**3GPP TSG-RAN4 Meeting #98-e *R4-2103400***

**Online, , 25th Jan 2021 - 5th Feb 2021**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.101-1** | **CR** | **0588** | **rev** | **1** | **Current version:** | **16.6.0** |  |
|  | | | | | | | | |
| *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:*** | PC1 and PC3 Updates for Band n14 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | AT&T | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_n14-Core | | | | |  | ***Date:*** | | | 2021-02-25 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***Release:*** | | | Rel-16 |
|  | *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-15 (Release 15) Rel-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | 1) NR Band n14 specifies PC1 operation and the associated maximum output power requirements. However, some of the PC1 requirements associated with NR Band n14 have not been included in other affected clauses; 6.2.2 UE maximum output power reduction and 6.5.2.4.1 NR ACLR.  2) The PC3 maximum output power requirement for NR Band n14 should not include the deltaTC relaxation. From R4-091742, the feedback from duplex filter vendors indicated that the relative duplex gap should be used as a figure of merit when defining deltaTC. All bands that have a relative duplex gap < 1.75% should have deltaTC relaxation. However, NR Band n14 has a relative duplex gap of 2.5%. Therefore, the PC3 maximum output power requirement for NR Band n14 should not include the deltaTC relaxation.  3) The indication of when UTRAACLR is not applicable for certain NR operating bands is not included in the specification. Similar statements exist in the E-UTRA specification and should be leveraged.  4) The applicability of UE power class 1 requirements for NR Band n14 should be clarified in the core specification. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1) Updated the associated PC1 requirements based on leveraging the principles used for E-UTRA PC1 for Band 14.  2) Updated the PC3 maximum output power requirement for NR Band n14 to remove the deltaTC relaxation note.  3) Added statements concerning when UTRAACLR is not applicable for certain NR operating bands based on deployment scenarios and leveraging the approach utilized in the E-UTRA specification.  4) Added a statement in Note 6 in clause 6.2.1 to indicate that the UE power class 1 requirements for NR Band n14 are applicable for public safety scenario only. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | 1) The remaining PC1 requirements would not be specified for Band n14.  2) The PC3 maximum output power requirement for NR Band 14 would remain incorrect in the specification.  3) The specification would not be clear as to when UTRAACLR is not applicable for certain NR operating bands.  4) The applicability of UE power class 1 requirements for NR Band n14 may be unclear. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 6.2.1, 6.2.2, 6.5.2.4.1, and 6.5.2.4.2  **Isolated impact analysis:**  Updates PC1 and PC3 requirements for Band n14. Includes updates to identify when UTRAACLR is not applicable for certain NR operating bands.  . | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS/TR 38.521-1 CR ... | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

<< Unchanged content omitted >>

## 6.2 Transmitter power

### 6.2.1 UE maximum output power

The following UE Power Classes define the maximum output power for any transmission bandwidth within the channel bandwidth of NR carrier unless otherwise stated. The period of measurement shall be at least one sub frame (1ms).

Table 6.2.1-1: UE Power Class

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR  band | Class 1 (dBm) | Tolerance (dB) | Class 1.5 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) |
| n1 |  |  |  |  |  |  | 23 | ±2 |
| n2 |  |  |  |  |  |  | 23 | ±23 |
| n3 |  |  |  |  |  |  | 23 | ±23 |
| n5 |  |  |  |  |  |  | 23 | ±2 |
| n7 |  |  |  |  |  |  | 23 | ±23 |
| n8 |  |  |  |  |  |  | 23 | ±23 |
| n12 |  |  |  |  |  |  | 23 | ±23 |
| n14 | 316 | +2/-3 |  |  |  |  | 23 | ±2 |
| n18 |  |  |  |  |  |  | 23 | ±2 |
| n20 |  |  |  |  |  |  | 23 | ±23 |
| n25 |  |  |  |  |  |  | 23 | ±23 |
| n26 |  |  |  |  |  |  | 23 | ±23 |
| n28 |  |  |  |  |  |  | 23 | +2/-2.5 |
| n30 |  |  |  |  |  |  | 23 | ±2 |
| n34 |  |  |  |  |  |  | 23 | ±2 |
| n38 |  |  |  |  |  |  | 23 | ±2 |
| n39 |  |  |  |  |  |  | 23 | ±2 |
| n40 |  |  |  |  | 26 | +2/-33 | 23 | ±2 |
| n41 |  |  | 295 | \_2/-33 | 26 | +2/-33 | 23 | ±23 |
| n47 |  |  |  |  |  |  | 23 | ±2 |
| n48 |  |  |  |  |  |  | 23 | +2/-3 |
| n50 |  |  |  |  |  |  | 23 | ±2 |
| n51 |  |  |  |  |  |  | 23 | ±2 |
| n53 |  |  |  |  |  |  | 23 | ±2 |
| n65 |  |  |  |  |  |  | 23 | ±2 |
| n66 |  |  |  |  |  |  | 23 | ±2 |
| n70 |  |  |  |  |  |  | 23 | ±2 |
| n71 |  |  |  |  |  |  | 23 | +2/-2.5 |
| n74 |  |  |  |  |  |  | 23 | ±2 |
| n77 |  |  |  |  | 26 | +2/-3 | 23 | +2/-3 |
| n78 |  |  |  |  | 26 | +2/-3 | 23 | +2/-3 |
| n79 |  |  |  |  | 26 | +2/-3 | 23 | +2/-3 |
| n80 |  |  |  |  |  |  | 23 | ±2 |
| n81 |  |  |  |  |  |  | 23 | ±2 |
| n82 |  |  |  |  |  |  | 23 | ±2 |
| n83 |  |  |  |  |  |  | 23 | ±2/-2.5 |
| n84 |  |  |  |  |  |  | 23 | ±2 |
| n86 |  |  |  |  |  |  | 23 | ±2 |
| n89 |  |  |  |  |  |  | 23 | ±2 |
| n91 |  |  |  |  |  |  | 23 | ±23, 4 |
| n92 |  |  |  |  |  |  | 23 | ±23, 4 |
| n93 |  |  |  |  |  |  | 23 | ±23, 4 |
| n94 |  |  |  |  |  |  | 23 | ±23, 4 |
| n95 |  |  |  |  |  |  | 23 | ±2 |
| NOTE 1: PPowerClass is the maximum UE power specified without taking into account the tolerance  NOTE 2: Powerclass 3 is default power class unless otherwise stated  NOTE 3: Refers to the transmission bandwidths confined within FUL\_low and FUL\_low + 4 MHz or FUL\_high – 4 MHz and FUL\_high, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dB.  NOTE 4: The maximum output power requirement is relaxed by reducing the lower tolerance limit by 0.3 dB  NOTE 5: Achieved via dual Tx  NOTE 6: Generally, PC1 UE for Band n14 is not targeted for smartphone form factor. The UE power class 1 requirements for Band n14 are applicable for public safety scenario only. | | | | | | | | |

If a UE supports a different power class than the default UE power class for the band and the supported power class enables the higher maximum output power than that of the default power class:

- if the field of UE capability *maxUplinkDutyCycle-PC2-FR1* is absent and the percentage of uplink symbols transmitted in a certain evaluation period is larger than 50% (The exact evaluation period is no less than one radio frame); or

- if the field of UE capability *maxUplinkDutyCycle-PC2-FR1* is not absent and the percentage of uplink symbols transmitted in a certain evaluation period is larger than *maxUplinkDutyCycle-PC2-FR1* as defined in TS 38.331 (The exact evaluation period is no less than one radio frame); or

- if the IE P-Max as defined in TS 38.331 [7] is provided and set to the maximum output power of the default power class or lower;

- shall apply all requirements for the default power class to the supported power class and set the configured transmitted power as specified in clause 6.2.4;

- else if the UE does not support a power class with higher maximum output power than PC2; or

- if the field of UE capability maxUplinkDutyCycle is absent and the percentage of uplink symbols transmitted in a certain evaluation period is larger than 25% (The exact evaluation period is no less than one radio frame); or

- if the field of UE capability maxUplinkDutyCycle is not absent and the percentage of uplink symbols transmitted in a certain evaluation period is larger than maxUplinkDutyCycle/2 (The exact evaluation period is no less than one radio frame); or  
if the IE P-Max as defined in TS 38.331 [7] is provided and set to the maximum output power of the power class 2 or lower;  
shall apply all requirements for power class 2 to the supported power class and set the configured transmitted power as specified in clause 6.2.4;

- else shall apply all requirements for the supported power class and set the configured transmitted power as specified in clause 6.2.4.

### 6.2.2 UE maximum output power reduction

UE is allowed to reduce the maximum output power due to higher order modulations and transmit bandwidth configurations. For UE power class 1.5, 2 and 3 and UE power class 1 in Band n14, the allowed maximum power reduction (MPR) is defined in Table 6.2.2-4, Table 6.2.2-2, Table 6.2.2-1 and Table 6.2.2-5, respectively for channel bandwidths that meets both following criteria:

Channel bandwidth ≤ 100 MHz.

Relative channel bandwidth ≤ 4 % for TDD bands and ≤ 3 % for FDD bands. Unless otherwise stated, the ∆MPR is set to zero.

If the relative channel bandwidth is larger than 4% for TDD bands or 3% for FDD bands, the ∆MPR is defined in Table 6.2.2-3.

Where relative channel bandwidth = 2\*BWChannel / (FUL\_low + FUL\_high)

The allowed MPR for SRS, PUCCH formats 0, 1, 3 and 4, and PRACH shall be as specified for QPSK modulated DFT-s-OFDM of equivalent RB allocation. The allowed MPR for PUCCH format 2 shall be as specified for QPSK modulated CP-OFDM of equivalent RB allocation.

Table 6.2.2-1 Maximum power reduction (MPR) for power class 3

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Modulation | | MPR (dB) | | |
|  | | Edge RB allocations | Outer RB allocations | Inner RB allocations |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 3.51 | ≤ 1.21 | ≤ 0.21 |
|  |  | ≤ 0.52 | ≤ 0.52 | 02 |
|  | Pi/2 BPSK w Pi/2 BPSK DMRS | ≤ 0.52 | ≤ 02 | 02 |
|  | QPSK | ≤ 1 | | 0 |
|  | 16 QAM | ≤ 2 | | ≤ 1 |
|  | 64 QAM | ≤ 2.5 | | |
|  | 256 QAM | ≤ 4.5 | | |
| CP-OFDM | QPSK | ≤ 3 | | ≤ 1.5 |
|  | 16 QAM | ≤ 3 | | ≤ 2 |
|  | 64 QAM | ≤ 3.5 | | |
|  | 256 QAM | ≤ 6.5 | | |
| NOTE 1: Applicable for UE operating in TDD mode with Pi/2 BPSK modulation and UE indicates support for UE capability *powerBoosting-pi2BPSK* and if the IE *powerBoostPi2BPSK* is set to 1 and 40 % or less slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79. The reference power of 0 dB MPR is 26 dBm.  NOTE 2: Applicable for UE operating in FDD mode, or in TDD mode in bands other than n40, n41, n77, n78 and n79 with Pi/2 BPSK modulation and if the IE *powerBoostPi2BPSK* is set to 0 and if more than 40 % of slots in radio frame are used for UL transmission for bands n40, n41, n77, n78 and n79. | | | | |

Table 6.2.2-2 Maximum power reduction (MPR) for power class 2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Modulation | | MPR (dB) | | |
|  | | Edge RB allocations | Outer RB allocations | Inner RB allocations |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 3.5 | ≤ 0.5 | 0 |
|  | QPSK | ≤ 3.5 | ≤ 1 | 0 |
|  | 16 QAM | ≤ 3.5 | ≤ 2 | ≤ 1 |
|  | 64 QAM | ≤ 3.5 | ≤ 2.5 | |
|  | 256 QAM | ≤ 4.5 | | |
| CP-OFDM | QPSK | ≤ 3.5 | ≤ 3 | ≤ 1.5 |
|  | 16 QAM | ≤ 3.5 | ≤ 3 | ≤ 2 |
|  | 64 QAM | ≤ 3.5 | | |
|  | 256 QAM | ≤ 6.5 | | |

Table 6.2.2-3: ∆MPR

|  |  |  |  |
| --- | --- | --- | --- |
| NR Band | Power class | Channel bandwidth | ∆MPR (dB) |
| n28 | Power class 3 | 30 MHz | 0.5 |

Table 6.2.2-4 Maximum power reduction (MPR) for power class 1.5 with dual Tx

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Modulation | | MPR (dB) | | |
|  | | Edge RB allocations | Outer RB allocations | Inner RB allocations |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 6.5 | ≤ 3.5 | ≤ 1.5 |
|  | QPSK | ≤ 6.5 | ≤ 4 | ≤ 1.5 |
|  | 16 QAM | ≤ 6.5 | ≤ 5 | ≤ 2.5 |
|  | 64 QAM | ≤ 6.5 | ≤ 5.5 | ≤ 4 |
|  | 256 QAM | ≤ 7.5 | ≤ 7.5 | ≤ 7.5 |
| CP-OFDM | QPSK | ≤ 6.5 | ≤ 6 | ≤ 3 |
|  | 16 QAM | ≤ 6.5 | ≤ 6 | ≤ 3.5 |
|  | 64 QAM | ≤ 6.5 | ≤ 6.5 | ≤ 5 |
|  | 256 QAM | ≤ 9.5 | ≤ 9.5 | ≤ 9.5 |

Table 6.2.2-5 Maximum power reduction (MPR) for power class 1 for Band n14

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Modulation | | MPR (dB) | | |
|  | | Edge RB allocations | Outer RB allocations | Inner RB allocations |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 0.5 | ≤ 0.5 | 0 |
|  | Pi/2 BPSK w Pi/2 BPSK DMRS | ≤ 0.5 | ≤ 0 | 0 |
|  | QPSK | ≤ 1 | | 0 |
|  | 16 QAM | ≤ 2 | | ≤ 1 |
|  | 64 QAM | ≤ 2.5 | | |
|  | 256 QAM | ≤ 4.5 | | |
| CP-OFDM | QPSK | ≤ 3 | | ≤ 1.5 |
|  | 16 QAM | ≤ 3 | | ≤ 2 |
|  | 64 QAM | ≤ 3.5 | | |
|  | 256 QAM | ≤ 6.5 | | |

Where the following parameters are defined to specify valid RB allocation ranges for Outer and Inner RB allocations:

NRB is the maximum number of RBs for a given Channel bandwidth and sub-carrier spacing defined in Table 5.3.2-1. RBStart,Low = max(1, floor(LCRB/2))

where max() indicates the largest value of all arguments and floor(x) is the greatest integer less than or equal to x.

RBStart,High = NRB – RBStart,Low – LCRB

The RB allocation is an Inner RB allocation if the following conditions are met

RBStart,Low ≤ RBStart ≤ RBStart,High,and

LCRB ≤ ceil(NRB/2)

where ceil(x) is the smallest integer greater than or equal to x.

An Edge RB allocation is the one for which the RB(s) is (are) allocated at the lowermost or uppermost edge of the channel with LCRB ≤ 2 RBs.

The RB allocation is an Outer RB allocation for all other allocations which are not an Inner RB allocation or Edge RB allocation.

If CP-OFDM allocation satisfies following conditions, it is considered as almost contiguous allocation

NRB\_gap / (NRB\_alloc + NRB\_gap ) ≤ 0.25

and NRB\_alloc + NRB\_gap is larger than 106, 51 or 24 RBs for 15 kHz, 30 kHz or 60 kHz respectively where NRB\_gap is the total number of unallocated RBs between allocated RBs and NRB\_alloc is the total number of allocated RBs. The size and location of allocated and unallocated RBs are restricted by RBG parameters specified in clause 6.1.2.2 of TS 38.214 [10]. For these almost contiguous signals in power class 2 and 3, the allowed maximum power reduction defined in Table 6.2.2-1 is increased by

CEIL{ 10 log10(1 + NRB\_gap / NRB\_alloc), 0.5 } dB,

where CEIL{x,0.5} means x rounding upwards to closest 0.5dB. The parameters of RBStart,Low and RBStart,High to specify valid RB allocation ranges for Outer and Inner RB allocations are defined as following:

RBStart,Low = max(1, floor((NRB\_alloc + NRB\_gap)/2))

RBStart,High = NRB – RBStart,Low – NRB\_alloc –NRB\_gap

For the UE maximum output power modified by MPR, the power limits specified in clause 6.2.4 apply.

<< Unchanged content omitted >>

#### 6.5.2.4 Adjacent channel leakage ratio

Adjacent Channel Leakage power Ratio (ACLR) is the ratio of the filtered mean power centred on the assigned channel frequency to the filtered mean power centred on an adjacent channel frequency.

To improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

##### 6.5.2.4.1 NR ACLR

NR Adjacent Channel Leakage power Ratio (NRACLR) is the ratio of the filtered mean power centred on the assigned NR channel frequency to the filtered mean power centred on an adjacent NR channel frequency at nominal channel spacing.

The assigned NR channel power and adjacent NR channel power are measured with rectangular filters with measurement bandwidths specified in Table 6.5.2.4.1-1.

If the measured adjacent channel power is greater than –50 dBm then the NRACLR shall be higher than the value specified in Table 6.5.2.4.1-2.

Table 6.5.2.4.1-1: NR ACLR measurement bandwidth

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR channel bandwidth / NR ACLR measurement bandwidth | | | | | | | | | | | | | |
|  | 5 MHz | 10 MHz | 15 MHz | 20 MHz | 25 MHz | 30 MHz | 40 MHz | 50 MHz | 60 MHz | 70 MHz | 80 MHz | 90 MHz | 100 MHz |
| NR ACLR measurement bandwidth  (MHz) | 4.515 | 9.375 | 14.235 | 19.095 | 23.955 | 28.815 | 38.895 | 48.615 | 58.35 | 68.07 | 78.15 | 88.23 | 98.31 |

Table 6.5.2.4.1-2: NR ACLR requirement

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Power class 11 | Power class 1.5 | Power class 2 | Power class 3 |
| NR ACLR | 37 dB1 | 31 dB | 31 dB | 30 dB |
| NOTE 1: Applicable for power class 1 UE operating in Band n14. | | | | |



##### 6.5.2.4.2 UTRA ACLR

UTRA adjacent channel leakage power ratio (UTRAACLR) is the ratio of the filtered mean power centred on the assigned NR channel frequency to the filtered mean power centred on an adjacent(s) UTRA channel frequency.

UTRAACLR is specified for the first adjacent UTRA channel (UTRAACLR1) which center frequency is ± 2.5 MHz from NR channel edge and for the 2nd adjacent UTRA channel (UTRAACLR2) which center frequency is ± 7.5 MHz from NR channel edge.

The UTRA channel power is measured with a RRC filter with roll-off factor = 0.22 and bandwidth of 3.84 MHz. The assigned NR channel power is measured with a rectangular filter with measurement bandwidth specified in Table 6.5.2.4.1-1.

If the measured adjacent channel power is greater than – 50 dBm then the UTRAACLR1 and UTRAACLR2 shall be higher than the value specified in Table 6.5.2.4.2-1.

UTRAACLR is not applicable to the power class 3 UE operating in Band n12, n14, n17, and n30.

UTRAACLR is not applicable to the power class 1 UE operating in Band n14.

Table 6.5.2.4.2-1: UTRA ACLR requirement

|  |  |
| --- | --- |
|  | Power class 3 |
| UTRAACLR1 | 33 dB |
| UTRAACLR2 | 36 dB |

UTRA ACLR requirement is applicable when signalled by the network with network signalling value indicated by the field *additionalSpectrumEmission*.

## << End of changes >>