

3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation (Release 8)



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

The present document has not been subject to any approval process by the 3GPP Organizational Partners and shall not be implemented.

This Specification is provided for future development work within 3GPP only. The Organizational Partners accept no liability for any use of this Specification.

Keywords

UMTS, radio, layer 1

3GPP

Postal address

3GPP support office address

650 Route des Lucioles - Sophia Antipolis

Valbonne - 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.

© 2006, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TTA, TTC).
All rights reserved.

Contents

Foreword.....	6
1 Scope.....	6
2 References	6
3 Definitions, symbols and abbreviations	7
3.1 Symbols	7
3.2 Abbreviations.....	8
4 Frame structure.....	8
4.1 Frame structure type 1	8
4.2 Frame structure type 2	9
5 Uplink.....	9
5.1 Overview	9
5.1.1 Physical channels	9
5.1.2 Physical signals	9
5.2 Slot structure and physical resources	10
5.2.1 Resource grid	10
5.2.2 Resource elements.....	11
5.2.3 Resource blocks	11
5.3 Physical uplink shared channel.....	11
5.3.1 Scrambling	11
5.3.2 Modulation.....	12
5.3.3 Transform precoding	12
5.3.4 Mapping to physical resources	12
5.4 Physical uplink control channel	12
5.4.1 Scrambling	13
5.4.2 Modulation	13
5.4.2.1 Sequence modulation for PUCCH format 0 and 1.....	13
5.4.2.2 Sequence modulation for PUCCH format 2	14
5.4.3 Mapping to physical resources	14
5.5 Reference signals	14
5.5.1 Generation of the base reference signal sequence	14
5.5.1.1 Reference signal sequences of length 36 or larger.....	15
5.5.1.2 Reference signal sequences of length less than 36	15
5.5.2 Demodulation reference signal.....	15
5.5.2.1 Demodulation reference signal for PUSCH.....	15
5.5.2.1.1 Reference signal sequence	15
5.5.2.1.2 Mapping to physical resources.....	16
5.5.2.2 Demodulation reference signal for PUCCH	16
5.5.2.2.1 Reference signal sequence	16
5.5.2.2.2 Mapping to physical resources.....	17
5.5.3 Sounding reference signal	17
5.5.3.1 Sequence generation	17
5.5.3.2 Mapping to physical resources	17
5.6 SC-FDMA baseband signal generation.....	18
5.7 Physical random access channel	18
5.7.1 Time and frequency structure.....	18
5.7.2 Preamble sequence generation	19
5.7.3 Baseband signal generation	19
5.8 Modulation and upconversion.....	20
6 Downlink.....	20
6.1 Overview	20
6.1.1 Physical channels	20
6.1.2 Physical signals	21
6.2 Slot structure and physical resource elements	21

6.2.1	Resource grid	21
6.2.2	Resource elements.....	21
6.2.3	Resource blocks	22
6.2.4	Guard Period for TDD Operation.....	25
6.3	General structure for downlink physical channels.....	25
6.3.1	Scrambling	25
6.3.2	Modulation.....	26
6.3.3	Layer mapping	26
6.3.3.1	Layer mapping for transmission on a single antenna port	26
6.3.3.2	Layer mapping for spatial multiplexing.....	26
6.3.3.3	Layer mapping for transmit diversity	27
6.3.4	Precoding	27
6.3.4.1	Precoding for transmission on a single antenna port	27
6.3.4.2	Precoding for spatial multiplexing.....	27
6.3.4.2.1	Precoding for zero and small-delay CDD	27
6.3.4.2.2	Precoding for large delay CDD.....	28
6.3.4.2.3	Codebook for precoding	29
6.3.4.3	Precoding for transmit diversity	30
6.3.5	Mapping to resource elements.....	31
6.4	Physical downlink shared channel	31
6.5	Physical multicast channel.....	31
6.6	Physical broadcast channel	32
6.6.1	Scrambling	32
6.6.2	Modulation	32
6.6.3	Layer mapping and precoding	32
6.6.4	Mapping to resource elements.....	32
6.7	Physical control format indicator channel	32
6.7.1	Scrambling	33
6.7.2	Modulation.....	33
6.7.3	Layer mapping and precoding	33
6.7.4	Mapping to resource elements.....	33
6.8	Physical downlink control channel	33
6.8.1	PDCCH formats	33
6.8.2	Scrambling	33
6.8.3	Modulation	34
6.8.4	Layer mapping and precoding	34
6.8.5	Mapping to resource elements.....	34
6.9	Physical hybrid ARQ indicator channel.....	34
6.9.1	Scrambling	34
6.9.2	Modulation.....	35
6.9.3	Layer mapping and precoding	35
6.9.4	Mapping to resource elements.....	35
6.10	Reference signals	35
6.10.1	Cell-specific reference signals.....	36
6.10.1.1	Sequence generation.....	36
6.10.1.1.1	Orthogonal sequence generation	36
6.10.1.1.2	Pseudo-random sequence generation	37
6.10.1.2	Mapping to resource elements	37
6.10.2	MBSFN reference signals	41
6.10.2.1	Sequence generation	41
6.10.2.2	Mapping to resource elements	41
6.10.3	UE-specific reference signals	43
6.10.3.1	Sequence generation	44
6.10.3.2	Mapping to resource elements	44
6.11	Synchronization signals	44
6.11.1	Primary synchronization signal	44
6.11.1.1	Sequence generation	44
6.11.1.2	Mapping to resource elements	44
6.11.2	Secondary synchronization signal	45
6.11.2.1	Sequence generation	45
6.11.2.2	Mapping to resource elements	45
6.12	OFDM baseband signal generation.....	45

6.13	Modulation and upconversion.....	46
7	Modulation mapper	46
7.1	BPSK	46
7.2	QPSK.....	46
7.3	16QAM.....	47
7.4	64QAM.....	47
8	Timing	49
8.1	Uplink-downlink frame timing	49
Annex A (informative): Change history		49

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.