

ETSI TS 136 104 V14.12.0 (2026-02)



TECHNICAL SPECIFICATION

LTE;
Evolved Universal Terrestrial Radio Access (E-UTRA);
Base Station (BS) radio transmission and reception
(3GPP TS 36.104 version 14.12.0 Release 14)

get full document from standards.iteh.ai



Reference

RTS/TSGR-0436104vec0

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 - APE 7112B
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° w061004871

Important notice

The present document can be downloaded from the
[ETSI Search & Browse Standards](#) application.

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 on [ETSI deliver](#) repository.

Users should be aware that the present document may be revised or have its status changed, this information is available in the [Milestones listing](#).

If you find errors in the present document, please send your comments to the relevant service listed under [Committee Support Staff](#).

If you find a security vulnerability in the present document, please report it through our [Coordinated Vulnerability Disclosure \(CVD\)](#) program.

Notice of disclaimer & limitation of liability

The information provided in the present deliverable is directed solely to professionals who have the appropriate degree of experience to understand and interpret its content in accordance with generally accepted engineering or other professional standard and applicable regulations.

No recommendation as to products and services or vendors is made or should be implied.

No representation or warranty is made that this deliverable is technically accurate or sufficient or conforms to any law and/or governmental rule and/or regulation and further, no representation or warranty is made of merchantability or fitness for any particular purpose or against infringement of intellectual property rights.

In no event shall ETSI be held liable for loss of profits or any other incidental or consequential damages.

Any software contained in this deliverable is provided "AS IS" with no warranties, express or implied, including but not limited to, the warranties of merchantability, fitness for a particular purpose and non-infringement of intellectual property rights and ETSI shall not be held liable in any event for any damages whatsoever (including, without limitation, damages for loss of profits, business interruption, loss of information, or any other pecuniary loss) arising out of or related to the use of or inability to use the software.

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 2026.
All rights reserved.

Intellectual Property Rights

Essential patents

IPRs essential or potentially essential to normative deliverables may have been declared to ETSI. The declarations pertaining to these essential IPRs, if any, are 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 IPR online database](#).

Pursuant to the ETSI Directives including the ETSI IPR Policy, no investigation regarding the essentiality of IPRs, 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.

DECT™, **PLUGTESTS™**, **UMTS™** and the ETSI logo are trademarks of ETSI registered for the benefit of its Members. **3GPP™**, **LTE™** and **5G™** logo 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.

Legal Notice

This Technical Specification (TS) has been produced by 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 at [3GPP to ETSI numbering cross-referencing](#).

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.....	8
1 Scope	9
2 References	9
3 Definitions, symbols and abbreviations	10
3.1 Definitions	10
3.2 Symbols.....	13
3.3 Abbreviations	14
4 General	16
4.1 Relationship between minimum requirements and test requirements	16
4.2 Base station classes	16
4.3 Regional requirements.....	16
4.4 Applicability of requirements.....	17
4.5 Requirements for BS capable of multi-band operation	18
5 Operating bands and channel arrangement.....	19
5.1 General	19
5.2 Void.....	19
5.3 Void.....	19
5.4 Void.....	19
5.5 Operating bands.....	19
5.6 Channel bandwidth.....	41
5.7 Channel arrangement.....	45
5.7.1 Channel spacing.....	45
5.7.1A CA Channel spacing	45
5.7.2 Channel raster	46
5.7.3 Carrier frequency and EARFCN.....	46
5.7.4 EARFCN sets for Type B multi-carrier downlink transmissions and conversion to Type 2 channel access for multi-carrier uplink transmissions on multiple Scells configured in Band 46	49
5.8 Requirements for contiguous and non-contiguous spectrum.....	50
6 Transmitter characteristics	50
6.1 General	50
6.2 Base station output power	51
6.2.1 Minimum requirement	51
6.2.2 Additional requirement (regional)	51
6.2.3 Home BS output power for adjacent UTRA channel protection.....	52
6.2.4 Home BS output power for adjacent E-UTRA channel protection.....	53
6.2.5 Home BS Output Power for co-channel E-UTRA protection.....	54
6.3 Output power dynamics.....	55
6.3.1 RE Power control dynamic range	55
6.3.1.1 Minimum requirements	55
6.3.2 Total power dynamic range	55
6.3.2.1 Minimum requirements	55
6.3.3 NB-IoT RB power dynamic range for in-band or guard band operation	56
6.3.3.1 Minimum Requirement	56
6.4 Transmit ON/OFF power	56
6.4.1 Transmitter OFF power	56
6.4.1.1 Minimum Requirement	56
6.4.2 Transmitter transient period.....	56
6.4.2.1 Minimum requirements.....	57
6.5 Transmitted signal quality	57

6.5.1	Frequency error.....	57
6.5.1.1	Minimum requirement	57
6.5.2	Error Vector Magnitude.....	58
6.5.3	Time alignment error.....	58
6.5.3.1	Minimum Requirement	58
6.5.4	DL RS power	59
6.5.4.1	Minimum requirements	59
6.6	Unwanted emissions.....	59
6.6.1	Occupied bandwidth	59
6.6.1.1	Minimum requirement	60
6.6.2	Adjacent Channel Leakage power Ratio (ACLR)	60
6.6.2.1	Minimum requirement	60
6.6.2.2	Cumulative ACLR requirement in non-contiguous spectrum.....	63
6.6.3	Operating band unwanted emissions	64
6.6.3.1	Minimum requirements for Wide Area BS (Category A).....	66
6.6.3.2	Minimum requirements for Wide Area BS (Category B).....	69
6.6.3.2.1	Category B requirements (Option 1)	69
6.6.3.2.2	Category B (Option 2).....	72
6.6.3.2A	Minimum requirements for Local Area BS (Category A and B).....	74
6.6.3.2B	Minimum requirements for Home BS (Category A and B).....	75
6.6.3.2C	Minimum requirements for Medium Range BS (Category A and B).....	76
6.6.3.2D	Minimum requirements for Local Area and Medium Range BS in Band 46 (Category A and B).....	78
6.6.3.2E	Minimum requirements for standalone NB-IoT Wide Area BS.....	79
6.6.3.3	Additional requirements.....	79
6.6.4	Transmitter spurious emissions.....	83
6.6.4.1	Mandatory Requirements	84
6.6.4.1.1	Spurious emissions (Category A).....	84
6.6.4.1.2	Spurious emissions (Category B).....	84
6.6.4.2	Protection of the BS receiver of own or different BS	84
6.6.4.2.1	Minimum Requirement	85
6.6.4.3	Additional spurious emissions requirements.....	85
6.6.4.3.1	Minimum Requirement	85
6.6.4.4	Co-location with other base stations	98
6.6.4.4.1	Minimum Requirement	98
6.7	Transmitter intermodulation.....	108
6.7.1	Minimum requirement	108
6.7.2	Additional requirement for Band 41	110
7	Receiver characteristics.....	110
7.1	General	110
7.2	Reference sensitivity level.....	111
7.2.1	Minimum requirement	111
7.3	Dynamic range	113
7.3.1	Minimum requirement	114
7.4	In-channel selectivity	117
7.4.1	Minimum requirement	117
7.5	Adjacent Channel Selectivity (ACS) and narrow-band blocking.....	121
7.5.1	Minimum requirement	121
7.6	Blocking.....	126
7.6.1	General blocking requirement.....	126
7.6.1.1	Minimum requirement	126
7.6.2	Co-location with other base stations	135
7.6.2.1	Minimum requirement	135
7.6.3	Additional requirement (regional)	144
7.7	Receiver spurious emissions.....	144
7.7.1	Minimum requirement	144
7.8	Receiver intermodulation	145
7.8.1	Minimum requirement	145
8	Performance requirement	153
8.1	General	153
8.2	Performance requirements for PUSCH	154

8.2.1	Requirements in multipath fading propagation conditions	154
8.2.1.1	Minimum requirements	154
8.2.2	Requirements for UL timing adjustment	173
8.2.2.1	Minimum requirements	174
8.2.3	Requirements for high speed train	174
8.2.3.1	Minimum requirements	175
8.2.4	Requirements for HARQ-ACK multiplexed on PUSCH	175
8.2.4.1	Minimum requirement	176
8.2.5	Requirements for PUSCH with TTI bundling and enhanced HARQ pattern	176
8.2.5.1	Minimum requirements	177
8.2.6	Enhanced performance requirement type A in multipath fading propagation conditions with synchronous interference	177
8.2.6.1	Minimum requirements	178
8.2.6A	Enhanced performance requirement type A in multipath fading propagation conditions with asynchronous interference	180
8.2.6A.1	Minimum requirements	181
8.2.7	Requirements for PUSCH supporting coverage enhancement	183
8.2.8	Requirements for PUSCH of Frame structure type 3	184
8.3	Performance requirements for PUCCH	185
8.3.1	DTX to ACK performance	185
8.3.1.1	Minimum requirement	185
8.3.2	ACK missed detection requirements for single user PUCCH format 1a	186
8.3.2.1	Minimum requirements	186
8.3.3	CQI performance requirements for PUCCH format 2	186
8.3.3.1	Minimum requirements	187
8.3.4	ACK missed detection requirements for multi user PUCCH format 1a	187
8.3.4.1	Minimum requirement	187
8.3.5	ACK missed detection requirements for PUCCH format 1b with Channel Selection	187
8.3.5.1	Minimum requirements	188
8.3.6	ACK missed detection requirements for PUCCH format 3	188
8.3.6.1	Minimum requirements	188
8.3.7	NACK to ACK requirements for PUCCH format 3	189
8.3.7.1	Minimum requirement	189
8.3.8	CQI performance requirements for PUCCH format 2 with DTX detection	189
8.3.8.1	Minimum requirements	190
8.3.9	PUCCH performance requirements for coverage enhancement	190
8.3.9.1	DTX to ACK performance	190
8.3.9.1.1	Minimum requirement	190
8.3.9.2	ACK missed detection requirements for single user PUCCH format 1a	190
8.3.9.2.1	Minimum requirements	191
8.3.9.3	CQI performance requirements for PUCCH format 2	191
8.3.9.3.1	Minimum requirements	191
8.3.10	ACK missed detection requirements for PUCCH format 4	191
8.3.10.1	Minimum requirements	192
8.3.11	ACK missed detection requirements for PUCCH format 5	192
8.3.11.1	Minimum requirements	192
8.4	Performance requirements for PRACH	193
8.4.1	PRACH False alarm probability	193
8.4.1.1	Minimum requirement	193
8.4.2	PRACH detection requirements	193
8.4.2.1	Minimum requirements	193
8.5	Performance requirements for Narrowband IoT	195
8.5.1	Requirements for NPUSCH format 1	195
8.5.1.1	Requirements	195
8.5.1.1.1	Minimum requirements	196
8.5.2	Performance requirements for NPUSCH format 2	197
8.5.2.1	DTX to ACK performance	197
8.5.2.1.1	Minimum requirement	197
8.5.2.2	ACK missed detection requirements	197
8.5.2.2.1	Minimum requirements	197
8.5.3	Performance requirements for NPRACH	198
8.5.3.1	NPRACH False alarm probability	198

8.5.3.1.1	Minimum requirement.....	198
8.5.3.2	NPRACH detection requirements	198
8.5.3.2.1	Minimum requirements	198
9	Channel access procedures	199
9.1	Downlink channel access procedure.....	199
9.1.1	Channel access parameters	199
9.1.2	Minimum requirement	199
Annex A (normative): Reference measurement channels		200
A.1	Fixed Reference Channels for reference sensitivity and in-channel selectivity (QPSK, R=1/3)	201
A.2	Fixed Reference Channels for dynamic range (16QAM, R=2/3).....	202
A.3	Fixed Reference Channels for performance requirements (QPSK 1/3)	202
A.4	Fixed Reference Channels for performance requirements (16QAM 3/4)	203
A.5	Fixed Reference Channels for performance requirements (64QAM 5/6)	203
A.6	PRACH Test preambles	203
A.7	Fixed Reference Channels for UL timing adjustment (Scenario 1)	204
A.8	Fixed Reference Channels for UL timing adjustment (Scenario 2)	205
A.9	Multi user PUCCH test.....	205
A.10	PUCCH transmission on two antenna ports test.....	205
A.11	Fixed Reference Channel for PUSCH with TTI bundling and enhanced HARQ pattern	206
A.12	Fixed Reference Channels for performance requirements (QPSK 0.36)	206
A.13	Fixed Reference Channels for performance requirements (16QAM 1/2)	207
A.14	Fixed Reference Channels for NB-IOT reference sensitivity ($\pi/2$ BPSK, R=1/3).....	207
A.15	Fixed Reference Channels for NB-IoT dynamic range ($\pi/4$ QPSK, R=2/3).....	207
A.16	Fixed Reference Channels for NB-IoT NPUSCH format 1	208
A.16.1	One PRB.....	208
A.17	Fixed Reference Channels for performance requirements (256QAM 5/6)	209
A.18	Fixed Reference Channels for PUSCH transmission in UpPTS (16QAM 0.65)	209
A.19	Fixed Reference Channels for PUSCH transmission in UpPTS (256QAM 0.69)	210
A.20	Fixed Reference Channels for PUSCH of Frame structure type 3	210
Annex B (normative): Propagation conditions.....		212
B.1	Static propagation condition.....	212
B.2	Multi-path fading propagation conditions	212
B.3	High speed train condition	213
B.4	Moving propagation conditions.....	214
B.5	Multi-Antenna channel models	215
B.5.1	Definition of MIMO Correlation Matrices	215
B.5.2	MIMO Correlation Matrices at High, Medium and Low Level	216
B.5A	Multi-Antenna channel models using cross polarized antennas.....	218
B.5A.1	Definition of MIMO Correlation Matrices using cross polarized antennas.....	219
B.5A.2	Spatial Correlation Matrices at UE and eNB sides.....	219
B.5A.2.1	Spatial Correlation Matrices at UE side.....	219
B.5A.2.2	Spatial Correlation Matrices at eNB side.....	220
B.5A.3	MIMO Correlation Matrices using cross polarized antennas	220

B.6	Interference model for enhanced performance requirements type A	220
B.6.1	Dominant interferer proportion	220
B.6.2	Interference model for synchronous scenario.....	221
B.6.3	Interference model for asynchronous scenario	221
Annex C (normative):	Characteristics of the interfering signals.....	222
Annex D (normative):	Environmental requirements for the BS equipment	223
Annex E (normative):	Error Vector Magnitude	224
E.1	Reference point for measurement.....	224
E.2	Basic unit of measurement	224
E.3	Modified signal under test.....	225
E.4	Estimation of frequency offset	225
E.5	Estimation of time offset	225
E.5.1	Window length	226
E.6	Estimation of TX chain amplitude and frequency response parameters	227
E.7	Averaged EVM	228
Annex F (Informative):	Unwanted emission requirements for multi-carrier BS	230
F.1	General	230
F.2	Multi-carrier BS of different E-UTRA channel bandwidths	230
F.3	Multi-carrier BS of E-UTRA and UTRA.....	230
Annex G (Informative):	Regional requirement for protection of DTT	231
G.1	Regional requirement for protection of DTT	231
G.2	Regional requirement for Public Safety LTE BS in Korea	231
Annex H (Informative):	Calculation of EIRP based on manufacturer declarations and site specific conditions	234
H.1	Calculation of EIRP based on manufacturer declarations and site specific conditions.....	234
Annex I (Informative):	Change history	235
History	246

Foreword

This Technical Specification 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 the 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.

Sample Document

get full document from standards.iteh.ai

1 Scope

The present document establishes the minimum RF characteristics and minimum performance requirements of E-UTRA, E-UTRA with NB-IoT or NB-IoT Base Station (BS).

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

- [1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".
- [2] ITU-R Recommendation SM.329: "Unwanted emissions in the spurious domain".
- [3] ITU-R Recommendation M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".
- [4] 3GPP TS 36.141: "Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing".
- [5] ITU-R recommendation SM.328: "Spectra and bandwidth of emissions".
- [6] 3GPP TS 25.104: "Base Station (BS) radio transmission and reception (FDD)".
- [7] 3GPP TS 25.105: "Base Station (BS) radio transmission and reception (TDD)".
- [8] 3GPP TR 25.942: "RF system scenarios".
- [9] 3GPP TR 36.942: "E-UTRA RF system scenarios".
- [10] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical Channels and Modulation".
- [11] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".
- [12] ECC/DEC/(09)03 "Harmonised conditions for MFCN in the band 790-862 MHz", 30 Oct. 2009
- [13] IEC 60721-3-3 (2002): "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 3: Stationary use at weather protected locations".
- [14] IEC 60721-3-4 (1995): "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 4: Stationary use at non-weather protected locations".
- [15] 3GPP TS 37.104: "E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) radio transmission and reception".
- [16] CEPT ECC Decision (13)03, "The harmonised use of the frequency band 1452-1492 MHz for Mobile/Fixed Communications Networks Supplemental Downlink (MFCN SDL)".
- [17] 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation".

- [18] 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

Aggregated Channel Bandwidth: RF bandwidth in which a base station transmits and/or receives multiple contiguously aggregated carriers.

NOTE: The Aggregated Channel Bandwidth is measured in MHz.

Base station receive period: time during which the base station is receiving data subframes or UpPTS.

Base Station RF Bandwidth: RF bandwidth in which a base station transmits and/or receives single or multiple carrier(s) within a supported operating band.

NOTE: In single E-UTRA carrier operation, the Base Station RF Bandwidth is equal to the channel bandwidth.

Base Station RF Bandwidth edge: frequency of one of the edges of the Base Station RF Bandwidth.

Carrier: modulated waveform conveying the E-UTRA or UTRA physical channels

Carrier aggregation: aggregation of two or more component carriers in order to support wider transmission bandwidths

Carrier aggregation band: a set of one or more operating bands across which multiple carriers are aggregated with a specific set of technical requirements.

NOTE: Carrier aggregation band(s) for an E-UTRA BS is declared by the manufacturer according to the designations in Tables 5.5-2 to 5.5-4.

Channel bandwidth: RF bandwidth supporting a single E-UTRA RF carrier with the transmission bandwidth configured in the uplink or downlink of a cell.

NOTE: The channel bandwidth is measured in MHz and is used as a reference for transmitter and receiver RF requirements.

Channel edge: lowest or highest frequency of the E-UTRA carrier, separated by the channel bandwidth.

Contiguous carriers: set of two or more carriers configured in a spectrum block where there are no RF requirements based on co-existence for un-coordinated operation within the spectrum block.

Contiguous spectrum: spectrum consisting of a contiguous block of spectrum with no sub-block gap(s).

DL RS power: resource element power of Downlink Reference Symbol.

DL NRS power: resource element power of Downlink Narrowband Reference Signal.

Downlink operating band: part of the operating band designated for downlink.

Enhanced performance requirements type A: This defines performance requirements assuming baseline receiver as demodulation reference signal based linear minimum mean square error interference rejection combining.

Highest carrier: carrier with the highest carrier centre frequency transmitted/received in a specified operating band.

Inter RF Bandwidth gap: frequency gap between two consecutive Base Station RF Bandwidths that are placed within two supported operating bands.

Inter-band carrier aggregation: carrier aggregation of component carriers in different operating bands.

NOTE: Carriers aggregated in each band can be contiguous or non-contiguous.

Inter-band gap: The frequency gap between two supported consecutive operating bands.

Intra-band contiguous carrier aggregation: contiguous carriers aggregated in the same operating band.

Intra-band non-contiguous carrier aggregation: non-contiguous carriers aggregated in the same operating band.

Lower sub-block edge: frequency at the lower edge of one sub-block.

NOTE: It is used as a frequency reference point for both transmitter and receiver requirements.

Lowest carrier: carrier with the lowest carrier centre frequency transmitted/received in a specified operating band.

Maximum output power: mean power level per carrier of the base station measured at the antenna connector in a specified reference condition.

Maximum throughput: maximum achievable throughput for a reference measurement channel.

Mean power: power measured in the channel bandwidth of the carrier.

NOTE: The period of measurement shall be at least one subframe (1ms), unless otherwise stated.

Measurement bandwidth: RF bandwidth in which an emission level is specified.

Multi-band base station: base station characterized by the ability of its transmitter and/or receiver to process two or more carriers in common active RF components simultaneously, where at least one carrier is configured at a different operating band (which is not a sub-band or superseding-band of another supported operating band) than the other carrier(s).

Multi-band transmitter: transmitter characterized by the ability to process two or more carriers in common active RF components simultaneously, where at least one carrier is configured at a different operating band (which is not a sub-band or superseding-band of another supported operating band) than the other carrier(s).

Multi-band receiver: receiver characterized by the ability to process two or more carriers in common active RF components simultaneously, where at least one carrier is configured at a different operating band (which is not a sub-band or superseding-band of another supported operating band) than the other carrier(s).

Multi-carrier transmission configuration: set of one or more contiguous or non-contiguous carriers that a BS is able to transmit simultaneously according to the manufacturer's specification.

NB-IoT In-band operation: NB-IoT is operating in-band when it utilizes the resource block(s) within a normal E-UTRA carrier

NB-IoT guard band operation: NB-IoT is operating in guard band when it utilizes the unused resource block(s) within a E-UTRA carrier's guard-band.

NB-IoT standalone operation: NB-IoT is operating standalone when it utilizes its own spectrum, for example the spectrum currently being used by GERAN systems as a replacement of one or more GSM carriers, as well as scattered spectrum for potential IoT deployment.

Non-contiguous spectrum: spectrum consisting of two or more sub-blocks separated by sub-block gap(s).

Occupied bandwidth: width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage $\beta/2$ of the total mean power of a given emission.

Operating band: frequency range in which E-UTRA operates (paired or unpaired), that is defined with a specific set of technical requirements.

NOTE: The operating band(s) for an E-UTRA BS is declared by the manufacturer according to the designations in table 5.5-1.

Output power: mean power of one carrier of the base station, delivered to a load with resistance equal to the nominal load impedance of the transmitter.

Radio Bandwidth: frequency difference between the upper edge of the highest used carrier and the lower edge of the lowest used carrier.

Rated output power: mean power level per carrier that the manufacturer has declared to be available at the antenna connector during the transmitter ON period.

RE power control dynamic range: difference between the power of a RE and the average RE power for a BS at maximum output power for a specified reference condition.

RRC filtered mean power: mean power of an UTRA carrier as measured through a root raised cosine filter with roll-off factor α and a bandwidth equal to the chip rate of the radio access mode.

NOTE 1: The RRC filtered mean power of a perfectly modulated UTRA signal is 0.246 dB lower than the mean power of the same signal.

Sub-band: A sub-band of an operating band contains a part of the uplink and downlink frequency range of the operating band.

Sub-block: one contiguous allocated block of spectrum for transmission and reception by the same base station.

NOTE: There may be multiple instances of sub-blocks within a Base Station RF Bandwidth.

Sub-block bandwidth: bandwidth of one sub-block.

Sub-block gap: frequency gap between two consecutive sub-blocks within a Base Station RF Bandwidth, where the RF requirements in the gap are based on co-existence for un-coordinated operation.

Superseding-band: A superseding-band of an operating band includes the whole of the uplink and downlink frequency range of the operating band.

Synchronized operation: operation of TDD in two different systems, where no simultaneous uplink and downlink occur.

Throughput: number of payload bits successfully received per second for a reference measurement channel in a specified reference condition.

Total power dynamic range: difference between the maximum and the minimum transmit power of an OFDM symbol for a specified reference condition.

Transmission bandwidth: RF Bandwidth of an instantaneous transmission from a UE or BS, measured in resource block units.

Transmission bandwidth configuration: highest transmission bandwidth allowed for uplink or downlink in a given channel bandwidth, measured in resource block units.

Transmitter ON period: time period during which the BS transmitter is transmitting data and/or reference symbols, i.e. data subframes or DwPTS.

Transmitter OFF period: time period during which the BS transmitter is not allowed to transmit.

Transmitter transient period: time period during which the transmitter is changing from the OFF period to the ON period or vice versa.

Unsynchronized operation: operation of TDD in two different systems, where the conditions for synchronized operation are not met.

Uplink operating band: part of the operating band designated for uplink.

Upper sub-block edge: frequency at the upper edge of one sub-block.

NOTE: It is used as a frequency reference point for both transmitter and receiver requirements.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

α	Roll-off factor
β	Percentage of the mean transmitted power emitted outside the occupied bandwidth on the assigned channel
BW	Bandwidth
BW_{Channel}	Channel bandwidth
$BW_{\text{Channel,CA}}$	Aggregated Channel Bandwidth, expressed in MHz. $BW_{\text{Channel,CA}} = F_{\text{edge,high}} - F_{\text{edge,low}}$.
$BW_{\text{Channel,block}}$	Sub-block bandwidth, expressed in MHz. $BW_{\text{Channel,block}} = F_{\text{edge,block,high}} - F_{\text{edge,block,low}}$.
BW_{Config}	Transmission bandwidth configuration, expressed in MHz, where $BW_{\text{Config}} = N_{\text{RB}} \times 180$ kHz in the uplink and $BW_{\text{Config}} = 15$ kHz + $N_{\text{RB}} \times 180$ kHz in the downlink.
CA_X	Intra-band contiguous CA of component carriers in one sub-block within band X where X is the applicable E-UTRA operating band
CA_X-X	Intra-band non-contiguous CA of component carriers in two sub-blocks within band X where X is the applicable E-UTRA operating band
CA_X-Y	Inter-band CA of component carrier(s) in one sub-block within band X and component carrier(s) in one sub-block within Band Y where X and Y are the applicable E-UTRA operating bands
CA_X-X-Y	CA of component carriers in two sub-blocks within Band X and component carrier(s) in one sub-block within Band Y where X and Y are the applicable E-UTRA operating bands
f	Frequency
Δf	Separation between the channel edge frequency and the nominal -3dB point of the measuring filter closest to the carrier frequency
Δf_{max}	The largest value of Δf used for defining the requirement
F_{C}	Carrier centre frequency
$F_{\text{C,block,high}}$	Centre frequency of the highest transmitted/received carrier in a sub-block.
$F_{\text{C,block,low}}$	Centre frequency of the lowest transmitted/received carrier in a sub-block.
$F_{\text{C,low}}$	The carrier centre frequency of the lowest carrier, expressed in MHz.
$F_{\text{C,high}}$	The carrier centre frequency of the highest carrier, expressed in MHz.
$F_{\text{edge,low}}$	The lower edge of Aggregated Channel Bandwidth, expressed in MHz. $F_{\text{edge,low}} = F_{\text{C,low}} - F_{\text{offset}}$.
$F_{\text{edge,high}}$	The upper edge of Aggregated Channel Bandwidth, expressed in MHz. $F_{\text{edge,high}} = F_{\text{C,high}} + F_{\text{offset}}$.
$F_{\text{edge,block,low}}$	The lower sub-block edge, where $F_{\text{edge,block,low}} = F_{\text{C,block,low}} - F_{\text{offset}}$.
$F_{\text{edge,block,high}}$	The upper sub-block edge, where $F_{\text{edge,block,high}} = F_{\text{C,block,high}} + F_{\text{offset}}$.
F_{offset}	Frequency offset from $F_{\text{C,high}}$ to the upper Base Station RF Bandwidth edge, or from $F_{\text{C,block,high}}$ to the upper sub-block edge, or $F_{\text{C,low}}$ to the lower Base Station RF Bandwidth edge, or from $F_{\text{C,block,low}}$ to the lower sub-block edge.
F_{filter}	Filter centre frequency
f_{offset}	Separation between the channel edge frequency and the centre of the measuring filter
$f_{\text{offset,max}}$	The maximum value of f_{offset} used for defining the requirement
$F_{\text{DL,low}}$	The lowest frequency of the downlink operating band
$F_{\text{DL,high}}$	The highest frequency of the downlink operating band
$F_{\text{UL,low}}$	The lowest frequency of the uplink operating band
$F_{\text{UL,high}}$	The highest frequency of the uplink operating band
G_{ant}	Net antenna gain
M_{DL}	Offset of NB-IoT Downlink channel number to Downlink EARFCN
M_{UL}	Offset of NB-IoT Uplink channel number to Uplink EARFCN
N_{ant}	Number of transmitter antennas
N_{DL}	Downlink EARFCN
$N_{\text{Offs-DL}}$	Offset used for calculating downlink EARFCN
$N_{\text{Offs-UL}}$	Offset used for calculating uplink EARFCN
N_{CS}	Number of Cyclic shifts for preamble generation in PRACH
N_{RB}	Transmission bandwidth configuration, expressed in units of resource blocks
N_{UL}	Uplink EARFCN
$P_{10\text{MHz}}$	Maximum output Power within 10 MHz
$P_{\text{EIRP,N}}$	EIRP level for channel N
$P_{\text{EIRP,N,MAX}}$	Maximum EIRP level for channel N
$P_{\text{EM,N}}$	Declared emission level for channel N
$P_{\text{EM,B32,ind}}$	Declared emission level in Band 32, ind=a, b, c, d, e
$P_{\text{max,c}}$	Maximum carrier output power
P_{out}	Output power (per carrier)

$P_{\text{rated,c}}$	Rated output power (per carrier)
P_{REFSENS}	Reference Sensitivity power level
T_A	Timing advance command, as defined in [11]
T_s	Basic time unit, as defined in [10]
W_{gap}	Sub-block gap or Inter RF Bandwidth gap size

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

ACLR	Adjacent Channel Leakage Ratio
ACK	Acknowledgement (in HARQ protocols)
ACS	Adjacent Channel Selectivity
AWGN	Additive White Gaussian Noise
BS	Base Station
CA	Carrier Aggregation
CACLR	Cumulative ACLR
CP	Cyclic prefix
CRC	Cyclic Redundancy Check
CW	Continuous Wave
DC	Direct Current
DFT	Discrete Fourier Transformation
DIP	Dominant Interferer Proportion
DTT	Digital Terrestrial Television
DTX	Discontinuous Transmission
DwPTS	Downlink part of the special subframe (for TDD operation)
EARFCN	E-UTRA Absolute Radio Frequency Channel Number
EIRP	Effective Isotropic Radiated Power
EPA	Extended Pedestrian A model
ETU	Extended Typical Urban model
E-UTRA	Evolved UTRA
EVA	Extended Vehicular A model
EVM	Error Vector Magnitude
FDD	Frequency Division Duplex
FFT	Fast Fourier Transformation
FRC	Fixed Reference Channel
GP	Guard Period (for TDD operation)
GSM	Global System for Mobile communications
HARQ	Hybrid Automatic Repeat Request
ICS	In-Channel Selectivity
ITU-R	Radiocommunication Sector of the ITU
LA	Local Area
LNA	Low Noise Amplifier
MCS	Modulation and Coding Scheme
MR	Medium Range
NB-IoT	Narrowband – Internet of Things
NPDSCH	Narrowband Physical Downlink Shared Channel
NPUSCH	Narrowband Physical Uplink Shared Channel
NRS	Narrowband Reference Signal
OFDM	Orthogonal Frequency Division Multiplex
OOB	Out-of-band
PA	Power Amplifier
PBCH	Physical Broadcast Channel
PDCCH	Physical Downlink Control Channel
PDSCH	Physical Downlink Shared Channel
PUSCH	Physical Uplink Shared Channel
PUCCH	Physical Uplink Control Channel
PRACH	Physical Random Access Channel