

3GPP TS 36.213 V14.7.0 (2018-06)

Technical Specification

3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures (Release 14)



Keywords

E-UTRA, 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.

© 2018, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, 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 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

Contents

Foreword	8
1 Scope	9
2 References	9
3 Symbols and abbreviations	9
3.1 Symbols	9
3.2 Abbreviations	10
4 Synchronization procedures	12
4.1 Cell search	12
4.2 Timing synchronization	12
4.2.1 Radio link monitoring	12
4.2.2 Inter-cell synchronization	12
4.2.3 Transmission timing adjustments	12
4.3 Timing for Secondary Cell Activation / Deactivation	13
5 Power control	14
5.1 Uplink power control	14
5.1.1 Physical uplink shared channel	14
5.1.1.1 UE behaviour	14
5.1.1.2 Power headroom	23
5.1.2 Physical uplink control channel	26
5.1.2.1 UE behaviour	27
5.1.3 Sounding Reference Symbol (SRS)	31
5.1.3.1 UE behaviour	31
5.1.3.2 Power headroom for Type3 report	33
5.1.4 Power allocation for dual connectivity	33
5.1.4.1 Dual connectivity power control Mode 1	34
5.1.4.2 Dual connectivity power control Mode 2	41
5.1.5 Power allocation for PUCCH-SCell	46
5.2 Downlink power allocation	46
5.2.1 eNodeB Relative Narrowband TX Power (RNTP) restrictions	48
6 Random access procedure	50
6.1 Physical non-synchronized random access procedure	50
6.1.1 Timing	51
6.2 Random Access Response Grant	52
7 Physical downlink shared channel related procedures	55
7.1 UE procedure for receiving the physical downlink shared channel	57
7.1.1 Single-antenna port scheme	67
7.1.2 Transmit diversity scheme	68
7.1.3 Large delay CDD scheme	68
7.1.4 Closed-loop spatial multiplexing scheme	68
7.1.5 Multi-user MIMO scheme	68
7.1.5A Dual layer scheme	68
7.1.5B Up to 8 layer transmission scheme	68
7.1.6 Resource allocation	68
7.1.6.1 Resource allocation type 0	70
7.1.6.2 Resource allocation type 1	71
7.1.6.3 Resource allocation type 2	72
7.1.6.4 PDSCH starting position	73
7.1.6.4A PDSCH starting position for BL/CE UEs	75
7.1.6.5 Physical Resource Block (PRB) bundling	75
7.1.7 Modulation order and transport block size determination	77
7.1.7.1 Modulation order and redundancy version determination	78
7.1.7.2 Transport block size determination	81
7.1.7.2.1 Transport blocks not mapped to two or more layer spatial multiplexing	83
7.1.7.2.2 Transport blocks mapped to two-layer spatial multiplexing	91

7.1.7.2.3	Transport blocks mapped for DCI Format 1C and DCI Format 6-2	91
7.1.7.2.4	Transport blocks mapped to three-layer spatial multiplexing	92
7.1.7.2.5	Transport blocks mapped to four-layer spatial multiplexing	93
7.1.7.2.6	Transport blocks mapped for BL/CE UEs configured with CEModeB and PDSCH bandwidth up to 1.4MHz	93
7.1.7.2.7	Transport blocks mapped for BL/CE UEs <i>SystemInformationBlockType1-BR</i>	94
7.1.7.2.8	Transport blocks mapped for UEs configured with <i>ce-pdsch-maxBandwidth-config</i> value of 5 MHz or with <i>pdsch-MaxBandwidth-SC-MTCH</i> value of 24 PRBs.....	94
7.1.7.3	Redundancy Version determination for Format 1C.....	94
7.1.8	Storing soft channel bits.....	95
7.1.9	PDSCH resource mapping parameters	95
7.1.10	Antenna ports quasi co-location for PDSCH.....	96
7.1.11	PDSCH subframe assignment for BL/CE UE	97
7.2	UE procedure for reporting Channel State Information (CSI)	99
7.2.1	Aperiodic CSI Reporting using PUSCH	107
7.2.2	Periodic CSI Reporting using PUCCH	131
7.2.3	Channel Quality Indicator (CQI) definition	171
7.2.4	Precoding Matrix Indicator (PMI) definition	182
7.2.5	Channel-State Information – Reference Signal (CSI-RS) definition	210
7.2.6	Channel-State Information – Interference Measurement (CSI-IM) Resource definition	212
7.2.7	Zero Power CSI-RS Resource definition	212
7.2.8	CSI-RS Activation / Deactivation	212
7.3	UE procedure for reporting HARQ-ACK.....	213
7.3.1	FDD HARQ-ACK reporting procedure	213
7.3.2	TDD HARQ-ACK reporting procedure	217
7.3.2.1	TDD HARQ-ACK reporting procedure for same UL/DL configuration.....	217
7.3.2.2	TDD HARQ-ACK reporting procedure for different UL/DL configurations.....	229
7.3.3	FDD-TDD HARQ-ACK reporting procedure for primary cell frame structure type 1	236
7.3.4	FDD-TDD HARQ-ACK reporting procedure for primary cell frame structure type 2	237
8	Physical uplink shared channel related procedures	238
8.0	UE procedure for transmitting the physical uplink shared channel	238
8.0.1	Single-antenna port scheme	252
8.0.2	Closed-loop spatial multiplexing scheme.....	252
8.1	Resource allocation for PDCCH/EPDCCH with uplink DCI format.....	253
8.1.1	Uplink resource allocation type 0.....	253
8.1.2	Uplink resource allocation type 1.....	253
8.1.3	Uplink resource allocation type 2.....	254
8.1.4	Uplink resource allocation type 3.....	254
8.1.5	Uplink resource allocation type 4.....	255
8.1.5.1	UL Resource Block Groups.....	255
8.2	UE sounding procedure	256
8.3	UE HARQ-ACK procedure	266
8.4	UE PUSCH hopping procedure	268
8.4.1	Type 1 PUSCH hopping.....	269
8.4.2	Type 2 PUSCH hopping.....	269
8.5	UE Reference Symbol (RS) procedure	269
8.6	Modulation order, redundancy version and transport block size determination	270
8.6.1	Modulation order and redundancy version determination.....	270
8.6.2	Transport block size determination	276
8.6.3	Control information MCS offset determination	279
8.7	UE transmit antenna selection	283
8.8	Transmission timing adjustments	283
9	Physical downlink control channel procedures	283
9.1	UE procedure for determining physical downlink control channel assignment.....	284
9.1.1	PDCCH assignment procedure.....	284
9.1.2	PHICH assignment procedure	288
9.1.3	Control Format Indicator (CFI) assignment procedure	290
9.1.4	EPDCCH assignment procedure	290
9.1.4.1	EPDCCH starting position.....	297
9.1.4.2	Antenna ports quasi co-location for EPDCCH	298

9.1.4.3	Resource mapping parameters for EPDCCH.....	298
9.1.4.4	PRB-pair indication for EPDCCH.....	299
9.1.5	MPDCCH assignment procedure	299
9.1.5.1	MPDCCH starting position	306
9.1.5.2	Antenna ports quasi co-location for MPDCCH.....	306
9.2	PDCCH/EPDCCH/MPDCCH validation for semi-persistent scheduling.....	307
9.3	PDCCH/EPDCCH/MPDCCH control information procedure	308
10	Physical uplink control channel procedures.....	309
10.1	UE procedure for determining physical uplink control channel assignment	309
10.1.1	PUCCH format information	312
10.1.2	FDD HARQ-ACK feedback procedures.....	317
10.1.2.1	FDD HARQ-ACK procedure for one configured serving cell	317
10.1.2.2	FDD HARQ-ACK procedures for more than one configured serving cell.....	319
10.1.2.2.1	PUCCH format 1b with channel selection HARQ-ACK procedure	319
10.1.2.2.2	PUCCH format 3 HARQ-ACK procedure.....	323
10.1.2.2.3	PUCCH format 4 HARQ-ACK procedure.....	325
10.1.2.2.4	PUCCH format 5 HARQ-ACK procedure.....	326
10.1.3	TDD HARQ-ACK feedback procedures.....	327
10.1.3.1	TDD HARQ-ACK procedure for one configured serving cell.....	329
10.1.3.2	TDD HARQ-ACK procedure for more than one configured serving cell	341
10.1.3.2.1	PUCCH format 1b with channel selection HARQ-ACK procedure	341
10.1.3.2.2	PUCCH format 3 HARQ-ACK procedure.....	357
10.1.3.2.3	PUCCH format 4 HARQ-ACK procedure.....	364
10.1.3.2.4	PUCCH format 5 HARQ-ACK procedure.....	381
10.1.3A	FDD-TDD HARQ-ACK feedback procedures for primary cell frame structure type 2.....	381
10.1.4	HARQ-ACK Repetition procedure	383
10.1.5	Scheduling Request (SR) procedure.....	384
10.2	Uplink HARQ-ACK timing.....	385
11	Physical Multicast Channel (PMCH) related procedures.....	389
11.1	UE procedure for receiving the PMCH.....	389
11.2	UE procedure for receiving MCCH and system information change notification	389
12	Assumptions independent of physical channel	389
13	Uplink/Downlink configuration determination procedure for Frame Structure Type 2	390
13.1	UE procedure for determining eIMTA-uplink/downlink configuration	390
13A	Subframe configuration for Frame Structure Type 3	391
14	UE procedures related to Sidelink	395
14.1	Physical Sidelink Shared Channel related procedures	396
14.1.1	UE procedure for transmitting the PSSCH.....	396
14.1.1.1	UE procedure for determining subframes for transmitting PSSCH for sidelink transmission mode 1	397
14.1.1.1.1	Determination of subframe indicator bitmap	398
14.1.1.2	UE procedure for determining resource blocks for transmitting PSSCH for sidelink transmission mode 1	400
14.1.1.2.1	PSSCH resource allocation for sidelink transmission mode 1	400
14.1.1.2.2	PSSCH frequency hopping for sidelink transmission mode 1	401
14.1.1.3	UE procedure for determining subframes for transmitting PSSCH for sidelink transmission mode 2	401
14.1.1.4	UE procedure for determining resource blocks for transmitting PSSCH for sidelink transmission mode 2	402
14.1.1.4A	UE procedure for determining subframes and resource blocks for transmitting PSSCH for sidelink transmission mode 3	402
14.1.1.4B	UE procedure for determining subframes and resource blocks for transmitting PSSCH and reserving resources for sidelink transmission mode 4	403
14.1.1.4C	UE procedure for determining subframes and resource blocks for PSSCH transmission associated with an SCI format 1	403
14.1.1.5	UE procedure for PSSCH power control.....	405
14.1.1.6	UE procedure for determining the subset of resources to be reported to higher layers in PSSCH resource selection in sidelink transmission mode 4.....	406

14.1.1.7	Conditions for selecting resources when the number of HARQ transmissions is two in sidelink transmission mode 4	409
14.1.2	UE procedure for receiving the PSSCH	409
14.1.3	UE procedure for determining resource block pool and subframe pool for sidelink transmission mode 2	409
14.1.5	UE procedure for determining resource block pool and subframe pool for sidelink transmission mode 3 and 4	410
14.2	Physical Sidelink Control Channel related procedures	411
14.2.1	UE procedure for transmitting the PSCCH	411
14.2.1.1	UE procedure for determining subframes and resource blocks for transmitting PSCCH for sidelink transmission mode 1	414
14.2.1.2	UE procedure for determining subframes and resource blocks for transmitting PSCCH for sidelink transmission mode 2	415
14.2.1.3	UE procedure for PSCCH power control	415
14.2.2	UE procedure for receiving the PSCCH	416
14.2.3	UE procedure for determining resource block pool and subframe pool for PSCCH	416
14.2.4	UE procedure for determining resource block pool for PSCCH in sidelink transmission mode 3 and 4	417
15	Channel access procedures for LAA	420
15.1	Downlink channel access procedures	420
15.1.1	Channel access procedure for transmission(s) including PDSCH/PDCCH/EPDCCH	421
15.1.2	Channel access procedure for transmissions including discovery signal transmission(s) and not including PDSCH	422
15.1.3	Contention window adjustment procedure	422
15.1.4	Energy detection threshold adaptation procedure	423
15.1.5	Channel access procedure for transmission(s) on multiple carriers	424
15.1.5.1	Type A multi-carrier access procedures	424
15.1.5.1.1	Type A1	424
15.1.5.1.2	Type A2	425
15.1.5.2	Type B multi-carrier access procedure	425
15.1.5.2.1	Type B1	425
15.1.5.2.2	Type B2	426
15.2	Uplink channel access procedures	426
15.2.1	Channel access procedure for Uplink transmission(s)	426
15.2.1.1	Type 1 UL channel access procedure	428
15.2.1.2	Type 2 UL channel access procedure	429
15.2.2	Contention window adjustment procedure	429
15.2.3	Energy detection threshold adaptation procedure	430
15.2.3.1	Default maximum energy detection threshold computation procedure	430
16	UE Procedures related to narrowband IoT	431
16.1	Synchronization procedures	431
16.1.1	Cell search	431
16.1.2	Timing synchronization	431
16.2	Power control	432
16.2.1	Uplink power control	432
16.2.1.1	Narrowband physical uplink shared channel	432
16.2.1.1.1	UE behaviour	432
16.2.1.1.2	Power headroom	433
16.2.2	Downlink power allocation	433
16.3	Random access procedure	433
16.3.1	Physical non-synchronized random access procedure	433
16.3.2	Timing	434
16.3.3	Narrowband random access response grant	435
16.4	Narrowband physical downlink shared channel related procedures	435
16.4.1	UE procedure for receiving the narrowband physical downlink shared channel	436
16.4.1.1	Single-antenna port scheme	439
16.4.1.2	Transmit diversity scheme	439
16.4.1.3	Resource allocation	439
16.4.1.4	NPDSCH starting position	440
16.4.1.5	Modulation order and transport block size determination	441

16.4.1.5.1	Transport blocks not mapped for <i>SystemInformationBlockType1-NB</i>	441
16.4.1.5.2	Transport blocks mapped for <i>SystemInformationBlockType1-NB</i>	442
16.4.2	UE procedure for reporting ACK/NACK.....	442
16.5	Narrowband physical uplink shared channel related procedures	443
16.5.1	UE procedure for transmitting format 1 narrowband physical uplink shared channel	443
16.5.1.1	Resource allocation	444
16.5.1.2	Modulation order, redundancy version and transport block size determination	445
16.5.2	UE procedure for NPUSCH retransmission	447
16.6	Narrowband physical downlink control channel related procedures	447
16.6.1	NPDCCH starting position.....	451
16.6.2	NPDCCH control information procedure.....	452
16.7	Assumptions independent of physical channel related to narrowband IoT.....	452
16.8	UE procedure for acquiring cell-specific reference signal sequence and raster offset.....	452
Annex A (informative):	Change history	454