physical multicast channel related procedures	111
11.1	UE procedure for receiving the physical multicast channel	111
11.2	UE procedure for receiving MCCH change notification	111
Annex A (informative):	Change history	112

Foreword

This Technical Specification (TS) has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of this present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
 - 1 presented to TSG for information;
 - 2 presented to TSG for approval;
 - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

3GPP

IPR2022-00464

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.