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5G;

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Multi-Standard Radio (MSR) Base Station (BS)

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Contents

Intellectual Property Rights	2
Legal Notice	2
Modal verbs terminology.....	2
Foreword.....	6
1 Scope	7
2 References	7
3 Definitions, symbols and abbreviations	8
3.1 Definitions	8
3.2 Symbols.....	11
3.3 Abbreviations	13
4 General	15
4.1 Relation between the MSR specification and the single-RAT specifications	15
4.2 Relationship between minimum requirements and test requirements	15
4.3 Base station classes	15
4.4 Regional requirements.....	16
4.5 Operating bands and Band Categories.....	17
4.5.1 Band category 1 aspects (BC1).....	21
4.5.2 Band category 2 aspects (BC2).....	22
4.5.3 Band category 3 aspects (BC3).....	22
4.6 Channel arrangement.....	22
4.6.1 Channel spacing.....	22
4.6.1A CA Channel spacing	23
4.6.2 Channel raster	24
4.6.3 Carrier frequencies and numbering.....	24
4.7 Requirements for contiguous and non-contiguous spectrum.....	24
4.8 Requirements for BS capable of multi-band operation	25
5 Applicability of requirements.....	25
5.1 Band category 1.....	25
5.2 Band category 2.....	28
5.3 Band category 3.....	31
5.4 Inclusion of requirements by reference	34
6 Transmitter characteristics	34
6.1 General	34
6.2 Base station output power	35
6.2.1 Minimum requirement	35
6.2.2 Additional requirement (regional)	35
6.2.3 E-UTRA minimum requirement for DL RS power	36
6.2.4 UTRA FDD minimum requirement for primary CPICH power	36
6.2.4A UTRA FDD minimum requirement for secondary CPICH power.....	36
6.2.5 UTRA TDD minimum requirement for primary CCPCH power	36
6.2.6 NB-IoT minimum requirement for DL NRS power	36
6.3 Output power dynamics.....	36
6.3.1 E-UTRA minimum requirement	36
6.3.2 UTRA FDD minimum requirement.....	37
6.3.3 UTRA TDD minimum requirement.....	37
6.3.4 GSM/EDGE minimum requirement	37
6.3.5 NB-IoT minimum requirement	37
6.3.6 NR minimum requirement	37
6.4 Transmit ON/OFF power	37
6.4.1 Transmitter OFF power	37
6.4.1.1 Minimum Requirement	37
6.4.2 Transmitter transient period.....	37

6.4.2.1	Minimum requirements	38
6.5	Transmitted signal quality	39
6.5.1	Modulation quality	39
6.5.1.1	E-UTRA minimum requirement	39
6.5.1.2	UTRA FDD minimum requirement	39
6.5.1.3	UTRA TDD minimum requirement	39
6.5.1.4	GSM/EDGE minimum requirement	39
6.5.1.5	NB-IoT minimum requirement	39
6.5.1.6	NR minimum requirement	39
6.5.2	Frequency error	39
6.5.2.1	E-UTRA minimum requirement	39
6.5.2.2	UTRA FDD minimum requirement	39
6.5.2.3	UTRA TDD minimum requirement	40
6.5.2.4	GSM/EDGE minimum requirement	40
6.5.2.5	NB-IoT minimum requirement	40
6.5.2.6	NR minimum requirement	40
6.5.3	Time alignment error	40
6.5.3.1	E-UTRA minimum Requirement	40
6.5.3.2	UTRA FDD minimum requirement	40
6.5.3.3	UTRA TDD minimum requirement	40
6.5.3.4	NB-IoT minimum Requirement	40
6.5.3.5	NR minimum Requirement	40
6.6	Unwanted emissions	41
6.6.1	Transmitter spurious emissions	41
6.6.1.1	Mandatory Requirements	42
6.6.1.1.1	Minimum requirement (Category A)	42
6.6.1.1.2	Minimum requirement (Category B)	42
6.6.1.1.3	Additional minimum requirement for BC2 (Category B)	42
6.6.1.2	Protection of the BS receiver of own or different BS	43
6.6.1.2.1	Minimum Requirement	43
6.6.1.3	Additional spurious emissions requirements	43
6.6.1.3.1	Minimum Requirement	43
6.6.1.4	Co-location with other base stations	52
6.6.1.4.1	Minimum Requirement	52
6.6.2	Operating band unwanted emissions	57
6.6.2.1	General minimum requirement for Band Categories 1 and 3	58
6.6.2.2	General minimum requirement for Band Category 2	65
6.6.2.3	GSM/EDGE single-RAT requirements	74
6.6.2.4	Additional requirements	74
6.6.2.4.1	Limits in FCC Title 47	74
6.6.2.4.2	Unsynchronized operation for BC3	74
6.6.2.4.3	Protection of DTT	74
6.6.2.4.4	Void	75
6.6.2.4.5	Co-existence with RNSS/GPS services in North America	75
6.6.2.4.6	Void	75
6.6.2.4.7	Additional band 32, 50, 51, 74, 75 and 76 unwanted emissions	75
6.6.2.4.8	Additional requirements for band 45	77
6.6.2.4.9	Additional requirements for band 48	77
6.6.3	Occupied bandwidth	77
6.6.3.1	Minimum requirement	78
6.6.4	Adjacent Channel Leakage Power Ratio (ACLR)	78
6.6.4.1	E-UTRA minimum requirement	78
6.6.4.2	UTRA FDD minimum requirement	80
6.6.4.3	UTRA TDD minimum requirement	80
6.6.4.4	Cumulative ACLR requirement in non-contiguous spectrum	80
6.6.4.5	NB-IoT minimum requirement	81
6.6.4.6	NR minimum requirement	82
6.7	Transmitter intermodulation	83
6.7.1	General minimum requirement	83
6.7.2	Additional minimum requirement (BC1 and BC2)	84
6.7.3	Additional minimum requirement (BC3)	85
6.7.4	Additional requirements	85

7	Receiver characteristics	86
7.1	General	86
7.2	Reference sensitivity level.....	86
7.2.1	E-UTRA minimum requirement	86
7.2.2	UTRA FDD minimum requirement.....	86
7.2.3	UTRA TDD minimum requirement.....	87
7.2.4	GSM/EDGE minimum requirement	87
7.2.5	NB-IoT minimum requirement	87
7.2.6	NR minimum requirement	87
7.2.7	Void	87
7.3	Dynamic range	87
7.3.1	E-UTRA minimum requirement	87
7.3.2	UTRA FDD minimum requirement.....	87
7.3.3	UTRA TDD minimum requirement.....	87
7.3.4	GSM/EDGE minimum requirement	87
7.3.5	NB-IoT minimum requirement.....	87
7.3.6	NR minimum requirement	87
7.4	In-band selectivity and blocking	88
7.4.1	General blocking minimum requirement	88
7.4.2	General narrowband blocking minimum requirement	89
7.4.3	Additional Narrowband blocking minimum requirement for GSM/EDGE	91
7.4.4	GSM/EDGE requirements for AM suppression	91
7.4.5	Additional BC3 blocking minimum requirement	91
7.5	Out-of-band blocking	91
7.5.1	General minimum requirement.....	91
7.5.2	Co-location minimum requirement.....	92
7.6	Receiver spurious emissions.....	97
7.6.1	General minimum requirement.....	97
7.6.2	Additional minimum requirement for BC2 (Category B).....	98
7.7	Receiver intermodulation	98
7.7.1	General intermodulation minimum requirement.....	98
7.7.2	General narrowband intermodulation minimum requirement.....	101
7.7.3	Additional narrowband intermodulation minimum requirement for GSM/EDGE	105
7.8	In-channel selectivity	105
7.8.1	E-UTRA minimum requirement	105
7.8.2	NR minimum requirement	105
8	Performance requirements.....	105
8.1	E-UTRA minimum requirement.....	105
8.2	UTRA FDD minimum requirement	105
8.3	UTRA TDD minimum requirement	106
8.4	GSM/EDGE minimum requirement.....	106
8.5	NR minimum requirement.....	106
Annex A (normative): Characteristics of interfering signals		107
A.1	UTRA FDD interfering signal.....	107
A.2	UTRA TDD interfering signal	107
A.3	E-UTRA interfering signal.....	107
Annex B (normative): Environmental requirements for the BS equipment		108
Annex C (informative): Change history		109
History		116

Foreword

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1 Scope

The present document establishes the minimum RF characteristics of NR, E-UTRA, UTRA, GSM/EDGE and NB-IoT Multi-Standard Radio (MSR) Base Station (BS). Requirements for multi-RAT and single-RAT operation of MSR BS are covered in the present document. The requirements in the present document for E-UTRA, UTRA and NB-IoT single-RAT operation of MSR BS are also applicable to E-UTRA, UTRA and NB-IoT multi-carrier capable single-RAT BS. Requirements for GSM BS that are only single-RAT capable in all supported operating bands are not covered.

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] 3GPP TS 25.104, Technical Specification, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Base Station (BS) radio transmission and reception (FDD)"
- [3] 3GPP TS 25.105, Technical Specification, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Base Station (BS) radio transmission and reception (TDD)"
- [4] 3GPP TS 36.104, Technical Specification, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) radio transmission and reception"
- [5] 3GPP TS 45.005, Technical Specification, "3rd Generation Partnership Project; Technical Specification Group GSM/EDGE Radio Access Network; Radio transmission and reception"
- [6] ITU-R Recommendation SM.329-10, "Unwanted emissions in the spurious domain".
- [7] 3GPP TR 25.942, "Technical Report 3rd Generation Partnership Project; Technical Specification Group Radio Access Networks; Radio Frequency (RF) system scenarios"
- [8] "Title 47 of the Code of Federal Regulations (CFR)", Federal Communications Commission.
- [9] ITU-R Recommendation M.1545: "Measurement uncertainty as it applies to test limits for the terrestrial component of International Mobile Telecommunications-2000".
- [10] 3GPP TS 37.141, Technical Specification, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR, E-UTRA, UTRA and GSM/EDGE; Multi-Standard Radio (MSR) Base Station (BS) conformance testing"
- [11] IEC 60721-3-3: "Classification of environmental conditions - Part 3-3: Classification of groups of environmental parameters and their severities - Stationary use at weather protected locations".
- [12] IEC 60721-3-4: "Classification of environmental conditions - Part 3: Classification of groups of environmental parameters and their severities - Section 4: Stationary use at non-weather protected locations".

- [13] ETSI EN 300 019-1-3, *European Standard (Telecommunications series)*, "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-3: Classification of environmental conditions; Stationary use at weather protected locations"
- [14] ETSI EN 300 019-1-4, *European Standard (Telecommunications series)*, "Environmental Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment; Part 1-4: Classification of environmental conditions; Stationary use at non-weather protected locations".
- [15] CEPT ECC Decision (13)03, "The harmonised use of the frequency band 1452-1492 MHz for Mobile/Fixed Communications Networks Supplemental Downlink (MFCN SDL)".
- [16] CEPT ECC Decision (17)06, "The harmonised use of the frequency bands 1427-1452 MHz and 1492-1518 MHz for Mobile/Fixed Communications Networks Supplemental Downlink (MFCN SDL)".
- [17] 3GPP TS 38.104, Technical Specification, "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; NR; Base Station (BS) radio transmission and reception"
- [18] Void.
- [19] 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone"

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].

Band category: group of operating bands for which the same MSR scenarios apply

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

NOTE: In single 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 NR, E-UTRA, UTRA or GSM/EDGE physical channels

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

Carrier aggregation band: set of one or more operating bands across which multiple E-UTRA 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 of TS 36.104 [4]

Channel bandwidth: RF bandwidth supporting a single NR, E-UTRA, UTRA or GSM/EDGE 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.

NOTE: The term channel bandwidth is referred to as BS channel bandwidth in the NR specifications, since for NR the BS and UE may operate with differing bandwidths.

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.

Carrier power: power at the antenna connector in the channel bandwidth of the carrier averaged over at least one subframe for NR or E-UTRA, at least one slot for UTRA and the useful part of the burst for GSM/EDGE.

Configured carrier power: target maximum power for a specific carrier for the operating mode set in the base station

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

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

Highest Carrier: carrier with the highest carrier centre frequency transmitted/received in the specified operating band(s).

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 NR or E-UTRA 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 NR or E-UTRA carriers aggregated in the same operating band.

Intra-band non-contiguous carrier aggregation: non-contiguous NR or E-UTRA carriers aggregated in the same operating band.

Lowest Carrier: carrier with the lowest carrier centre frequency transmitted/received in the specified operating band(s).

Lower Base Station RF Bandwidth edge: frequency of the lower edge of the Base Station RF bandwidth, used as a frequency reference point for transmitter and receiver requirements.

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.

Maximum Base Station RF Bandwidth: maximum RF bandwidth supported by a BS within each supported operating band.

NOTE: The maximum Base Station RF Bandwidth for BS configured for contiguous and non-contiguous operation within each supported operating band is declared separately.

Maximum carrier output power: carrier power available at the antenna connector for a specified reference condition.

Maximum RAT output power: sum of the power of all carriers of the same RAT available at the antenna connector for a specified reference condition.

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

Maximum total output power: sum of the power of all carriers available at the antenna connector for a specified reference condition.

MB-MSR Base Station: MSR 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).

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

MSR Base station: base station characterized by the ability of its receiver and transmitter to process two or more carriers in common active RF components simultaneously in a declared Base Station RF Bandwidth, where at least one carrier is of a different RAT 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).

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

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.

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 NR, E-UTRA, UTRA or GSM/EDGE operates (paired or unpaired), that is defined with a specific set of technical requirements.

NOTE: The operating band(s) for a BS is declared by the manufacturer.

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

Rated total output power: The total power level that the manufacturer has declared to be available at the antenna connector.

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

Single-RAT operation: operation of a base station in an operating band with only one RAT configured in that operating band.

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 use by the same base station.

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

Sub-block bandwidth: RF 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.

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

Transmitter ON period: time period during which the BS transmitter is transmitting data and/or reference symbols

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 Base Station RF Bandwidth edge: frequency of the upper edge of the Base Station RF Bandwidth, used as a frequency reference point for transmitter and receiver requirements

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:

β	Percentage of the mean transmitted power emitted outside the occupied bandwidth on the assigned channel
BW_{Channel}	Channel bandwidth (for E-UTRA and NR)
BW_{Config}	Transmission bandwidth configuration (for E-UTRA), 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. Transmission bandwidth configuration (for NR), where $BW_{\text{Config}} = N_{\text{RB}} \times \text{SCS} \times 12$.
BW_{RF}	Base Station RF Bandwidth, where $BW_{\text{RF}} = F_{\text{BW RF,high}} - F_{\text{BW RF,low}}$
$BW_{\text{RF,max}}$	Maximum Base Station RF Bandwidth
$DwPTS$	Downlink part of the special subframe (for E-UTRA TDD operation)
f	Frequency
Δf	Separation between the Base Station RF Bandwidth 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
Δf_{OBUe}	Maximum offset of the <i>operating band</i> unwanted emissions mask from the downlink <i>operating band edge</i>
Δf_{OOB}	Maximum offset of the out-of-band boundary from the uplink <i>operating band edge</i>
F_{C}	Carrier centre frequency
F_{filter}	Filter centre frequency
f_{offset}	Separation between the Base Station RF Bandwidth edge frequency and the centre of the measuring filter
$f_{\text{offset,max}}$	The maximum value of f_{offset} used for defining the requirement
$F_{\text{block,high}}$	Upper sub-block edge, where $F_{\text{block,high}} = F_{\text{C,block,high}} + F_{\text{offset, RAT}}$
$F_{\text{block,low}}$	Lower sub-block edge, where $F_{\text{block,low}} = F_{\text{C,block,low}} - F_{\text{offset, RAT}}$
$F_{\text{BW RF,high}}$	Upper Base Station RF Bandwidth edge, where $F_{\text{BW RF,high}} = F_{\text{C,high}} + F_{\text{offset, RAT}}$
$F_{\text{BW RF,low}}$	Lower Base Station RF Bandwidth edge, where $F_{\text{BW RF,low}} = F_{\text{C,low}} - F_{\text{offset, RAT}}$
$F_{\text{C band, high}}$	Center frequency of the highest transmitted/received carrier in a band.
$F_{\text{C band, low}}$	Center frequency of the lowest transmitted/received carrier in a band.
$F_{\text{C,block, high}}$	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.
$F_{\text{C,high}}$	Centre frequency of the highest transmitted/received carrier.
$F_{\text{C,low}}$	Centre frequency of the lowest transmitted/received carrier.
$F_{\text{offset, RAT}}$	Frequency offset from the centre frequency of the <i>highest</i> transmitted/received carrier to the <i>upper</i> Base Station RF Bandwidth edge, sub-block edge or Inter-RF Bandwidth edge, or from the centre frequency of the <i>lowest</i> transmitted/received to the <i>lower</i> Base Station RF Bandwidth edge, sub-block edge or Inter-RF Bandwidth edge for a specific RAT.
$F_{\text{DL,low}}$	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

$P_{EM,N}$	Declared emission level for channel N
$P_{EM,B32,B75,B76,ind}$	Declared emission level in Band 32, Band 75 and Band 76, ind=a, b, c
$P_{EM,B32,ind}$	Declared emission level in Band 32, ind= d, e
$P_{EM,B50,B74,B75,ind}$	Declared emission level for Band 50, Band 74 and Band 75, ind=a,b
P_{max}	Maximum total output power
$P_{max,RAT}$	Maximum RAT output power
$P_{max,c}$	Maximum carrier output power
$P_{Rated,c}$	Rated carrier output power
$P_{REFSENS}$	Reference Sensitivity power level
W_{gap}	Sub-block gap or Inter RF Bandwidth gap size

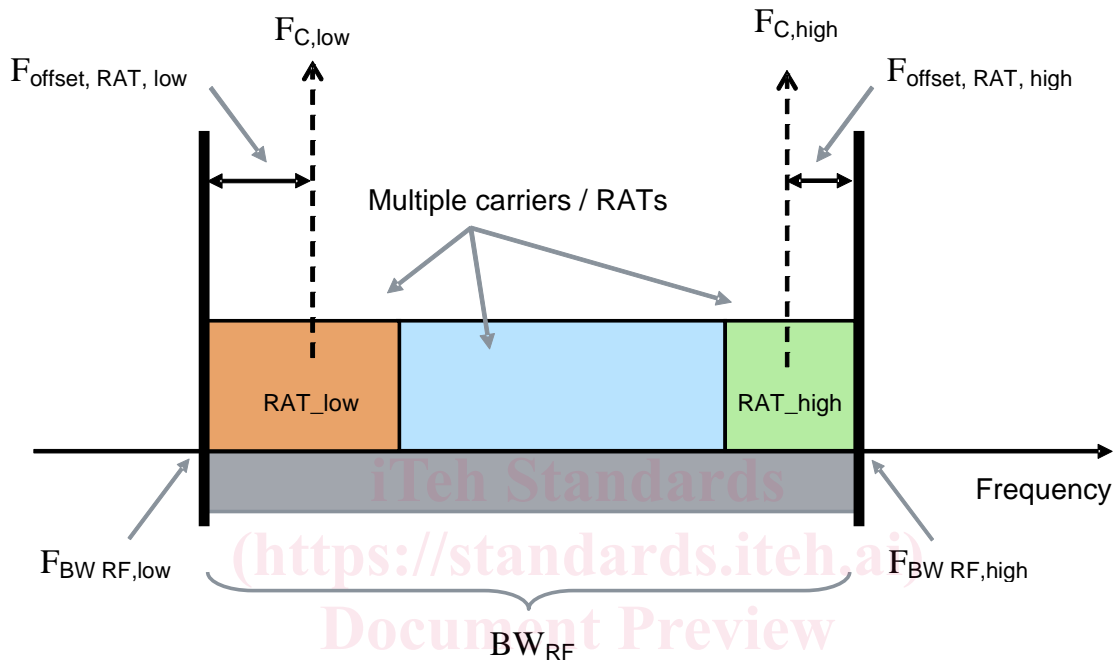


Figure 3.2-1: Illustration of Base Station RF Bandwidth related symbols and definitions for Multi-Standard Radio.

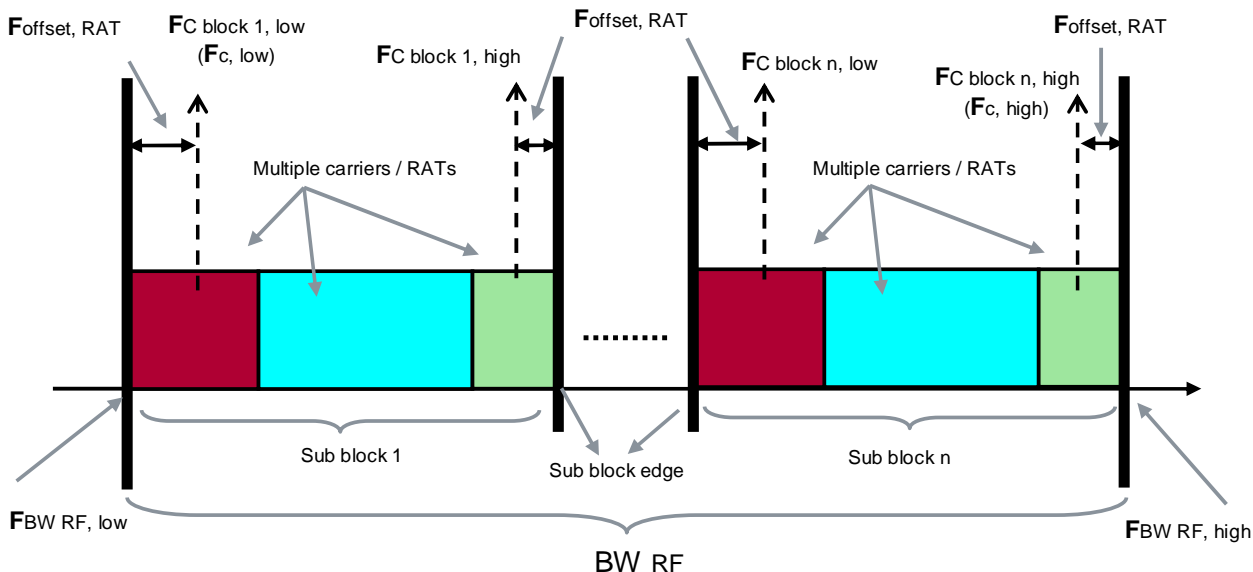


Figure 3.2-2: Illustration of Base Station RF Bandwidth related symbols and definitions for non-contiguous Multi-Standard Radio.

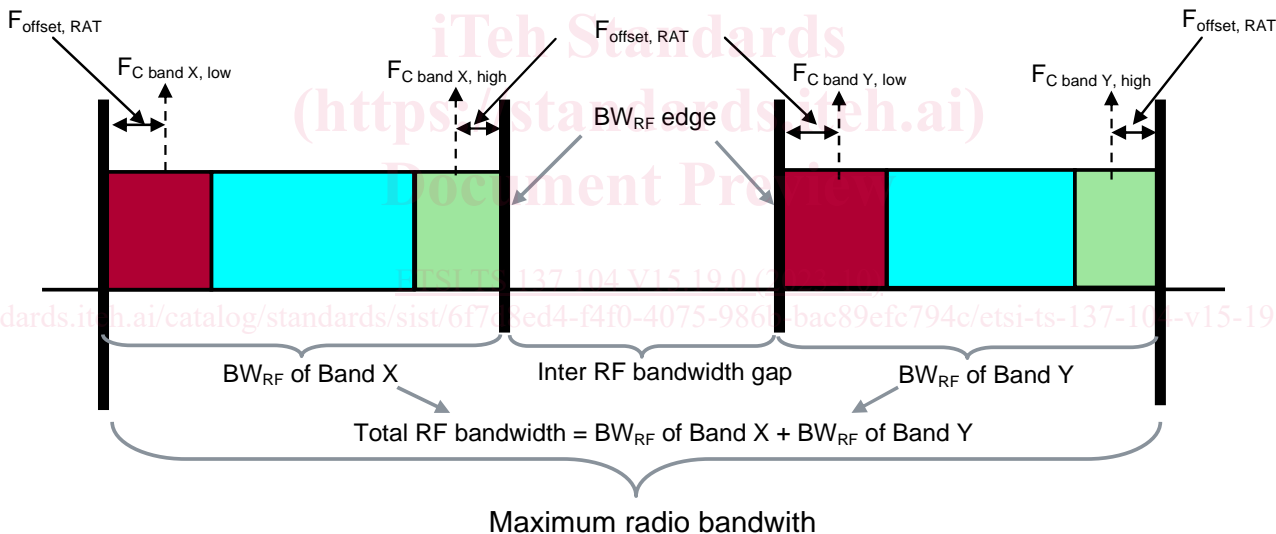


Figure 3.2-3: Illustration of Radio Bandwidth related symbols and definitions for Multi-band Multi-standard Radio (Dual-band Base Station)

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
ACS	Adjacent Channel Selectivity
ARFCN	Absolute Radio Frequency Channel Number
AWGN	Additive White Gaussian Noise
BC	Band Category
BER	Bit Error Ratio
BS	Base Station