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Universal Mobile Telecommunications System (UMTS);
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5G;
NR, E-UTRA, UTRA and GSM/EDGE;
Multi-Standard Radio (MSR) Base Station (BS)
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Contents

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"

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 β/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 $BW_{Config} = N_{RB}$ x 180 kHz in the uplink and BW_{Config} = 15 kHz + N_{RB} x 180 kHz in the downlink. Transmission bandwidth configuration (for NR), where $BW_{Config} = N_{RB}$ x SCS x 12.
BW_{RF}	Base Station RF Bandwidth, where $BW_{RF} = F_{BW\ RF,high} – F_{BW\ RF,low}$
$BW_{RF,max}$	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 *operating band* unwanted emissions mask from the downlink *operating band* edge
$Δf_{OOB}$	Maximum offset of the out-of-band boundary from the uplink *operating band* edge
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_offset_{max}	The maximum value of f_offset used for defining the requirement
$F_{block,high}$	Upper sub-block edge, where $F_{block,high} = F_{C,block,high} + F_{offset,\ RAT}$
$F_{block,low}$	Lower sub-block edge, where $F_{block,low} = F_{C,block,low} - F_{offset,\ RAT}$
$F_{BW\ RF,high}$	Upper Base Station RF Bandwidth edge, where $F_{BW\ RF,high} = F_{C,high} + F_{offset,\ RAT}$
$F_{BW\ RF,low}$	Lower Base Station RF Bandwidth edge, where $F_{BW\ RF,low} = F_{C,low} - F_{offset,\ RAT}$
$F_{C\ band,\ high}$	Center frequency of the highest transmitted/received carrier in a band.
$F_{C\ band,\ low}$	Center frequency of the lowest transmitted/received carrier in a band.
$F_{C,block,\ high}$	Centre frequency of the highest transmitted/received carrier in a sub-block.
$F_{C,block,\ low}$	Centre frequency of the lowest transmitted/received carrier in a sub-block.
$F_{C,high}$	Centre frequency of the highest transmitted/received carrier.
$F_{C,low}$	Centre frequency of the lowest transmitted/received carrier.
$F_{offset,\ RAT}$	Frequency offset from the centre frequency of the *highest* transmitted/received carrier to the *upper* Base Station RF Bandwidth edge, sub-block edge or Inter-RF Bandwidth edge, or from the centre frequency of the *lowest* transmitted/received to the *lower* Base Station RF Bandwidth edge, sub-block edge or Inter-RF Bandwidth edge for a specific RAT.
F_{DL_low}	The lowest frequency of the downlink operating band
F_{DL_high}	The highest frequency of the downlink operating band
F_{UL_low}	The lowest frequency of the uplink operating band
F_{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

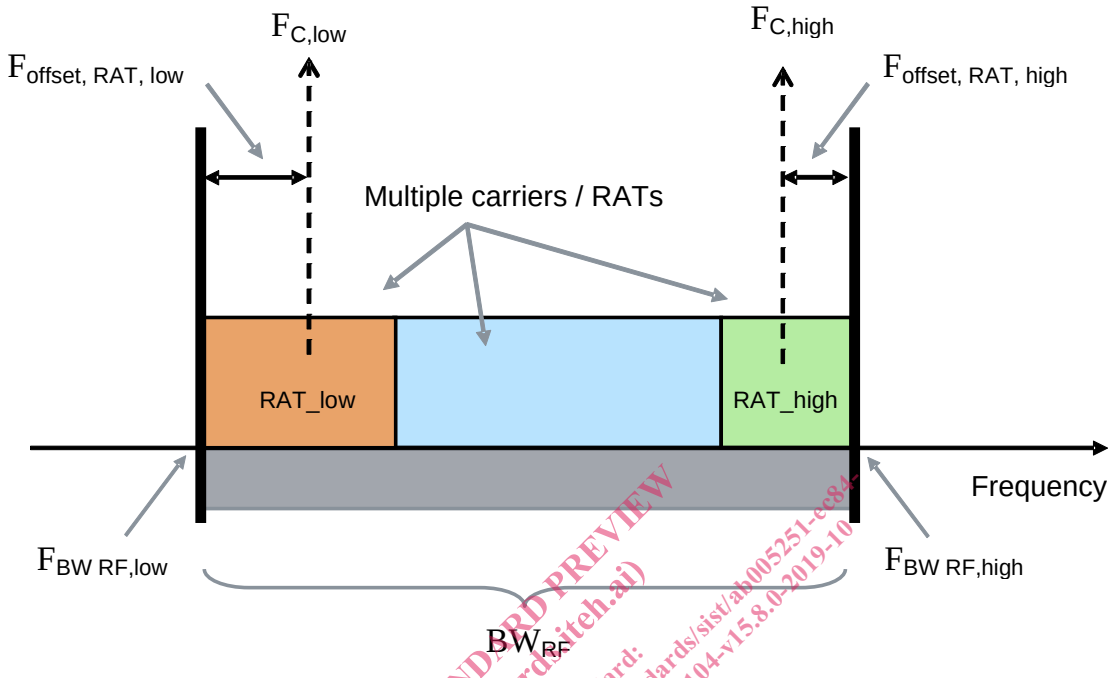

Figure 3.2-1: Illustration of Base Station RF Bandwidth related symbols and definitions for Multi-Standard Radio.

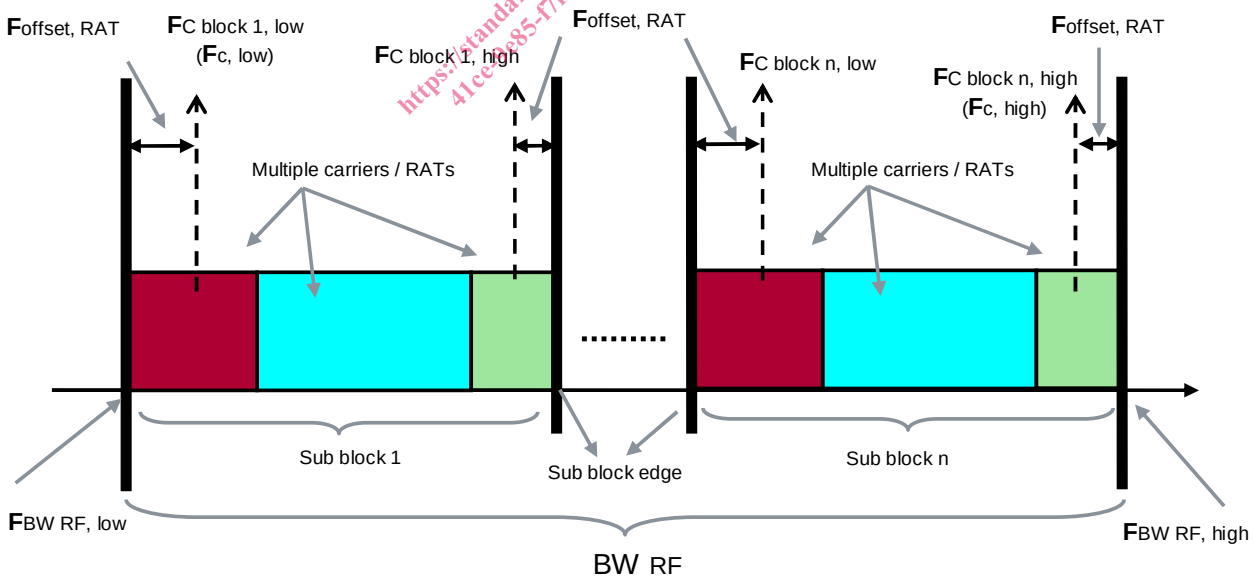

Figure 3.2-2: Illustration of Base Station RF Bandwidth related symbols and definitions for non-contiguous Multi-Standard Radio.