

ETSI TS 136 133 V13.18.0 (2020-02)



TECHNICAL SPECIFICATION

LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Requirements for support of radio resource management
(3GPP TS 36.133 version 13.18.0 Release 13)

Standard PREVIEW
Full standard available at <https://standards.iteh.ai/catalog/standards/si/2305742-b898-4670-b728-875af27829f/etsi-ts-136-133-v13-18-0-2020-02>



Reference

RTS/TSGR-0436133vD10

Keywords

LTE

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:

<http://www.etsi.org/standards-search>

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the prevailing version of an ETSI deliverable is the one made publicly available in PDF format at www.etsi.org/deliver.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at

<https://portal.etsi.org/TB/ETSIDeliverableStatus.aspx>

If you find errors in the present document, please send your comment to one of the following services:

<https://portal.etsi.org/People/CommiteeSupportStaff.aspx>

Copyright Notification

No part may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm except as authorized by written permission of ETSI.

The content of the PDF version shall not be modified without the written authorization of ETSI.

The copyright and the foregoing restriction extend to reproduction in all media.

© ETSI 2020.
All rights reserved.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members.

3GPP™ and **LTE™** are trademarks of ETSI registered for the benefit of its Members and of the 3GPP Organizational Partners.

oneM2M™ logo is a trademark of ETSI registered for the benefit of its Members and of the oneM2M Partners.

GSM® and the GSM logo are trademarks registered and owned by the GSM Association.

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: "*Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards*", which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (<https://ipr.etsi.org/>).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Trademarks

The present document may include trademarks and/or tradenames which are asserted and/or registered by their owners. ETSI claims no ownership of these except for any which are indicated as being the property of ETSI, and conveys no right to use or reproduce any trademark and/or tradename. Mention of those trademarks in the present document does not constitute an endorsement by ETSI of products, services or organizations associated with those trademarks.

Legal notice

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

The present document may refer to technical specifications or reports using their 3GPP identities. These shall be interpreted as being references to the corresponding ETSI deliverables.

The cross reference between 3GPP and ETSI identities can be found under <http://webapp.etsi.org/key/queryform.asp>.

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Contents

Intellectual Property Rights	2
Legal notice	2
Modal verbs terminology.....	2
Foreword.....	65
1 Scope	66
2 References	66
3 Definitions, symbols and abbreviations	67
3.1 Definitions	67
3.2 Symbols.....	69
3.3 Abbreviations	70
3.4 Test tolerances	72
3.5 Additional notation.....	72
3.5.1 Groups of bands	72
3.6 General	74
3.6.1 Applicability of requirements in this specification version	74
4 E-UTRAN RRC_IDLE state mobility.....	78
4.1 Cell Selection	78
4.2 Cell Re-selection	78
4.2.1 Introduction.....	78
4.2.2 Requirements	78
4.2.2.1 Measurement and evaluation of serving cell	79
4.2.2.2 Void.....	80
4.2.2.3 Measurements of intra-frequency E-UTRAN cells	80
4.2.2.4 Measurements of inter-frequency E-UTRAN cells	81
4.2.2.5 Measurements of inter-RAT cells	83
4.2.2.5.1 Measurements of UTRAN FDD cells	84
4.2.2.5.2 Measurements of UTRAN TDD cells	85
4.2.2.5.3 Measurements of GSM cells.....	87
4.2.2.5.4 Measurements of HRPD cells.....	87
4.2.2.5.5 Measurements of cdma2000 1X.....	88
4.2.2.6 Evaluation of cell re-selection criteria.....	89
4.2.2.7 Maximum interruption in paging reception.....	90
4.2.2.8 void	90
4.2.2.9 UE measurement capability	90
4.2.2.9a UE measurement capability (Increased UE carrier monitoring)	91
4.2.2.10 Reselection to CSG cells	91
4.2.2.10.1 Reselection from a non CSG to an inter-frequency CSG cell.....	91
4.2.2.10.2 Reselection from a non CSG to an inter-RAT UTRAN FDD CSG cell.....	92
4.2.2.11 Void	93
4.3 Minimization of Drive Tests (MDT).....	93
4.3.1 Introduction.....	94
4.3.2 Measurements	94
4.3.2.1 Requirements	94
4.3.3 Relative Time Stamp Accuracy	94
4.3.3.1 Requirements	94
4.3.4 Relative Time Stamp Accuracy for RRC Connection Establishment Failure Log Reporting	94
4.3.4.1 Requirements	94
4.3.5 Relative Time Stamp Accuracy for Radio Link Failure and Handover Failure Log Reporting.....	95
4.3.5.1 Requirements for <i>timeSinceFailure</i>	95
4.4 MBSFN Measurements	95
4.4.1 Introduction.....	95
4.4.2 MBSFN RSRP measurements	95
4.4.3 MBSFN RSRQ measurements.....	95
4.4.4 MCH BLER measurements	96

4.5	Proximity-based Services	96
4.5.1	Introduction.....	96
4.5.2	Requirements	96
4.5.2.1	Interruptions with ProSe Direct Discovery	96
4.5.2.2	Interruptions with ProSe Direct Communication	96
4.5.2.3	Initiation/Cease of SLSS transmissions with ProSe Direct Discovery.....	96
4.5.2.4	Initiation/Cease of SLSS transmissions with ProSe Direct Communication	97
4.6	Cell Selection and Re-selection Requirements for UE category NB1	97
4.6.1	Cell Selection.....	97
4.6.2	Cell Re-selection.....	97
4.6.2.1	Measurement and evaluation of serving NB-IoT cell for UE category NB1 in normal coverage.....	98
4.6.2.2	Measurements of intra-frequency NB-IoT cells for UE category NB1 in normal coverage	99
4.6.2.3	Measurement and evaluation of serving NB-IoT cell for UE category NB1 in enhanced coverage ...	100
4.6.2.4	Measurements of intra-frequency NB-IoT cells for UE category NB1 in enhanced coverage	100
4.6.2.5	Measurements of inter-frequency NB cells for UE category NB1 in normal coverage	102
4.6.2.6	Measurements of inter-frequency NB-IoT cells for UE category NB1 in enhanced coverage	103
4.6.2.7	Maximum interruption in paging reception in normal coverage	104
4.6.2.7A	Maximum interruption in paging reception in enhanced coverage	104
4.6.2.8	UE measurement capability	105
4.7	Cell Selection and Re-selection Requirements for UE category M1	105
4.7.1	Cell Selection.....	105
4.7.2	Cell Re-selection.....	105
4.7.2.1	Cell Re-selection requirements for UE category M1 in normal coverage.....	105
4.7.2.1.1	Measurement and evaluation of serving cell for UE category M1 in normal coverage.....	105
4.7.2.1.2	Measurements of intra-frequency cells for UE category M1 in normal coverage	105
4.7.2.2	Cell Re-selection requirements for UE category M1 in enhanced coverage	107
4.7.2.2.1	Measurement and evaluation of serving cell for UE category M1 in enhanced coverage.....	107
4.7.2.2.2	Measurements of intra-frequency cells for UE category M1 in enhanced coverage	108
5	E-UTRAN RRC_CONNECTED state mobility	109
5.1	E-UTRAN Handover.....	110
5.1.1	Introduction.....	110
5.1.2	Requirements	110
5.1.2.1	E-UTRAN FDD – FDD	110
5.1.2.1.1	Handover delay.....	110
5.1.2.1.2	Interruption time	110
5.2.2.2	E-UTRAN FDD – TDD	110
5.2.2.2.1	(Void)	111
5.2.2.2.2	(Void)	111
5.2.2.3	E-UTRAN TDD – FDD	111
5.2.2.3.1	(Void)	111
5.2.2.3.2	(Void)	111
5.2.2.4	E-UTRAN TDD – TDD.....	111
5.2.2.4.1	Handover delay	111
5.2.2.4.2	Interruption time	111
5.2.2.5	E-UTRAN HD–FDD	111
5.2.2.5.1	Handover delay.....	112
5.2.2.5.2	Interruption time	112
5.3	Handover to other RATs	112
5.3.1	E-UTRAN - UTRAN FDD Handover	112
5.3.1.1	Introduction.....	112
5.3.1.1.1	Handover delay.....	112
5.3.1.1.2	Interruption time	113
5.3.2	E-UTRAN - UTRAN TDD Handover	113
5.3.2.1	Introduction.....	113
5.3.2.2	Requirements	113
5.3.2.2.1	Handover delay.....	113
5.3.2.2.2	Interruption time	114
5.3.3	E-UTRAN - GSM Handover	114
5.3.3.1	Introduction.....	114
5.3.3.2	Requirements	114
5.3.3.2.1	Handover delay.....	114

5.3.3.2.2	Interruption time	115
5.4	Handover to Non-3GPP RATs	115
5.4.1	E-UTRAN – HRPD Handover.....	115
5.4.1.1	Introduction	115
5.4.1.1.1	Handover delay.....	115
5.4.1.1.2	Interruption time.....	115
5.4.2	E-UTRAN – cdma2000 1X Handover.....	116
5.4.2.1	Introduction	116
5.4.2.1.1	Handover delay.....	116
5.4.2.1.2	Interruption time.....	116
5.5	E-UTRAN Handover for Cat-M1 UEs.....	117
5.5.1	Introduction.....	117
5.5.2	Requirements in CEModeA.....	117
5.5.2.1	E-UTRAN FDD – FDD for Cat-M1 FDD UEs	117
5.5.2.1.1	Handover delay.....	117
5.5.2.1.2	Interruption time.....	117
5.5.2.2	E-UTRAN FDD – FDD for Cat-M1 HD – FDD UEs.....	117
5.5.2.3	E-UTRAN TDD – TDD for Cat-M1 TDD UEs.....	118
5.5.2.3.1	Void.....	118
5.5.2.3.2	Vlid.....	118
5.5.3	Requirements in CEModeB	118
5.5.3.1	E-UTRAN FDD – FDD for Cat-M1 FDD UEs	118
5.5.3.1.1	Handover delay.....	118
5.5.3.1.2	Interruption time.....	118
5.5.3.2	E-UTRAN FDD – FDD for Cat-M1 HD – FDD UEs.....	119
5.5.3.3	E-UTRAN TDD – TDD for Cat-M1 TDD UEs.....	119
5.6	Void.....	119
6	RRC Connection Mobility Control	119
6.1	RRC Re-establishment	119
6.1.1	Introduction.....	119
6.1.2	Requirements	119
6.1.2.1	UE Re-establishment delay requirement.....	119
6.2	Random Access	120
6.2.1	Introduction.....	120
6.2.2	Requirements	120
6.2.2.1	Contention based random access.....	120
6.2.2.1.1	Correct behaviour when receiving Random Access Response reception	120
6.2.2.1.2	Correct behaviour when not receiving Random Access Response reception	120
6.2.2.1.3	Correct behaviour when receiving a NACK on msg3	120
6.2.2.1.4	Void.....	120
6.2.2.1.5	Correct behaviour when receiving a message over Temporary C-RNTI.....	120
6.2.2.1.6	Correct behaviour when contention Resolution timer expires.....	121
6.2.2.2	Non-Contention based random access	121
6.2.2.2.1	Correct behaviour when receiving Random Access Response.....	121
6.2.2.2.2	Correct behaviour when not receiving Random Access Response.....	121
6.2.3	Requirements for Cat-M1 UEs	121
6.3	RRC Connection Release with Redirection.....	121
6.3.1	Introduction.....	121
6.3.2	Requirements	121
6.3.2.1	RRC connection release with redirection to UTRAN FDD	121
6.3.2.2	RRC connection release with redirection to GERAN	122
6.3.2.3	RRC connection release with redirection to UTRAN TDD	122
6.4	CSG Proximity Indication for E-UTRAN and UTRAN.....	123
6.4.1	Introduction.....	123
6.4.2	Requirements	123
6.5	RRC Re-establishment for NB-IoT UEs	123
6.5.1	Introduction.....	123
6.5.2	Requirements	123
6.5.2.1	UE Re-establishment delay requirement in normal coverage	124
6.5.2.2	UE Re-establishment delay requirement in enhanced coverage.....	124
6.6	Random Access for UE category NB1	125

6.6.1	Introduction.....	125
6.6.2	Requirements	125
6.6.2.1	Correct behaviour when receiving Random Access Response reception.....	125
6.6.2.2	Correct behaviour when not receiving Random Access Response reception.....	125
6.6.2.3	Correct behaviour when receiving a NACK on msg3.....	125
6.6.2.4	Correct behaviour when receiving a message over Temporary C-RNTI	125
6.6.2.5	Correct behaviour when contention Resolution timer expires	125
6.6.3	Requirements for NPRACH configuration.....	125
6.7	RRC Re-establishment for Cat-M1 UEs	126
6.7.1	Introduction.....	126
6.7.2	Requirements	126
6.7.2.1	UE Re-establishment delay requirement for CEModeA	126
6.7.2.2	UE Re-establishment delay requirement for CEModeB	127
6.8	RRC Connection Release with Redirection for Cat-M1 UEs.....	127
6.8.1	Introduction.....	127
6.8.2	Requirements	127
6.8.2.1	RRC connection release with redirection to E-UTRAN with CE Mode A	127
6.9	RRC Connection Redirection to Non-anchor Carrier in NB-IoT	128
6.9.1	Introduction.....	128
6.9.2	Requirements	128
7	Timing and signalling characteristics.....	129
7.1	UE transmit timing	129
7.1.1	Introduction.....	129
7.1.2	Requirements	129
7.2	UE timer accuracy	130
7.2.1	Introduction.....	130
7.2.2	Requirements	130
7.3	Timing Advance	131
7.3.1	Introduction.....	131
7.3.2	Requirements	131
7.3.2.1	Timing Advance adjustment delay.....	131
7.3.2.2	Timing Advance adjustment accuracy.....	131
7.4	Cell phase synchronization accuracy (TDD).....	131
7.4.1	Definition.....	131
7.4.2	Minimum requirements.....	131
7.5	Synchronization Requirements for E-UTRAN to 1xRTT and HRPD Handovers.....	132
7.5.1	Introduction.....	132
7.5.2	eNodeB Synchronization Requirements	132
7.5.2.1	Synchronized E-UTRAN	132
7.5.2.2	Non-Synchronized E-UTRAN	132
7.6	Radio Link Monitoring.....	132
7.6.1	Introduction.....	132
7.6.2	Requirements	134
7.6.2.1	Minimum requirement when no DRX is used.....	134
7.6.2.2	Minimum requirement when DRX is used.....	135
7.6.2.3	Minimum requirement at transitions	136
7.6.2.4	Minimum requirement during SI Acquisition with autonomous gaps	136
7.6.2.5	Minimum requirement under IDC Interference	137
7.7	SCell Activation and Deactivation Delay for E-UTRA Carrier Aggregation	137
7.7.1	Introduction.....	137
7.7.2	SCell Activation Delay Requirement for Deactivated SCell	137
7.7.3	SCell Deactivation Delay Requirement for Activated SCell	138
7.7.4	SCell Activation Delay Requirement for Deactivated SCell with Multiple Downlnk SCells.....	138
7.7.5	SCell Deactivation Delay Requirement for Activated SCell with Multiple Downlink SCells	139
7.7.6	SCell Activation Delay Requirement for Deactivated PUCCH SCell	139
7.7.7	SCell Activation Delay Requirement for Deactivated PUCCH SCell with Multiple SCells	140
7.7.8	SCell Deactivation Delay Requirement for Activated PUCCH SCell	140
7.7.9	SCell Deactivation Delay Requirement for Activated PUCCH SCell with Multiple SCells	140
7.7.10	SCell Activation Delay Requirement for Deactivated SCell under Frame Structure 3.....	141
7.7.11	SCell Deactivation Delay Requirement for Activated SCell under Frame Structure 3.....	142

7.7.12	SCell Activation Delay Requirement for Deactivated SCell with Multiple Downlink SCells under Frame Structure 3	142
7.7.13	SCell Deactivation Delay Requirement for Activated SCell with Multiple Downlink SCells under Frame Structure 3	143
7.8	Interruptions with Carrier Aggregation	143
7.8.1	Introduction.....	143
7.8.2	Requirements	143
7.8.2.1	Interruptions at SCell addition/release for intra-band CA.....	143
7.8.2.2	Interruptions at SCell addition/release for inter-band CA.....	143
7.8.2.3	Interruptions at SCell activation/deactivation for intra-band CA.....	144
7.8.2.4	Interruptions at SCell activation/deactivation for inter-band CA.....	144
7.8.2.5	Interruptions during measurements on SCC for intra-band CA	144
7.8.2.6	Interruptions during measurements on SCC for inter-band CA	144
7.8.2.7	Interruptions at SCell addition/release with multiple downlink SCells.....	144
7.8.2.8	Interruptions at SCell activation/deactivation with multiple downlink SCells.....	144
7.8.2.9	Interruptions during measurements on SCC with multiple downlink SCells.....	145
7.8.2.10	Interruptions at overlapping addition/release/activation/deactivation of SCells	146
7.8.2.11	Interruptions during RSSI measurements on one SCC under Frame Structure 3.....	146
7.8.2.12	Interruptions during RSSI measurements on multiple SCCs under Frame Structure 3.....	146
7.9	Maximum Transmission Timing Difference in Carrier Aggregation	147
7.9.1	Introduction.....	147
7.9.2	Minimum Requirements for Interband Carrier Aggregation	147
7.9.3	Minimum Requirements for Intra-band non-contiguous Carrier Aggregation.....	147
7.9.4	Minimum Requirements for Inter-Band Carrier Aggregation under Frame Structure 3.....	148
7.10	Interruptions with RSTD Measurements with Carrier Aggregation.....	148
7.10.1	Introduction.....	148
7.10.2	Requirements	148
7.10.2.1	Interruptions during RSTD measurements on SCC for intra-band CA with one downlink SCell	148
7.10.2.2	Interruptions during RSTD measurements on SCC for inter-band CA with one downlink SCell	148
7.10.2.3	Interruptions during RSTD measurements on SCC with multiple downlink SCells.....	148
7.10.2.4	Interruptions at overlapping RSTD and inter-frequency measurements	149
7.11	Radio Link Monitoring for UE Category 0	149
7.11.1	Introduction.....	149
7.11.2	Requirements for FD-FDD and TDD	150
7.11.2.1	Minimum requirement when no DRX is used.....	150
7.11.2.2	Minimum requirement when DRX is used.....	151
7.11.2.3	Minimum requirement at transitions	152
7.11.3	Requirements for HD-FDD	152
7.11.3.1	Minimum requirement when no DRX is used.....	152
7.11.3.2	Minimum requirement when DRX is used.....	152
7.11.3.3	Minimum requirement at transitions	153
7.12	Interruptions with Dual Connectivity	153
7.12.1	Introduction.....	153
7.12.2	Requirements	153
7.12.2.1	Interruptions at PSCell addition/release	153
7.12.2.2	Interruptions at transitions between active and non-active during DRX.....	153
7.12.2.3	Interruptions at transitions from non-DRX to DRX.....	154
7.12.2.4	Interruptions at SCell addition/release	154
7.12.2.5	Interruptions at SCell activation/deactivation	154
7.12.2.6	Interruptions during measurements on SCC	155
7.13	Cell phase synchronization accuracy (Synchronized mode of dual connectivity).....	155
7.13.1	Definition.....	155
7.13.2	Minimum requirements.....	155
7.14	PSCell Addition and Release Delay for E-UTRA Dual Connectivity.....	156
7.14.1	Introduction.....	156
7.14.2	PSCell Addition Delay Requirement	156
7.14.3	PSCell Release Delay Requirement.....	156
7.15	Maximum Receive Timing Difference in Dual Connectivity	156
7.15.1	Introduction.....	156
7.15.2	Minimum Requirements for Inter-band Dual Connectivity	157
7.16	Proximity-based Services	157
7.16.1	Introduction.....	157

7.16.2	Requirements	157
7.16.2.1	ProSe UE transmission timing	157
7.16.2.1.1	Serving cell or PCell as timing reference	157
7.16.2.1.2	SCell or non-serving cell as timing reference	158
7.16.3	Interruptions with ProSe	158
7.16.3.1	Interruptions at ProSe Direct Discovery configuration	158
7.16.3.2	Interruptions at ProSe Direct Communication configuration	158
7.16.3.3	Interruptions during ProSe Direct Discovery	158
7.16.3.4	Interruptions during ProSe Direct Discovery with discovery gaps	159
7.16.3.5	Interruptions during ProSe Direct Communication	159
7.16.4	Cell reselection for ProSe Direct Discovery on non-serving frequency	159
7.16.4.1	Measurement and evaluation of selected cell	160
7.16.4.2	Measurement of intra-frequency E-UTRAN cells	160
7.16.5	Selection / Reselection of ProSe relay UE	160
7.16.6	ProSe operation under deactivated SCell	161
7.17	Maximum Transmission Timing Difference in Dual Connectivity	161
7.17.1	Introduction	161
7.17.2	Minimum Requirements for maximum transmission timing difference Inter-band Dual Connectivity ...	161
7.18.1	Introduction	161
7.18.2	SCell Activation Delay Requirement for Deactivated SCell	162
7.18.3	SCell Deactivation Delay Requirement for Activated SCell	162
7.19	Radio Link Monitoring for UE Category M1	162
7.19.1	Introduction	162
7.19.2	Requirements for FD-FDD and TDD CE mode A	162
7.19.2.1	Minimum requirement when no DRX is used	162
7.19.2.2	Minimum requirement when DRX is used	163
7.19.2.3	Minimum requirement at transitions	164
7.19.3	Requirements for HD-FDD with CE mode A	164
7.19.3.1	Minimum requirement when no DRX is used	164
7.19.3.2	Minimum requirement when DRX is used	164
7.19.3.3	Minimum requirement at transitions	165
7.19.4	Requirements for FD-FDD and TDD with CE mode B	165
7.19.4.1	Minimum requirement when no DRX is used	166
7.19.4.2	Minimum requirement when DRX is used	166
7.19.4.3	Minimum requirement at transitions	167
7.19.5	Requirements for HD-FDD with CE mode B	167
7.19.5.1	Minimum requirement when no DRX is used	167
7.19.5.2	Minimum requirement when DRX is used	167
7.19.5.3	Minimum requirement at transitions	168
7.20	UE transmit timing for NB-IoT	168
7.20.1	Introduction	168
7.20.2	Requirements	169
7.21	UE timer accuracy for NB-IoT	169
7.21.1	Introduction	169
7.21.2	Requirements	169
7.22	Timing Advance for NB-IoT	170
7.22.1	Introduction	170
7.22.2	Requirements	170
7.22.2.1	Timing Advance adjustment delay	170
7.22.2.2	Timing Advance adjustment accuracy	170
7.23	Radio Link Monitoring for Category NB1 UE	170
7.23.1	Introduction	170
7.23.2	Requirements for HD-FDD Category NB1 UE	170
7.23.2.1	Minimum requirement when no DRX is used	171
7.23.2.2	Minimum requirement when DRX is used	171
7.23.2.3	Minimum requirement at transitions	172
7.24	UE transmit timing for Category M1	172
7.24.1	Introduction	172
7.24.2	Requirements	172
7.25	Timing Advance for Category M1	173
7.25.1	Introduction	173
7.25.2	Requirements	173

7.26	UE timer accuracy for category M1	173
7.26.1	Introduction.....	173
7.26.2	Requirements	174
8	UE Measurements Procedures in RRC_CONNECTED State	174
8.1	General Measurement Requirements.....	174
8.1.1	Introduction.....	174
8.1.2	Requirements	174
8.1.2.1	UE measurement capability	174
8.1.2.1.1	Monitoring of multiple layers using gaps	176
8.1.2.1.1a	Monitoring of multiple layers using gaps (Increased UE carrier monitoring).....	178
8.1.2.2	E-UTRAN intra frequency measurements	179
8.1.2.2.1	E-UTRAN FDD intra frequency measurements.....	179
8.1.2.2.2	E-UTRAN TDD intra frequency measurements	182
8.1.2.2.3	E-UTRAN FDD intra frequency measurements with autonomous gaps	186
8.1.2.2.4	E-UTRAN TDD intra frequency measurements with autonomous gaps.....	187
8.1.2.3	E-UTRAN inter frequency measurements	188
8.1.2.3.1	E-UTRAN FDD – FDD inter frequency measurements.....	188
8.1.2.3.2	E-UTRAN TDD – TDD inter frequency measurements	192
8.1.2.3.3	E-UTRAN TDD – FDD inter frequency measurements.....	196
8.1.2.3.4	E-UTRAN FDD – TDD inter frequency measurements.....	196
8.1.2.3.5	E-UTRAN FDD-FDD inter frequency measurements with autonomous gaps.....	196
8.1.2.3.6	E-UTRAN TDD-FDD inter frequency measurements using autonomous gaps.....	197
8.1.2.3.7	E-UTRAN TDD-TDD inter frequency measurements with autonomous gaps	198
8.1.2.3.8	E-UTRAN FDD-TDD inter frequency measurements using autonomous gaps	199
8.1.2.4	Inter RAT measurements	200
8.1.2.4.1	E-UTRAN FDD – UTRAN FDD measurements	200
8.1.2.4.2	E-UTRAN TDD – UTRAN FDD measurements	205
8.1.2.4.3	E-UTRAN TDD – UTRAN TDD measurements	205
8.1.2.4.4	E-UTRAN FDD – UTRAN TDD measurements	209
8.1.2.4.5	E-UTRAN FDD – GSM measurements	209
8.1.2.4.6	E-UTRAN TDD – GSM measurements	215
8.1.2.4.7	E-UTRAN FDD – UTRAN FDD measurements for SON.....	215
8.1.2.4.8	E-UTRAN TDD – UTRAN FDD measurements for SON.....	217
8.1.2.4.9	E-UTRAN FDD – cdma2000 1xRTT measurements	217
8.1.2.4.9.1A	E-UTRAN FDD – cdma2000 1xRTT measurements when no DRX is used	217
8.1.2.4.10	E-UTRAN TDD – cdma2000 1xRTT measurements.....	217
8.1.2.4.11	E-UTRAN FDD – HRPD measurements	217
8.1.2.4.12	E-UTRAN TDD – HRPD measurements	217
8.1.2.4.13	E-UTRAN TDD – UTRAN TDD measurements for SON	217
8.1.2.4.14	E-UTRAN FDD – UTRAN TDD measurements for SON.....	219
8.1.2.4.15	E-UTRAN FDD – cdma2000 1xRTT measurements for SON ANR.....	219
8.1.2.4.16	E-UTRAN TDD – cdma2000 1xRTT measurements for SON ANR.....	220
8.1.2.4.17	E-UTRAN FDD-UTRAN FDD measurements with autonomous gaps	220
8.1.2.4.18	E-UTRAN TDD-UTRAN FDD measurements with autonomous gaps	220
8.1.2.4.19	E-UTRAN FDD – WLAN measurements	221
8.1.2.4.20	E-UTRAN TDD – WLAN measurements.....	222
8.1.2.5	E-UTRAN OTDOA Intra-Frequency RSTD Measurements	222
8.1.2.5.1	E-UTRAN FDD Intra-Frequency OTDOA Measurements.....	223
8.1.2.5.2	E-UTRAN TDD Intra-Frequency OTDOA Measurements.....	224
8.1.2.6	E-UTRAN Inter-Frequency OTDOA Measurements.....	226
8.1.2.6.1	E-UTRAN FDD-FDD Inter-Frequency OTDOA Measurements.....	226
8.1.2.6.2	E-UTRAN TDD-FDD Inter-Frequency OTDOA Measurements	228
8.1.2.6.3	E-UTRAN TDD-TDD Inter-Frequency OTDOA Measurements	229
8.1.2.6.4	E-UTRAN FDD-TDD Inter-Frequency OTDOA Measurements	231
8.1.2.7	E-UTRAN E-CID Measurements	233
8.1.2.7.1	E-UTRAN FDD UE Rx-Tx Time Difference Measurements	233
8.1.2.7.2	E-UTRAN TDD UE Rx-Tx Time Difference Measurements	234
8.1.2.7.3	E-UTRAN FDD Intra-frequency E-CID RSRP and RSRQ Measurements	235
8.1.2.7.4	E-UTRAN TDD Intra-frequency E-CID RSRP and RSRQ Measurements	236
8.1.2.8	E-UTRAN intra-frequency measurements under time domain measurement resource restriction	236
8.1.2.8.1	E-UTRAN FDD intra-frequency measurements	236

8.1.2.8.2	E-UTRAN TDD intra-frequency measurements	240
8.1.2.8.3	E-UTRAN FDD intra-frequency measurements with CRS assistance information	243
8.1.2.8.4	E-UTRAN TDD intra-frequency measurements with CRS assistance information	246
8.1.2.9	E-UTRAN E-CID Measurements when Time Domain Measurement Resource Restriction Pattern is Configured.....	250
8.1.2.9.1	E-UTRAN FDD UE Rx-Tx Time Difference Measurements	250
8.1.2.9.2	E-UTRAN TDD UE Rx-Tx Time Difference Measurements	250
8.1.2.9.3	E-UTRAN FDD UE Rx-Tx Time Difference Measurements with CRS Assistance Information	250
8.1.2.9.4	E-UTRAN TDD UE Rx-Tx Time Difference Measurements with CRS Assistance Information	251
8.2	Capabilities for Support of Event Triggering and Reporting Criteria	251
8.2.1	Introduction.....	251
8.2.2	Requirements	251
8.3	Measurements for E-UTRA carrier aggregation	254
8.3.1	Introduction.....	254
8.3.2	Measurements of the primary component carrier	254
8.3.3	Measurements of a secondary component carrier	254
8.3.3.1	Measurements of a secondary component carrier with active SCell	254
8.3.3.2	Measurements of a secondary component carrier with deactivated SCell	254
8.3.3.2.1	E-UTRAN secondary component carrier measurements when no common DRX is used	255
8.3.3.2.2	E-UTRAN secondary component carrier measurements when common DRX is used	256
8.4	OTDOA RSTD Measurements for E-UTRAN carrier aggregation	257
8.4.1	Introduction.....	257
8.4.2	Measurements on the primary component carrier	258
8.4.3	Measurements on a secondary component carrier	258
8.4.4	Measurements on both primary component carrier and a secondary component carrier	259
8.4.5	Measurements on different secondary component carriers	260
8.5	Measurements for UE category 0	261
8.5.1	Introduction.....	261
8.5.2	Requirements	261
8.5.2.1	E-UTRAN intra frequency measurements	261
8.5.2.1.1	E-UTRAN FDD intra frequency measurements.....	261
8.5.2.1.2	E-UTRAN intra frequency measurements for HD-FDD	265
8.5.2.1.3	E-UTRAN TDD intra frequency measurements	267
8.5.2.1.4	E-UTRAN FDD intra frequency measurements with autonomous gaps for UE category 0	270
8.5.2.1.5	E-UTRAN intra frequency measurements with autonomous gaps for HD-FDD UE category 0 ..	271
8.5.2.1.6	E-UTRAN TDD intra frequency measurements with autonomous gaps for UE category 0	271
8.6	Discovery signal measurements	272
8.6.1	Introduction.....	272
8.6.2	Requirements for CRS based discovery signal measurements	272
8.6.2.1	E-UTRAN intra frequency measurements	272
8.6.2.1.1	E-UTRAN FDD intra frequency measurements.....	273
8.6.2.1.2	E-UTRAN TDD intra frequency measurements	275
8.6.2.2	E-UTRAN inter frequency measurements	278
8.6.2.2.1	E-UTRAN FDD – FDD inter-frequency measurements	278
8.6.2.2.2	E-UTRAN TDD – TDD inter frequency measurements	281
8.6.2.2.3	E-UTRAN TDD – FDD inter frequency measurements.....	283
8.6.2.2.4	E-UTRAN FDD – TDD inter frequency measurements.....	283
8.6.3	Requirements for CSI-RS based discovery signal measurements.....	284
8.6.3.1	E-UTRAN intra frequency measurements	284
8.6.3.1.1	E-UTRAN FDD intra frequency measurements.....	284
8.6.3.1.2	E-UTRAN TDD intra frequency measurements	286
8.6.3.2	E-UTRAN inter frequency measurements	289
8.6.3.2.1	E-UTRAN FDD – FDD inter frequency measurements.....	289
8.6.3.2.2	E-UTRAN TDD – TDD inter frequency measurements	292
8.6.3.2.3	E-UTRAN TDD – FDD inter frequency measurements.....	294
8.6.3.2.4	E-UTRAN FDD – TDD inter frequency measurements.....	294
8.7	Discovery signal measurements for E-UTRA carrier aggregation	295
8.7.1	Introduction.....	295
8.7.2	Requirements for CRS based discovery signal measurements for E-UTRA carrier aggregation	295
8.7.2.1	Measurements of the primary component carrier.....	295

8.7.2.2	Measurements of a secondary component carrier	295
8.7.2.3	Measurements of a secondary component carrier with active SCell	295
8.7.2.4	Measurements of a secondary component carrier with deactivated SCell	295
8.7.2.4.1	E-UTRAN secondary component carrier measurements when no common DRX is used	295
8.7.2.4.2	E-UTRAN secondary component carrier measurements when common DRX is used	297
8.7.3	Requirements for CSI-RS based discovery signal measurements for E-UTRA carrier aggregation	298
8.7.3.1	Measurements of the primary component carrier	298
8.7.3.2	Measurements of a secondary component carrier	298
8.7.3.3	Measurements of a secondary component carrier with active SCell	298
8.7.3.4	Measurements of a secondary component carrier with deactivated SCell	298
8.7.3.4.1	E-UTRAN secondary component carrier measurements when no common DRX is used	298
8.7.3.4.2	E-UTRAN secondary component carrier measurements when common DRX is used	300
8.8	Measurements for E-UTRA dual connectivity	301
8.8.1	Introduction	301
8.8.2	Intra-frequency measurements requirements on PCell	301
8.8.3	Intra-frequency measurements requirements on PSCell	301
8.8.4	Inter-frequency and inter-RAT measurement requirements	302
8.8.5	Intra-frequency measurements with autonomous gaps	302
8.8.5.1	Identification of a new CGI of E-UTRA cell with autonomous gaps	302
8.8.5.2	ECGI reporting delay	303
8.8.6	Inter-frequency measurements with autonomous gaps	303
8.8.6.1	Identification of a new CGI of E-UTRA cell with autonomous gaps	303
8.8.6.2	ECGI reporting delay	304
8.8.7	SSTD Measurements	304
8.8.7.1	Introduction	304
8.8.7.2	SSTD Measurement requirements	304
8.8.7.3	SSTD Measurement Reporting Delay	305
8.8.8	Intra-frequency measurements requirements on SCell	305
8.9	MBSFN Measurements	305
8.9.1	Introduction	305
8.9.2	MBSFN RSRP Measurements	305
8.9.3	MBSFN RSRQ Measurements	306
8.9.4	MCH BLER Measurements	306
8.10	Proximity-based Services	306
8.10.1	Introduction	306
8.10.2	Requirements	306
8.10.2.1	Initiation/Cease of SLSS transmissions with ProSe Direct Discovery	306
8.10.2.2	Initiation/Cease of SLSS transmissions with ProSe Direct Communication	307
8.11	Discovery Signal Measurements under Operation with Frame Structure 3	307
8.11.1	Introduction	307
8.11.2	CRS based discovery signal measurements	308
8.11.2.1	E-UTRAN intra-frequency measurements	308
8.11.2.1.1	Requirements	308
8.11.2.1.1.1	Requirements when no DRX is used	308
8.11.2.1.1.1.1	Measurement Reporting Requirements	310
8.11.2.1.1.2	Requirements when DRX is used	310
8.11.2.1.1.2.1	Measurement Reporting Requirements	312
8.11.2.2	E-UTRAN inter-frequency measurements	313
8.11.2.2.1	E-UTRAN FDD-FS3 inter-frequency measurements	313
8.11.2.2.2	E-UTRAN TDD – FS3 inter-frequency measurements	317
8.11.3	CSI-RS based discovery signal measurements	317
8.11.3.1	E-UTRAN intra-frequency measurements	317
8.11.3.1.1	Requirements	317
8.11.3.1.1.1	Requirements when no DRX is used	317
8.11.3.1.1.1.1	Measurement Reporting Requirements	319
8.11.3.1.1.2	Requirements when DRX is used	319
8.11.3.1.1.2.1	Measurement Reporting Requirements	320
8.11.3.2	E-UTRAN inter-frequency measurements	321
8.11.3.2.1	E-UTRAN FDD – FS3 inter-frequency measurements	321
8.11.3.2.2	E-UTRAN TDD – FS3 inter-frequency measurements	325
8.11.4	RSSI measurements	325
8.11.4.1	E-UTRAN intra-frequency measurements	325

8.11.4.2	E-UTRAN inter-frequency measurements	325
8.11.5	Channel occupancy measurements	326
8.11.5.1	E-UTRAN intra-frequency channel occupancy measurements.....	326
8.11.5.2	E-UTRAN inter-frequency channel occupancy measurements.....	326
8.12	Discovery Signal Measurements for E-UTRA Carrier Aggregation under Operation with Frame Structure 3	326
8.12.1	Introduction.....	326
8.12.2	CRS based discovery signal measurements for E-UTRA carrier aggregation.....	326
8.12.2.1	Introduction.....	326
8.12.2.2	Measurements of a secondary component carrier	327
8.12.2.3	Measurements of a secondary component carrier with active SCell.....	327
8.12.2.4	Measurements of a secondary component carrier with deactivated SCell	327
8.12.2.4.1	E-UTRAN secondary component carrier measurements when no common DRX is used	327
8.12.2.4.2	E-UTRAN secondary component carrier measurements when common DRX is used	329
8.12.3	Requirements for CSI-RS based discovery signal measurements for E-UTRA carrier aggregation	331
8.12.3.1	Introduction.....	331
8.12.3.2	Measurements of a secondary component carrier	331
8.12.3.3	Measurements of a secondary component carrier with active SCell.....	331
8.12.3.4	Measurements of a secondary component carrier with deactivated SCell	331
8.12.3.4.1	E-UTRAN secondary component carrier measurements when no common DRX is used	331
8.12.3.4.2	E-UTRAN secondary component carrier measurements when common DRX is used.....	333
8.13	Measurements for UE Category M1.....	335
8.13.1	Introduction.....	335
8.13.2	Requirements for UE category M1 with CE mode A	335
8.13.2.1	E-UTRAN intra frequency measurements by UE category M1 with CE mode A	335
8.13.2.1.1	E-UTRAN FDD intra frequency measurements.....	336
8.13.2.1.2	E-UTRAN intra frequency measurements for HD-FDD.....	339
8.13.2.1.3	E-UTRAN TDD intra frequency measurements	341
8.13.2.2	E-UTRAN E-CID Measurements Requirements for UE category M1 with CE mode A	344
8.13.2.2.1	E-UTRAN FDD Intra-frequency E-CID RSRP Measurements	344
8.13.2.2.2	E-UTRAN HD-FDD Intra-frequency E-CID RSRP Measurements	344
8.13.2.2.3	E-UTRAN TDD Intra-frequency E-CID RSRP Measurements	345
8.13.3	Requirements for UE category M1 with CE mode B	345
8.13.3.1	E-UTRAN intra frequency measurements by UE category M1 with CE mode B	345
8.13.3.1.1	E-UTRAN FDD intra frequency measurements.....	345
8.13.3.1.2	E-UTRAN intra frequency measurements for HD-FDD	349
8.13.3.1.3	E-UTRAN TDD intra frequency measurements	351
8.13.3.1.4	E-UTRAN FDD intra frequency measurements with autonomous gaps for UE category M1 with CE mode B	355
8.13.3.1.5	E-UTRAN intra frequency measurements with autonomous gaps for HD-FDD UE category M1 with CE mode B	356
8.13.3.1.6	E-UTRAN TDD intra frequency measurements with autonomous gaps for UE category M1 with CE mode B	356
8.13.3.2	E-UTRAN E-CID Measurements Requirements for UE category M1 with CE mode B.....	357
8.13.3.2.1	E-UTRAN FDD Intra-frequency E-CID RSRP Measurements	357
8.13.3.2.2	E-UTRAN HD-FDD Intra-frequency E-CID RSRP Measurements	357
8.13.3.2.3	E-UTRAN TDD Intra-frequency E-CID RSRP Measurements	358
8.14	Measurements for UE category NB1.....	358
8.14.1	Introduction.....	358
8.14.2	NB-IoT intra frequency measurements under normal coverage	359
8.14.2.1	NB-IoT intra frequency measurements when no DRX is used	359
8.14.2.2	NB-IoT intra frequency measurements when DRX is used	359
8.14.3	NB-IoT intra frequency measurements under enhanced coverage	359
8.14.3.1	NB-IoT intra frequency measurements when no DRX is used	359
8.14.3.2	NB-IoT intra frequency measurements when DRX is used	359
9	Measurements performance requirements for UE.....	359
9.1	E-UTRAN measurements.....	360
9.1.1	Introduction.....	360
9.1.2	Intra-frequency RSRP Accuracy Requirements.....	360
9.1.2.1	Absolute RSRP Accuracy	360
9.1.2.2	Relative Accuracy of RSRP	361