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| **3GPP TSG-RAN4 Meeting #115 *R4-2506882***  **Malta, MT, 19th – 23rd May, 2025**   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | *CR-Form-v12.3* | | | | | | | | | **CHANGE REQUEST** | | | | | | | | |  | | | | | | | | |  | **38.101-1** | **CR** | draft | **rev** | **-** | **Current version:** | 19.0.0 |  | |  | | | | | | | | | *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* | | | | | | | | | |  | | | | | | | | |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **Proposed change affects:** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | | | | | | | | | | | | | ***Title:*** | Draft Big CR for LP-WUS UE RF requirements in Rel-19 | | | | | | | | | | |  |  | | | | | | | | | | | ***Source to WG:*** | vivo | | | | | | | | | | | ***Source to TSG:*** | R4 | | | | | | | | | | |  |  | | | | | | | | | | | ***Work item code:*** | NR\_LPWUS-Core | | | | |  | ***Date:*** | | | 2025-03-25 | |  |  | | | |  | |  | | |  | | ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-19 | |  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | | | | | | | | *Use one of the following releases: Rel-8 (Release 8) Rel-9 (Release 9) Rel-10 (Release 10) Rel-11 (Release 11) … Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19) Rel-20 (Release 20)* | | |  |  | | | | | | | | | | | | ***Reason for change:*** | | This CR provides content to accommodate LP-WUS/WUR related content. | | | | | | | | | |  | |  | | | | | | | | | | ***Summary of change:*** | | The following changes:   * Symbols * Abbreviations * Suffix * new sub-clause 5.2M * new sub-clause 5.3M * Adding diversity, and reference sensitivity * Adding reference measurement channel | | | | | | | | | |  | |  | | | | | | | | | | ***Consequences if not approved:*** | | The spec is not appicable for LP-WUS feature. | | | | | | | | | |  | |  | | | | | | | | | | | ***Clauses affected:*** | | 3.2, 3.3, 4.3, 5.2M, 5.3M, 7.1M, 7.2M, 7.3M, A.3M | | | | | | | | | |  | |  | | | | | | | | | |  | | **Y** | **N** |  | | | |  | | | | ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | | | ***affected:*** | | **X** |  | Test specifications | | | | TS/TR ... CR ... | | | | ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | | |  | |  | | | | | | | | | | ***Other comments:*** | |  | | | | | | | | | |  | |  | | | | | | | | | | | ***This CR's revision history:*** | |  | | | | | | | | | |

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**<<< START OF CHANGES >>>**

## 3.2 Symbols

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

ΔFGlobal Granularity of the global frequency raster

ΔFRaster Band dependent channel raster granularity

ΔfOOB Δ Frequency of Out Of Band emission

ΔFTX-RX Maximum deviation to the Tx-Rx carrier center frequency separation for asymmetric uplink/downlink channel bandwidth operation

∆MPRc Allowed Maximum Power Reduction relaxation for serving cell *c*

ΔPPowerClass Adjustment to maximum output power for a given power class

RB The starting frequency offset between the allocated RB and the measured non-allocated RB

ΔRIB,c Allowed reference sensitivity relaxation due to support for inter-band CA operation, for serving cell *c*

ΔRIBC Allowed relaxation to the power class 3 reference sensitivity level due to support for intra-band contiguous CA operation

ΔRIBNC Allowed relaxation to the power class 3 reference sensitivity level due to support for intra-band non-contiguous CA operation

ΔRIB,4R Reference sensitivity adjustment due to support for 4 antenna ports

ΔRIB,8R Reference sensitivity adjustment due to support for 8 antenna ports

ΔR1RReference sensitivity adjustment due to support for 1 antenna ports

ΔRXR,2R Reference sensitivity adjustment for two antenna ports XR UEs on bands defined in Table 7.3.2-2b

ΔShift Channel raster offset

TC Allowed operating band edge transmission power relaxation

TC,*c*Allowed operating band edge transmission power relaxation for serving cell *c*

ΔTIB,c Allowed maximum configured output power relaxation due to support for inter-band CA operation, inter-band NR-DC operation and due to support for SUL operations, for serving cell *c*

BWChannel Channel bandwidth

BWChannel,block Sub-block bandwidth, expressed in MHz. BWChannel,block= Fedge,block,high- Fedge,block,low

BWChannel\_CA Aggregated channel bandwidth, expressed in MHz

BWChannel,max Maximum channel bandwidth supported among all bands in a release

BWGB max(GBChannel,low, GBChannel,high)

BWDL Channel bandwidth for DL

BWUL Channel bandwidth for UL

BWinterferer Bandwidth of the interferer

Ceil(x) Rounding upwards; ceil(x) is the smallest integer such that ceil(x) ≥ x

Floor(x) Rounding downwards; floor(x) is the greatest integer such that floor(x) ≤ x

FC Center frequency of a carrier for a numerology defined by the *RF reference frequency* on the channel raster mapped to the carrier according to sub-clause 5.4.2.2FC,block, high Fc of the highest transmitted/received carrier in a *sub-block*

FC,block, low Fc of the lowest transmitted/received carrier in a *sub-block*

FC,low The Fc of the lowest carrier, expressed in MHz

FC,high The Fc of the highest carrier, expressed in MHz

FDL\_low The lowest frequency of the downlink *operating band*

FDL\_high The highest frequency of the downlink *operating band*

FUL\_low The lowest frequency of the uplink *operating band*

FUL\_high The highest frequency of the uplink *operating band*

Fedge,block,low The lower *sub-block* edge, where Fedge,block,low = FC,block,low - Foffset, low.

Fedge,block,high The upper *sub-block* edge, where Fedge,block,high = FC,block,high + Foffset, high.

Fedge , low The *lower edge* of *aggregated channel bandwidth*, expressed in MHz. Fedge,low = FC,low - Foffset,low.

Fedge, high The *higher edge* of *aggregated channel bandwidth*, expressed in MHz. Fedge,high = FC,high + Foffset,high.

FInterferer (offset) Frequency offset of the interferer (between the center frequency of the interferer and the carrier frequency of the carrier measured). For intra-band contiguous CA, the FInterferer (offset) is the frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer

FInterferer Frequency of the interferer

FIoffset Frequency offset of the interferer (between the center frequency of the interferer and the closest edge of the carrier measured)

Foffset Frequency offset from FC\_high to the *higher edge* or FC\_low to the *lower edge.*

Foffset,high Frequency offset from FC,high to the upper *UE RF Bandwidth edge*, or from FC,block, high to the upper sub-block edge

Foffset,low Frequency offset from FC,low to the lower *UE RF Bandwidth edge*, or from FC,block, low to the lower sub-block edge

FOOB The boundary between the NR out of band emission and spurious emission domains

FREF RF reference frequency

FREF-Offs Offset used for calculating FREF

FREF, shift RF reference frequency for Supplementary Uplink (SUL) bands, the uplink of all FDD bands, and TDD bands

Fuw (offset) The frequency separation of the center frequency of the carrier closest to the interferer and the center frequency of the interferer

Gn100post connector Declared value of the post chipset unit antenna connector gain for band n100, used for conversion of the radiated requirement into a conducted requirement (see principles described in annex M)

Gn101post connector Declared value of the post chipset unit antenna connector gain for band n101, used for conversion of the radiated requirement into a conducted requirement (see principles described in annex M)

GBChannel Minimum guard band defined in clause 5.3.3, expressed in kHz

GBChannel(i) Minimum guard band defined in clause 5.3.3 of carrier *i*

GBChannel,low Minimum guard band defined in clause 5.3.3 for the lowest assigned component carrier in clause 5.3A.3

GBChannel,high Minimum guard band defined in clause 5.3.3 for the highest assigned component carrier in clause 5.3A.3

LCRB Transmission bandwidth which represents the length of a contiguous resource block allocation expressed in units of resources blocks

Max() The largest of given numbers

Min() The smallest of given numbers

 Physical resource block number

NRACLR NR ACLR

NRB Transmission bandwidth configuration, expressed in units of resource blocks

NRB\_agg The number of the aggregated RBs within the fully allocated aggregated channel bandwidth

for carrier 1 to j, where *μ* is defined in TS 38.211 [6]

NRB,c The transmission bandwidth configuration of component carrier c, expressed in units of resource blocks

for carrier j, where *μ* is defined in TS 38.211 [6]

NRB,LP-WUS Number of RBs for LP-WUS

NRB,largest BW The largest transmission bandwidth configuration of the component carriers in the bandwidth combination, expressed in units of resource blocks

NRB,low The transmission bandwidth configurations according to Table 5.3.2-1 for the lowest assigned component carrier in clause 5.3A.1

NRB,high The transmission bandwidth configurations according to Table 5.3.2-1 for the highest assigned component carrier in clause 5.3A.1

NREF NR Absolute Radio Frequency Channel Number (NR-ARFCN)

NREF-Offs Offset used for calculating NREF

PCMAX The configured maximum UE output power

PCMAX, *c* The configured maximum UE output power for serving cell *c*

PCMAX, *f*, *c* The configured maximum UE output power for carrier *f* of serving cell *c* in each slot

PEMAX Maximum allowed UE output power signalled by higher layers

PEMAX, *c* Maximum allowed UE output power signalled by higher layers for serving cell *c*

PInterferer Modulated mean power of the interferer

Plargest BW Power of the largest transmission bandwidth configuration of the component carriers in the bandwidth combination

PPowerClass The nominal UE power (i.e., no tolerance)

Pmax,c,ACMaximum output power defined as the sum of measurement of all antenna connectors

Pmax,c,TABC Maximum carrier output power defined as the sum of measurement of all TAB connectors

Prated,c,AC Rated maximum output power defined as the sum of power over all antenna connectors

Prated,c,TABC Rated maximum output power defined as the sum of power over all TAB connectors

P-MPR*c* Power Management Maximum Power Reduction for serving cell *c*

PRB The transmitted power per allocated RB, measured in dBm

PREFSENS\_SL The REFSENS power for Sidelink

PUMAX The measured configured maximum UE output power

Puw Power of an unwanted DL signal

Pw Power of a wanted DL signal

RBstart The lowest RB index of transmitted resource blocks

RBstart\_CA The lowest RB index of transmitted resource blocks for intra-band contiguous CA

SCSc SCS for the component carrier c, expressed in kHz

SCSlargest BW SCS for the largest transmission bandwidth configuration of the component carriers in the bandwidth combination, expressed in kHz

SCSlow SCS for the lowest assigned component carrier in clause 5.3A.1, expressed in kHz

SCShigh SCS for the highest assigned component carrier in clause 5.3A.1, expressed in kHz

*tp* Transient Period value signalled by the UE

*tpstart* Start position of transient period relative to the symbol boundary

T(PCMAX, *f*, *c*) Tolerance for applicable values of PCMAX, *f*, *c* for configured maximum UE output power for carrier *f* of serving cell *c*

TL,c Absolute value of the lower tolerance for the applicable *operating band* as specified in clause 6.2.1

SSREF SS block reference frequency position

UTRAACLR UTRA ACLR

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP 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 3GPP TR 21.905 [1].

ACLR Adjacent Channel Leakage Ratio

ACS Adjacent Channel Selectivity

A-MPR Additional Maximum Power Reduction

ASCS Adjacent Subcarrier selectivity

ATG Air-To-Ground

BS Base Station

BW Bandwidth

BWP Bandwidth Part

CA Carrier Aggregation

CA\_nX-nY Inter-band CA of component carrier(s) in one sub-block within Band nX and component carrier(s) in one sub-block within Band nY where nX and nY are the applicable NR *operating bands*

CC Component Carriers

CG Carrier Group

CP-OFDM Cyclic Prefix-OFDM

CW Continuous Wave

DC Dual Connectivity

DFT-s-OFDM Discrete Fourier Transform-spread-OFDM

DM-RS Demodulation Reference Signal

DTX Discontinuous Transmission

E-UTRA Evolved UTRA

EIRP Equivalent Isotropically Radiated Power

(e)RedCap Redcap or eRedCap

eRedCap enhanced Reduced Capability

EVM Error Vector Magnitude

FAR False Alarm Rate

FR Frequency Range

FRC Fixed Reference Channel

FRMCS Future Railway Mobile Communication System

FWA Fixed Wireless Access

GSCN Global Synchronization Channel Number

HD Half Duplex

IBB In-band Blocking

IDFT Inverse Discrete Fourier Transformation

ITS Intelligent Transportation System

ITU‑R Radiocommunication Sector of the International Telecommunication Union

LP-WUR Low Power-Wake Up Receiver

LP-WUS Low Power-Wake Up Signal

LP-SS Low Power-Synchronization Signal

LR LP-WURMBW Measurement bandwidth

MCG Master Cell Group

MDR Miss-Detection Rate

MOP Maximum Output Power

MPR Allowed maximum power reduction

MR Main Radio

MSD Maximum Sensitivity Degradation

NR New Radio

NR-ARFCN NR Absolute Radio Frequency Channel Number

NS Network Signalling

OCNG OFDMA Channel Noise Generator

OOB Out-of-band

OOK On-Off keyingP-MPR Power Management Maximum Power Reduction

PRB Physical Resource Block

PS Public Safety

PSBCH Physical Sidelink Broadcast CHannel

PSCCH Physical Sidelink Control CHannel

PSFCH Physical Sidelink Feedback CHannel

PSSCH Physical Sidelink Shared CHannel

QAM Quadrature Amplitude Modulation

RE Resource Element

REFSENS Reference Sensitivity

RedCap Reduced Capability

RF Radio Frequency

RMR Railway Mobile Radio

RMS Root Mean Square (value)

RSRP Reference Signal Receiving PowerRx Receiver

Rx Receiver

SC Single Carrier

SCG Secondary Cell Group

SCS Subcarrier spacing

SDL Supplementary Downlink

SEM Spectrum Emission Mask

SL Sidelink

SL-MIMO Sidelink-Multiple Antenna transmission

SL-U Sidelink at unlicensed band

SNR Signal-to-Noise Ratio

SRS Sounding Reference Symbol

SS Synchronization Symbol

S-SSB Sidelink Synchronization Signal Block

SUL Supplementary uplink

TAB Transceiver Array Boundary

TAE Time Alignment Error

TAG Timing Advance Group

Tx Transmitter

TxD Tx Diversity

UAS Uncrewed Aircraft Systems

UAV Uncrewed Aerial Vehicle

UL MIMO Uplink Multiple Antenna transmission

ULFPTx Uplink Full Power Transmission

USS UAS Service Supplier

V2X Vehicle to Everything

XR eXtended Reality

<<< Skip Unchanged Sections >>>

## 4.3 Specification suffix information

Unless stated otherwise, the suffixes shown in Table 4.3-1 are used for indicating at 2nd level clause. For shared spectrum channel access, suffixes A, B, and D are used for indicating at 3rd level clause. For V2X, suffixes A and F are used for indicating at 3rd level clause.

Table 4.3-1: Definition of suffixes

|  |  |
| --- | --- |
| Clause suffix | Variant |
| None | Single Carrier |
| A | Carrier Aggregation (CA) |
| B | Dual-Connectivity (DC) |
| C | Supplementary Uplink (SUL) |
| D | UL MIMO |
| E | V2X |
| F | Shared spectrum channel access |
| G | Tx Diversity (TxD) |
| H | Carrier Aggregation (CA) with UL MIMO |
| I | (e)RedCap |
| J | ATG |
| K | Aerial UE (UAV) |
| L | Carrier Aggregation (CA) with Tx Diversity |
| M | LP-WUR |

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## 5.2M Operating bands for LP-WUR

LP-WUS/WUR is designed to operate in the operating bands defined in Table 5.2-1, excluding bands n46, n47, n96, n102 and SDL bands.

<<< Skip Unchanged Sections >>>

## 5.3M UE channel bandwidth for LP-WUR

### 5.3M.1 General

The LP-WUS carrier bandwidth corresponding to the UE channel bandwidth for LP-WUS/WUR is defined as the sum of resource blocks (RBs) occupied by the LP-WUS signal and the guard RBs separating it from the NR signal. The LP-WUS carrier is embedded within the NR channel and is flexibly positionable, provided alignment with the NR PRB grid is maintained.

A guard RB is referred to as an ASCS guard RB when located between an NR RB and an LP-WUS RB, and as an ACS guard RB when positioned between the NR guardband and an LP-WUS RB.

### 5.3M.2 Maximum transmission bandwidth

The maximum transmission bandwidth NRB\_WUR for LP-WUS within each NR UE channel bandwidth and subcarrier spacing is specified in Table 5.3M.2-1.

Table 5.3M.2-1: Maximum transmission bandwidth configuration NRB\_WUR for WUR

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| SCS (kHz) | 3  MHz | 5  MHz | 10  MHz | 15  MHz | 20  MHz | 25  MHz | 30  MHz | 35  MHz | 40  MHz | 45  MHz | 50  MHz | 60  MHz | 70  MHz | 80  MHz | 90  MHz | 100  MHz |
|  | NRB\_WUR | NRB\_WUR | NRB\_WUR | NRB\_WUR | NRB\_WUR | NRB\_WUR | NRB\_WUR | NRB\_WUR | NRB\_WUR | NRB\_WUR | NRB\_WUR | NRB\_WUR | NRB\_WUR | NRB\_WUR | NRB\_WUR | NRB\_WUR |
| 15 | N/A | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| 30 | N/A | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 | 11 |
| 60 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |

<<< Skip Unchanged Sections >>>

7.1M General for LP-WUR

The minimum requirements are specified assuming only one receiver for the wake-up signal. The criterion for verifying all receiver core RF requirements shall be MDR of the LP-WUS, which shall not exceed 1% with the LP-WUS parameters given in Annex A.3M.

7.2M Diversity characteristics for LP-WUR

There is no diversity gain for the LP-WUR.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* UNCHANGED CLAUSES HAVE BEEN OMITTED \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

7.3M Reference sensitivity for LP-WUR

### 7.3M.1 General

The reference sensitivity power level REFSENS is the minimum mean power applied to the UE antenna port, at which the MDR criterion with the side conditions specified in 7.1M shall be met or exceed.

### 7.3M.2 Reference sensitivity power level for LP-WUR

The REFSENS for the two types of LR shall be as specified in Table 7.3M.2-1a. The requirement shall apply to all bands for which LP-WUS is specified in clause 5.2M and supported by the UE.

Table 7.3M.2-1a: One antenna port reference sensitivity for FDD and TDD bands

| RX parameter | SCS kHz | Channel bandwidth (MHz) |
| --- | --- | --- |
| 3, 5, 7, 10, 15, 20, 25, 30, 35, 40, 45, 50, 60, 70,80, 90, 100 MHz (dBm) |
| REFSENS for UEs supporting [Type1 LR] | 15 | TBD |
| 30 | TBD |
| REFSENS for UEs supporting [Type2 LR] | 15 | TBD |
| 30 | TBD |

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A.3M LP-WUR reference channel

A.3M.1 General

Unless otherwise stated, Table A.3M.1-1 is applicable for all receiver requirements of LP-WUR when LP-WUS is generated with 15 KHz SCS. Table A.3M.1-2 is applicable for all receiver requirements of LP-WUR when LP-WUS is generated with 30 KHz SCS.

**Table A.3M.1-1. Common reference channel parameters for 15 KHz SCS.**

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| MR Channel bandwidth | MHz | All CBW |
| LP-WUS bandwidth | RB | 11 |
| Subcarrier spacing | KHz | 15 |
| RM coding | Bits | 16 |
| CRC |  | No CRC |
| Chip rate |  | M=4 (4 chips in an OFDM symbol) |
| Overlaid OFDM sequence |  | Length 33: generated by 31-length ZC sequence with extension |
| Number of overlaid OFDM sequence per chip to carry information |  | 4 |
| LP-WUS duration for OOK |  | 8 OFDM symbols |
| LP-WUS duration for OFDM |  | 2 OFDM symbols |
| Manchester coding for OOK |  | 1/2 |
| Number of information bits | Bits | 5 |

**Table A.3M.1-2. Common reference channel parameters for 30 KHz SCS.**

|  |  |  |
| --- | --- | --- |
| Parameter | Unit | Value |
| MR Channel bandwidth | MHz | All CBW |
| LP-WUS bandwidth | RB | 11 |
| Subcarrier spacing | KHz | 15 |
| RM coding | Bits | 16 |
| CRC |  | No CRC |
| Chip rate |  | M=4 (4 chips in an OFDM symbol) |
| Overlaid OFDM sequence |  | Length 33: generated by 31-length ZC sequence with extension |
| Number of overlaid OFDM sequence per chip to carry information |  | 4 |
| LP-WUS duration for OOK |  | 8 OFDM symbols |
| LP-WUS duration for OFDM |  | 2 OFDM symbols |
| Manchester coding for OOK |  | 1/2 |
| Number of information bits | Bits | 5 |

**<<< END OF CHANGES >>>**