**3GPP TSG-RAN4 Meeting # *R4-2206635***

 **Electronic Me**e**ting, 21st Feb – 3rd March 2022**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
|  |
|  | **38.101-2** | **CR** |  | **rev** | - | **Current version:** | **17.4.0** |  |
|  |
| *For* [***HELP***](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)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network |  | Core Network |  |

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|  |
| ***Title:***  | CR on RedCap UE FR2-TX and general |
|  |  |
| ***Source to WG:*** | Ericsson, Qualcomm Incorporated |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_redcap-Core |  | ***Date:*** | 2022-3-7 |
|  |  |  |  |  |
| ***Category:*** |  |  | ***Release:*** | Rel-17 |
|  | *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 canbe 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-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
|  |  |
| ***Reason for change:*** | R4-2206548 and R4-2206549: Redcap is introduced in Rel-17 in NR |
|  |  |
| ***Summary of change:*** | R4-2206548: Introduce the new power class for Redcap UE in FR2. CR updated:1. [Same peak EIRP and spherical coverage gain drop assumption as PC3]2. RedCap UE is PC73. Introduce MBR related notesR4-2206549:introduce the REFSENS and EIS for Redcap UE in FR2 |
|  |  |
| ***Consequences if not approved:*** | R4-2206548 and R4-2206549: No RedCap UE specificaion in specifications. |
|  |  |
| ***Clauses affected:*** | 3.3,5.3.5, 6.2.1.0, 6.2.1.7,6.2.2.6, 6.2.3.3.6, 6.2.3.4.6, 6.3.1.2, 6.4.2.2.7, 6.4.2.3.7, 6.6.8, 7.3.2.6, 7.3.4.6 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **N** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **Y** |  |  Test specifications | TS 38.521-2 |
| ***(show related CRs)*** |  | **N** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

## < start of changes >

## 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

AoA Angle of Arrival

BCS Bandwidth Combination Set

BPSK Binary Phase-Shift Keying

BS Base Station

BW Bandwidth

BWP Bandwidth Part

CA Carrier aggregation

CABW Cumulative Aggregated Channel Bandwidth

CA\_nX-nY 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 NR *operating band*

CC Component carrier

CDF Cumulative Distribution Function

CP-OFDM Cyclic Prefix-OFDM

CW Continuous Wave

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

DM-RS Demodulation Reference Signal

DTX Discontinuous Transmission

EIRP Effective Isotropic Radiated Power

EIS Effective Isotropic Sensitivity

EVM Error Vector Magnitude

FR Frequency Range

FWA Fixed Wireless Access

GSCN Global Synchronization Channel Number

IBB In-band Blocking

IBM Independent Beam Management

IDFT Inverse Discrete Fourier Transformation

ITU‑R Radiocommunication Sector of the International Telecommunication Union

MBW Measurement bandwidth defined for the protected band

MPR Allowed maximum power reduction

NR New Radio

NR-ARFCN NR Absolute Radio Frequency Channel Number

OCNG OFDMA Channel Noise Generator

OOB Out-of-band

OTA Over The Air

P-MPR Power Management Maximum Power Reduction

PRB Physical Resource Block

QAM Quadrature Amplitude Modulation

RF Radio Frequency

REFSENS Reference Sensitivity

RedCap Reduced CapabilityRIB Radiated Interface Boundary

RMS Root Mean Square (value)

RSRP Reference Signal Receiving Power

Rx Receiver

SCS Subcarrier spacing

SEM Spectrum Emission Mask

SRS Sounding Reference Symbol

SS Synchronization Symbol

TPC Transimission Power Control

TRP Total Radiated Power

Tx Transmitter

UE User Equipment

UL MIMO Uplink Multiple Antenna transmission

ULFPTx Uplink Full Power Transmission

## << Unchanged part is omitted>>

5.3.5 Channel bandwidth per operating band

The requirements in this specification apply to the combination of channel bandwidths, SCS and operating bands shown in Table 5.3.5-1. The transmission bandwidth configuration in Table 5.3.2-1 shall be supported for each of the specified channel bandwidths. The channel bandwidths are specified for both the Tx and Rx path.

Table 5.3.5-1: Channel bandwidths for each NR band

|  |  |  |
| --- | --- | --- |
| Operating band | SCS (kHz) | UE channel bandwidth (MHz) |
| 50 | 100 | 200 | 4001 |
| n257 | 60 | 50 | 100 | 200 |  |
|  | 120 | 50 | 100 | 200 | 400 |
| n258 | 60 | 50 | 100 | 200 |  |
|  | 120 | 50 | 100 | 200 | 400 |
| n259 | 60 | 50 | 100 | 200 |  |
|  | 120 | 50 | 100 | 200 | 400 |
| n260 | 60 | 50 | 100 | 200 |  |
|  | 120 | 50 | 100 | 200 | 400 |
| n261 | 60 | 50 | 100 | 200 |  |
|  | 120 | 50 | 100 | 200 | 400 |
| n262 | 60 | 50 | 100 | 200 |  |
|  | 120 | 50 | 100 | 200 | 400 |
| NOTE 1: This UE channel bandwidth is optional in this release of the specification.NOTE 2: For RedCap UEs, the maximum channel bandwidth is 100MHz |

## << Unchanged part is omitted>>

#### 6.2.1.0 General

NOTE: Power class 1, 2, 3, and 4 are specified based on the assumption of certain UE types with specific device architectures. The UE types can be found in Table 6.2.1.0-1.

Table 6.2.1.0-1: Assumption of UE Types

|  |  |
| --- | --- |
| UE Power class | UE type |
| 1 | Fixed wireless access (FWA) UE |
| 2 | Vehicular UE |
| 3 | Handheld UE |
| 4 | High power non-handheld UE |
| 5 | Fixed wireless access (FWA) UE |
| 7 | RedCap UE |
| Note: RedCap variants of non-RedCap UEs are not precluded |

Power class 3 is default power class.

## << Unchanged part is omitted>>

#### 6.2.1.7 UE maximum output power for power class 7

The following requirements define the maximum output power radiated by the UE for any transmission bandwidth within the channel bandwidth for non-CA configuration, unless otherwise stated. The period of measurement shall be at least one sub frame (1ms). The minimum output power values for EIRP are found in Table 6.2.1.7-1. The requirement is verified with the test metric of total component of EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 6.2.1.7-1: UE minimum peak EIRP for power class 7

|  |  |
| --- | --- |
| Operating band | Min peak EIRP (dBm) |
| n257 | [16.4] |
| n258 | [16.4] |
| n261 | [16.4] |
| NOTE 1: Minimum peak EIRP is defined as the lower limit without toleranceNOTE 2: Void |

The maximum output power values for TRP and EIRP are found on the Table 6.2.1.7-2. The max allowed EIRP is derived from regulatory requirements [8]. The requirements are verified with the test metrics of TRP (Link=TX beam peak direction, Meas=TRP grid) in beam locked mode and the total component of EIRP (Link=TX beam peak direction, Meas=Link angle.

Table 6.2.1.7-2: UE maximum output power limits for power class 7

|  |  |  |
| --- | --- | --- |
| Operating band | Max TRP (dBm) | Max EIRP (dBm) |
| n257 | 23 | 43 |
| n258 | 23 | 43 |
| n261 | 23 | 43 |

The minimum EIRP at the 50th percentile of the distribution of radiated power measured over the full sphere around the UE is defined as the spherical coverage requirement and is found in Table 6.2.1.7-3 below. The requirement is verified with the test metric of the total component of EIRP (Link=Beam peak search grids, Meas=Link angle).

Table 6.2.1.7-3: UE spherical coverage for power class 7

|  |  |
| --- | --- |
| Operating band | Min EIRP at 50%-tile CDF (dBm) |
| n257 | [5.5] |
| n258 | [5.5] |
| n261 | [5.5] |
| NOTE 1: Minimum EIRP at 50 %-tile CDF is defined as the lower limit without toleranceNOTE 2: The requirements in this table are verified only under normal temperature conditions as defined in Annex E.2.1. |

For power class 7 UEs that support multiple FR2 bands, minimum requirement for peak EIRP and EIRP spherical coverage in Tables 6.2.1.7-1 and 6.2.1.7-3 shall be decreased per band, respectively, by the peak EIRP relaxation parameter MBP,n and EIRP spherical coverage relaxation parameter MBS,n, as defined for power class 3 in Table 6.2.1.3-4.

## << Unchanged part is omitted>>

#### 6.2.2.6 UE maximum output power reduction for power class 7

For power class 7, MPR specified in sub-clause 6.2.2.3 applies.

## << Unchanged part is omitted>>

##### 6.2.3.3.6 A-MPR for NS\_202 for power class 7

For power class 7, A-MPR for NS\_202 specified in clause 6.2.3.3.3 applies.

## << Unchanged part is omitted>>

##### 6.2.3.4.6 A-MPR for NS\_203 for power class 7

For power class 7, AMPR for NS\_203 specified in subclause 6.2.3.4.3 applies.

## << Unchanged part is omitted>>

#### 6.3.1.3 Minimum output power for power class 7

The minimum output power shall not exceed the values specified in Table 6.3.1.3-1 for each operating band supported. The minimum power is verified in beam locked mode with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle).

Table 6.3.1.3-1: Minimum output power for power class 7

|  |  |  |  |
| --- | --- | --- | --- |
| Operating band | Channel bandwidth(MHz) | Minimum output power(dBm) | Measurement bandwidth(MHz) |
| n257, n258, n261 | 50 | -13 | 47.58 |
|  | 100 | -13 | 95.16 |

## << Unchanged part is omitted>>

##### 6.4.2.2.7 Carrier leakage for power class 7

When carrier leakage is contained inside the spectrum occupied by the configured UL CCs and DL CCs, the relative carrier leakage power specified in subclause 6.4.2.2.4 applies.

## << Unchanged part is omitted>>

##### 6.4.2.3.7 In-band emissions for power class 7

The average of the in-band emission specified in subclause 6.4.2.3.4 applies.

## << Unchanged part is omitted>>

### 6.6.8 Beam correspondence for power class 7

#### 6.6.8.1 General

The beam correspondence requirement for power class 7 UEs consists of two components: UE minimum peak EIRP (as defined in Clause 6.2.1.7), and UE spherical coverage (as defined in Clause 6.2.1.7). The beam correspondence requirement is fulfilled if the UE satisfies one of the following conditions, depending on the UE's beam correspondence capability IE *beamCorrespondenceWithoutUL-BeamSweeping*, as defined in TS 38.306 [14]:

-- If *beamCorrespondenceWithoutUL-BeamSweeping* is supported, the UE shall meet the minimum peak EIRP requirement according to Table 6.2.1.7-1 and spherical coverage requirement according to Table 6.2.1.7-3 with its autonomously chosen UL beams and without uplink beam sweeping. Such a UE is considered to have met the beam correspondence tolerance requirement.

- If *beamCorrespondenceWithoutUL-BeamSweeping* and *beamCorrespondenceSSB-based-r16* are supported, the UE shall meet the minimum peak EIRP requirement according to Table 6.2.1.7-1 and spherical coverage requirement according to Table 6.2.1.7-3 using the side conditions for SSB based enhanced beam correspondence requirements as defined in Clause 6.6.8.3.2.

- If *beamCorrespondenceWithoutUL-BeamSweeping* and *beamCorrespondenceCSI-RS-based-r16* are supported, the UE shall meet the minimum peak EIRP requirement according to Table 6.2.1.7-1 and spherical coverage requirement according to Table 6.2.1.7-3 using the side conditions for CSI-RS based enhanced beam correspondence requirements as defined in Clause 6.6.8.3.3.

#### 6.6.8.2 Void

#### 6.6.8.3 Side Conditions

##### 6.6.8.3.1 Side Condition for beam correspondence based on SSB and CSI-RS

The beam correspondence requirements are only applied under the following side conditions:

- The downlink reference signals including both SSB and CSI-RS are provided and Type D QCL shall be maintained between SSB and CSI-RS.

- The reference measurement channel for beam correspondence are fulfilled according to the CSI-RS configuration in Annex A.3.

- For beam correspondence, conditions for L1-RSRP measurements are fulfilled according to Table 6.6.8.3.1-1 and Table 6.6.8.3.1-2.

Table 6.6.8.3.1-1: Conditions for SSB based L1-RSRP measurements for beam correspondence

|  |  |  |  |
| --- | --- | --- | --- |
| Angle of arrival | NR operating bands | Minimum SSB\_RP Note 2 | SSB Ês/Iot |
|  |  | dBm / SCSSSB | dB |
|  |  | SCSSSB = 120 kHz |  |
| All angles **Note 1** | n257 | [-93.4] | ≥6 |
|  | n258 | [-93.4] |  |
|  | n261 | [-93.4] |  |
| NOTE 1: VoidNOTE 2: Values specified at the radiated requirements reference point to give minimum SSB Ês/Iot, with no applied noise. |

Table 6.6.8.3.1-2: Conditions for CSI-RS based L1-RSRP measurements for beam correspondence

|  |  |  |  |
| --- | --- | --- | --- |
| Angle of arrival | NR operating bands | Minimum CSI-RS\_RP Note 2 | CSI-RS Ês/Iot |
|  |  | dBm / SCSCSI-RS | dB |
|  |  | SCSCSI-RS = 120 kHz |  |
| All angles **Note 1** | n257 | [-93.4] | ≥6 |
|  | n258 | [-93.4] |  |
|  | n261 | [-93.4] |  |
| NOTE 1: For UEs that support multiple FR2 bands, the Minimum SSB\_RP values for all angles are increased by MBS,n, the UE multi-band relaxation factor in dB specified in clause 6.2.1.NOTE 2: Values specified at the radiated requirements reference point to give minimum CSI-RS Ês/Iot, with no applied noise. |

##### 6.6.8.3.2 Side Condition for SSB based enhanced Beam Correspondence requirements

The beam correspondence requirements for beam correspondence based on SSB are only applied under the following side conditions:

- The downlink reference signal SSB is provided and CSI-RS is not provided.

- For beam correspondence, conditions for L1-RSRP measurements are fulfilled according to Table 6.6.8.3.1-1.

##### 6.6.8.3.3 Side Condition for CSI-RS based enhanced Beam Correspondence requirements

The beam correspondence requirements for beam correspondence based on CSI-RS are only applied under the following side conditions:

- The downlink reference signals including both SSB and CSI-RS are provided.

- The reference measurement channel for beam correspondence are fulfilled according to the CSI-RS configuration in Annex A.3.

- For beam correspondence, conditions for L1-RSRP measurements are fulfilled according to Table 6.6.8.3.1-2 and SSB signal is provided according to Table 6.6.8.3.3-1.

Table 6.6.8.3.3-1: SSB signal conditions for CSI-RS based beam correspondence requirements

|  |  |  |  |
| --- | --- | --- | --- |
| Angle of arrival | NR operating bands | Minimum SSB\_RP Note 2 | SSB Ês/Iot |
|  |  | dBm / SCSSSB | dB |
|  |  | SCSSSB = 120 kHz |  |
| All angles **Note 1** | n257 | [-98.4] | ≥1 |
|  | n258 | [-98.4] |  |
|  | n261 | [-98.4] |  |
| NOTE 1: For UEs that support multiple FR2 bands, the Minimum SSB\_RP values for all angles are increased by MBS,n, the UE multi-band relaxation factor in dB specified in clause 6.2.1.NOTE 2: Values specified at the radiated requirements reference point to give minimum SSB Ês/Iot, with no applied noise. |

#### 6.6.8.4 Applicability

For UEs supporting more than one type of beam correspondence, the following applicability rules apply:

- If a UE meets enhanced beam correspondence requirements either based on SSB or based on CSI-RS, it is considered to have met the beam correspondence requirements based on SSB and CSI-RS.

- For a UE supporting either SSB based or CSI-RS based enhanced beam correspondence, the UE shall meet the supported enhanced beam correspondence requirements.

- For a UE supporting both SSB based and CSI-RS based enhanced beam correspondence, the UE shall meet both SSB based and CSI-RS based enhanced beam correspondence requirements and the following applicability rules for verifying the requirements apply:

- The enhanced beam correspondence requirements shall be verified with the SSB based enhanced beam correspondence side conditions in clause 6.6.8.3.2. If UE meets the SSB based enhanced beam correspondence requirements using the side conditions in clause 6.6.8.3.2 and meets the minimum peak EIRP requirement as defined in clause 6.2.1.7 using the CSI-RS based side conditions in clause 6.6.8.3.3, where the link direction is determined in the SSB based enhanced beam correspondence test, the UE is considered to have met both the SSB based and CSI-RS based enhanced beam correspondence requirements.

- Otherwise, if UE does not meet the minimum peak EIRP requirement as defined in clasue 6.2.1.7 using the CSI-RS based side conditions in clause 6.6.8.3.3, the enhanced beam correspondence requirements shall be further verified for the UE with the CSI-RS based enhanced beam correspondence side conditions in clause 6.6.8.3.3.

## << Unchanged part is omitted>>

#### 7.3.2.7 Reference sensitivity power level for power class 7

The throughput shall be ≥ 95 % of the maximum throughput of the reference measurement channels as specified in Annexes A.2.3.2 and A.3.3.2 (with one sided dynamic OCNG Pattern OP.1 TDD for the DL-signal as described in Annex A.5.2.1) with peak reference sensitivity specified in Table 7.3.2.7-1. The requirement is verified with the test metric of EIS (Link=RX beam peak direction, Meas=Link Angle).

Table 7.3.2.7-1: Reference sensitivity

|  |  |
| --- | --- |
| Operating band | REFSENS (dBm) / Channel bandwidth |
|  | 50 MHz | 100 MHz |
| n257 | [-85.3] | [-82.3] |
| n258 | [-85.3] | [-82.3] |
| n261 | [-85.3] | [-82.3] |
| NOTE 1: The transmitter shall be set to PUMAX as defined in clause 6.2.4 |

The REFSENS requirement shall be met for an uplink transmission using QPSK DFT-s-OFDM waveforms and for uplink transmission bandwidth of 50MHz and 100MHz specified in Table 7.3.2.1-2.

Unless given by Table 7.3.2.1-3, the minimum requirements for reference sensitivity shall be verified with the network signalling value NS\_200 (Table 6.2.3-1) configured.

## << Unchanged part is omitted>>

#### 7.3.4.7 EIS spherical coverage for power class 7

The reference measurement channels and throughput criterion shall be as specified in clause 7.3.2.7.

The maximum EIS at the 50th percentile of the CCDF of EIS measured over the full sphere around the UE is defined as the spherical coverage requirement and is found in Table 7.3.4.7-1 below. The requirement is verified with the test metric of EIS (Link=Spherical coverage grid, Meas=Link angle).

Table 7.3.4.7-1: EIS spherical coverage for power class 7

|  |  |
| --- | --- |
| **Operating band** | **EIS at 50th %-tile CCDF (dBm) / Channel bandwidth** |
|  | **50 MHz** | **100 MHz** |
| n257 | [-74.4] | [-71.4] |
| n258 | [-74.4] | [-71.4] |
| n261 | [-74.4] | [-71.4] |
| NOTE 1: The transmitter shall be set to PUMAX as defined in clause 6.2.4NOTE 2: The EIS spherical coverage requirements are verified only under normal thermal conditions as defined in Annex E.2.1. |

The requirement shall be met for an uplink transmission using QPSK DFT-s-OFDM waveforms and for uplink transmission bandwidth of 50MHz and 100MHz specified in Table 7.3.2.1-2.

Unless given by Table 7.3.2.1-3, the minimum requirements for reference sensitivity shall be verified with the network signalling value NS\_200 (Table 6.2.3-1) configured.

## < end of changes >