**3GPP TSG-RAN4 Meeting #103-e**

**Electronic Meeting, May 09 – May 20, 2022**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **38.101-2** | **CR** |  | **rev** | **-** | **Current version:** | **17.5.0** |  |
|  | | | | | | | | |
| *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)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network |  |

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| ***Title:*** | Big CR on NR FR2 enhancement Rel-17 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Nokia | | | | | | | | | |
| ***Source to TSG:*** | R4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_RF\_FR2\_req\_enh2 | | | | |  | ***Date:*** | | | 2022-05-24 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***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 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:*** | | Big VR for FR2 combining | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Draft CRs to be merged  R4-2210576 Draft CR on RF related UL gap for FR2 (38.101-2)  R4-2210783 FR2 CA BW classes up to 2400 MHz aggregated BW with mixed channel bandwidths | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Functionality missing | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 5.3A.4, 6.2.4, 6.2.5, 6.2A.4, 6.2A.5 | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | | TS/TR ... CR ... | | |
| ***affected:*** | | **X** |  | Test specifications | | | | TS 38.521-2 | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | | TS/TR ... CR ... | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

*< start of changes >*

### 5.3A.4 UE channel bandwidth per operating band for CA

For intra-band contiguous carrier aggregation, a carrier aggregation configuration is a single operating band supporting a carrier aggregation bandwidth class with associated bandwidth combination sets specified in clause 5.5A.1. For each carrier aggregation configuration, requirements are specified for all aggregated channel bandwidths contained in a bandwidth combination set, UE can indicate support of several bandwidth combination sets per carrier aggregation configuration. The requirements are applicable only when Uplink CCs are configured within the frequency range between lower edge of lowest downlink component carrier and upper edge of highest downlink component carrier.

For intra-band non-contiguous carrier aggregation, a carrier aggregation configuration is a single operating band supporting two or more sub-blocks, each supporting a carrier aggregation bandwidth class. The requirements are applicable only when Uplink CCs in each UL sub-block are configured within the frequency range between lower edge of lowest downlink component carrier and upper edge of highest downlink component carrier of a DL sub-block.

Frequency separation class (Fs) specified in Table 5.3A.4-2 indicates the maximum frequency span between lower edge of lowest component carrier and upper edge of highest component carrier that UE can support per band in downlink or uplink (DL Fs or UL Fs) respectively in non-contiguous intra-band operation within the bidirectional spectrum.

The DL-only frequency spectrum is the width of UE frequency spectrum available to network to configure DL CCs only, and it extends on one-side of the bidirectional spectrum in contiguous manner with no frequency gap between the two. Frequency separation class for DL-only spectrum (Fsd) specified in Table 5.3A.4-3 and is declared per band. The frequency separation class for DL-only spectrum (Fsd) can be equal but not larger than the frequency separation (DL Fs). The combined downlink spectrum (DL Fs + Fsd) cannot exceed 2400 MHz. A UE may configure DL-only spectrum only if the combined downlink spectrum (DL Fs + Fsd) exceeds 1400 MHz. When a UE configures DL-only spectrum, it shall not expect a CC to be configured across the boundary between bidirectional spectrum and DL-only spectrum UE can support respectively.

For inter-band carrier aggregation, a carrier aggregation configuration is a combination of operating bands, each supporting a carrier aggregation bandwidth class.

Table 5.3A.4-1: CA bandwidth classes

|  |  |  |  |
| --- | --- | --- | --- |
| NR CA bandwidth class | Aggregated channel bandwidth | Number of contiguous CC | Fallback group |
| A | BWChannel ≤ 400 MHz | 1 | 1,2,3,4,5 |
| B | 400 MHz < BWChannel\_CA ≤ 800 MHz | 2 | 1 |
| C | 800 MHz < BWChannel\_CA ≤ 1200 MHz | 3 |  |
| D | 200 MHz < BWChannel\_CA ≤ 400 MHz | 2 | 2 |
| E | 400 MHz < BWChannel\_CA ≤ 600 MHz | 3 |  |
| F | 600 MHz < BWChannel\_CA ≤ 800 MHz | 4 |  |
| R | 800 MHz < BWChannel\_CA ≤ 1000 MHz | 5 |  |
| S | 1000 MHz < BWChannel\_CA ≤ 1200 MHz | 6 |  |
| T | 1200 MHz < BWChannel\_CA ≤ 1400 MHz | 7 |  |
| U | 1400 MHz < BWChannel\_CA ≤ 1600 MHz | 8 |  |
| G | 100 MHz < BWChannel\_CA ≤ 200 MHz | 2 | 3 |
| H | 200 MHz < BWChannel\_CA ≤ 300 MHz | 3 |  |
| I | 300 MHz < BWChannel\_CA ≤ 400 MHz | 4 |  |
| J | 400 MHz < BWChannel\_CA ≤ 500 MHz | 5 |  |
| K | 500 MHz < BWChannel\_CA ≤ 600 MHz | 6 |  |
| L | 600 MHz < BWChannel\_CA ≤ 700 MHz | 7 |  |
| M | 700 MHz < BWChannel\_CA ≤ 800 MHz | 8 |  |
| O | 100 MHz ≤ BWChannel\_CA ≤ 200 MHz | 2 | 4 |
| P | 150 MHz ≤ BWChannel\_CA ≤ 300 MHz | 3 |  |
| Q | 200 MHz ≤ BWChannel\_CA ≤ 400 MHz | 4 |  |
| R2 | 200 MHz ≤ BWChannel\_CA ≤ 400 MHz | 2 | 5 |
| R3 | 300 MHz ≤ BWChannel\_CA ≤ 600 MHz | 3 |
| R4 | 400 MHz ≤ BWChannel\_CA ≤ 800 MHz | 4 |
| R5 | 500 MHz ≤ BWChannel\_CA ≤ 1000 MHz | 5 |
| R6 | 600 MHz ≤ BWChannel\_CA ≤ 1200 MHz | 6 |
| R7 | 700 MHz ≤ BWChannel\_CA ≤ 1400 MHz | 7 |
| R8 | 800 MHz ≤ BWChannel\_CA ≤ 1600 MHz | 8 |
| R9 | 900 MHz ≤ BWChannel\_CA ≤ 1800 MHz | 9 |
| R10 | 1000 MHz ≤ BWChannel\_CA ≤ 2000 MHz | 10 |
| R11 | 1100 MHz ≤ BWChannel\_CA ≤ 2200 MHz | 11 |
| R12 | 1200 MHz ≤ BWChannel\_CA ≤ 2400 MHz | 12 |
| NOTE 1: Maximum supported component carrier bandwidths for fallback groups 1, 2, 3, 4 and 5 are 400 MHz, 200 MHz, 100 MHz, 100 MHz and 200 MHz respectively except for CA bandwidth class A. For CA bandwidth classes of fallback group 5, requirements apply for non-interlaced 100 MHz and 200 MHz channel bandwidths (each CA bandwidth class consisting of up to two contiguous sub-blocks each with component carriers of a single channel bandwidth).  NOTE 2: It is mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration within a fallback group. It is not mandatory for a UE to be able to fallback to lower order CA bandwidth class configuration that belong to a different fallback group.  NOTE 3: In this release of the specification, the minimum requirements for intra-band contiguous CA configurations apply for aggregated channel bandwidths up to 1600 MHz (this note is not relevant for UE capability parsing by the network). | | | |

*< No changes >*

### **6.2.4 Configured transmitted power**

The UE can configure its maximum output power. The configured UE maximum output power PCMAX,f,c for carrier f of a serving cell c is defined as that available to the reference point of a given transmitter branch that corresponds to the reference point of the higher-layer filtered RSRP measurement as specified in TS 38.215 [11].

The configured UE maximum output power PCMAX,f,c for carrier *f* of a serving cell *c* shall be set such that the corresponding measured peak EIRP PUMAX,f,c is within the following bounds

PPowerclass + DPIBE – MAX(MAX(MPRf,c, A- MPRf,c,) + ΔMBP,n, P-MPRf,c) – MAX{T(MAX(MPRf,c, A- MPRf,c,)), T(P-MPRf,c)} ≤ PUMAX,f,c ≤ EIRPmax

while the corresponding measured total radiated power PTMAX,f,c is bounded by

PTMAX,f,c ≤ TRPmax

with PPowerclass the UE power class as specified in sub-clause 6.2.1, EIRPmax the applicable maximum EIRP as specified in sub-clause 6.2.1, MPRf,c as specified in sub-clause 6.2.2 , A-MPRf,c as specified in sub-clause 6.2.3, ΔMBP,n the peak EIRP relaxation as specified in clause 6.2.1 and TRPmax the maximum TRP for the UE power class as specified in sub-clause 6.2.1. DPIBE is 1.0 dB if UE declares support for *mpr-PowerBoost-FR2-r16*, UL transmission is QPSK, MPRf,c = 0 and when NS\_200 applies and the network configures the UE to operate with *mpr-PowerBoost-FR2-r16*otherwise DPIBE is 0.0 dB. The requirement is verified in beam peak direction.

*maxUplinkDutyCycle-FR2,* as defined in TS 38.306 [14], is a UE capability to facilitate electromagnetic power density exposure requirements. This UE capability is applicable to all FR2 power classes.

If the field of UE capability *maxUplinkDutyCycle-FR2* is present and the percentage of uplink symbols transmitted within any 1 s evaluation period is larger than *maxUplinkDutyCycle-FR2*, the UE follows the uplink scheduling and can apply P-MPRf,c.

If the field of UE capability *maxUplinkDutyCycle-FR2* is absent, the compliance to electromagnetic power density exposure requirements are ensured by means of scaling down the power density or by other means.

Start of Change 1

P-MPRf,c is the power management maximum output power reduction. The UE shall apply P-MPRf,c for carrier f of serving cell c only for the cases described below. For UE conformance testing P-MPRf,c shall be 0 dB ,  except for the testing of UL gap for Tx power management, where P-MPRf,c may be non-zero dB.

End of Change 1

a) ensuring compliance with applicable electromagnetic power density exposure requirements and addressing unwanted emissions / self desense requirements in case of simultaneous transmissions on multiple RAT(s) for scenarios not in scope of 3GPP RAN specifications;

b) ensuring compliance with applicable electromagnetic power density exposure requirements in case of proximity detection is used to address such requirements that require a lower maximum output power.

NOTE 1: P-MPRf,c was introduced in the PCMAX,f,c equation such that the UE can report to the gNB the available maximum output transmit power. This information can be used by the gNB for scheduling decisions.

NOTE 2: P-MPRf,c and *maxUplinkDutyCycle-FR2* may impact the maximum uplink performance for the selected UL transmission path.

NOTE 3: MPE P-MPR Reporting, as defined in TS 38.306 [14], is an optional UE capability to report P-MPRf,c when the reporting conditions configured by gNB are met. This UE capability is applicable to all FR2 power classes.

The tolerance T(∆P) for applicable values of ∆P (values in dB) is specified in Table 6.2.4-1.

Table 6.2.4-1: PUMAX,f,c tolerance

|  |  |  |
| --- | --- | --- |
| Operating Band | ∆P (dB) | Tolerance T(∆P)  (dB) |
| n257, n258, n259, n260, n261, n262 | DP = 0 | 0 |
|  | 0 < DP ≤ 2 | 1.5 |
|  | 2 < DP ≤ 3 | 2.0 |
|  | 3 < DP ≤ 4 | 3.0 |
|  | 4 < DP ≤ 5 | 4.0 |
|  | 5 < DP ≤ 10 | 5.0 |
|  | 10 < DP ≤ 15 | 7.0 |
|  | 15 < DP ≤ X | 8.0 |
| NOTE: X is the value such that Pumax,f,c lower bound, PPowerclass - DP – T(DP) = minimum output power specified in clause 6.3.1 | | |

Start of Change 2

### **6.2.5 Requirements for UL gap for TX power management**

The difference of the measured peak EIRP PUMAX,f,c\_GAP\_ON when UL gap for TX power management is configured and activated, and the measured peak EIRP PUMAX,f,c\_GAP\_OFF when UL gap is not configured or de-activated, shall meet the following requirement:

PUMAX,f,c\_GAP\_ON - PUMAX,f,c\_GAP\_OFF max((EIRPmeas\_peak – 23) + 10 \* log10(Z/20), 3)dB

where EIRPmeas\_peak  is the measured UE peak EIRP with zero MPR/A-MPR/P-MPR as specified in clause 6.2.1 for the corresponding power class, and Z% is duty cycle of the reference measurement channel. PUMAX,f,c\_GAP\_ONshall be measured outside of the UL gap symbol(s)*.* The period of measurement shall be at least 4s. The requirement is verified with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle) and in the test Z is set to 20 when maxUplinkDutyCycle-FR2 is less than 20 or not reported, and should be larger than maxUplinkDutyCycle-FR2 when maxUplinkDutyCycle-FR2 is equal to or greater than 20. The reference measurement channel is specified in Annex A.2.3.

When UL gap for Tx power management is configured and activated, the reported P-MPRf,c shall be less than 3dB. When UL gap for Tx power management is not configured and activated, UE shall set the P bit in PHR to 1 in the test when PHR is configured.

End of Change 2

### 6.2A.4 Configured transmitted power for CA

A UE configured with carrier aggregation can configure its maximum output power for each uplink activated serving cell *c* and its total configured maximum output power PCMAX. The definition of the configured UE maximum output power PCMAX,*f,c* for each carrier *f* of a serving cell *c* is used for power headroom reporting for carrier *f* of serving cell *c* only and is in accordance with that specified in clause 6.2.4 with parameters MPR, A-MPR and P-MPR replaced with those specified in subclause 6.2A.2, 6.2A.3 and 6.2.4, respectively. The UE maximum configured power PCMAX in a transmission occasion is determined by the UL grants for carriers *f* of all serving cells *c* with non-zero granted power in the respective reference point.

For uplink intra-band contiguous carrier aggregation, MPR is specified in clause 6.2A.2. PCMAX is calculated under the assumption that power spectral density for each RB in each component carrier is same.

The configured UE maximum output power PCMAX shall be set such that the corresponding measured total peak EIRP PUMAX is within the following bounds

PPowerclass – MAX(MAX(MPR, A-MPR) + ΔMBP,n, P-MPR) – MAX{T(MAX(MPR, A-MPR)),T(P-MPR)} ≤ PUMAX ≤ EIRPmax

with PPowerclass the peak EIRP as specified in sub-clause 6.2A.1, EIRPmax the applicable maximum EIRP as specified in sub-clause 6.2A.1, MPR as specified in sub-clause 6.2A.2, A-MPR as specified in sub-clause 6.2A.3, ΔMBP,n the peak EIRP relaxation as specified in clause 6.2.1, P-MPR the power management term for the UE as described in 6.2.4.

The measured configured power PUMAX for carrier aggregation is defined as

where pUMAX,f,c is the linear value of the measured power PUMAX,f,c for carrier *f=f(c)* of serving cell *c*. The measured total radiated power PTMAX for carrier aggregation is defined as

where pTMAX,f,c is the linear value of the measured total radiated power PTMAX,f,c for carrier *f* = *f*(*c*) of serving cell *c*. The total radiated power PTMAX is bounded by

PTMAX ≤ TRPmax

where TRPmax the maximum TRP for the UE power class as specified in sub-clause 6.2A.1.

The tolerance T(ΔP) for applicable values of ΔP (values in dB) is specified in Table 6.2A.4-1.

Table 6.2A.4-1: PUMAX tolerance

|  |  |  |
| --- | --- | --- |
| Operating Band | ∆P (dB) | Tolerance T(∆P)  (dB) |
| n257, n258, n259, n260, n261, n262 | P = 0 | 0 |
|  | 0 < P ≤ 2 | 1.5 |
|  | 2 < P ≤ 3 | 2.0 |
|  | 3 < P ≤ 4 | 3.0 |
|  | 4 < P ≤ 5 | 4.0 |
|  | 5 < P ≤ 10 | 5.0 |
|  | 10 < P ≤ 15 | 7.0 |
|  | 15 < P ≤ X | 8.0 |
| NOTE: X is the value such that Pumax lower bound, PPowerclass - P – T(P) = minimum output power specified in clause 6.3A.1 | | |

Start of Change 3

### **6.2A.5 Requirements for UL gap for TX power management in CA**

The difference of the measured peak EIRP PUMAX\_GAP\_ON for CA when UL gap for TX power management is configured and activated, and the measured peak EIRP PUMAX\_GAP\_OFF when UL gap is not configured or de-activated, shall meet the following requirement:

PUMAX\_GAP\_ON - PUMAX\_GAP\_OFF max((EIRPmeas\_peak – 23) + 10 \* log10(Z/20), 3)dB

where EIRPmeas\_peak  is the measured UE peak EIRP with zero MPR/A-MPR/P-MPR in clause 6.2A.1 for the corresponding power class, and Z% is duty cycle of the reference measurement channel. PUMAX,f,c\_GAP\_ONshall be measured outside of the UL gap symbol(s)*.* The period of measurement shall be at least 4s. The requirement is verified with the test metric of EIRP (Link=TX beam peak direction, Meas=Link angle) and in the test Z is set to 20 when *maxUplinkDutyCycle-FR2* is less than 20 or not reported, and should be larger than *maxUplinkDutyCycle-FR2* when *maxUplinkDutyCycle-FR2* is equal to or greater than 20, assuming all CCs share the same TX beam peak direction. The reference measurement channel is specified in Annex A.2.3.

When UL gap for Tx power management is configured and activated, the reported P-MPRf,c should be less than 3dB. When UL gap for Tx power management is not configured and activated, UE shall set the P bit in PHR to 1 in the test when PHR is configured.

End of Change 3

Start of Change 4

### 6.3.2 Transmit OFF power

The transmit OFF power is defined as the TRP in the channel bandwidth when the transmitter is OFF. The transmitter is considered OFF when the UE is not allowed to transmit on any of its ports.

The transmit OFF power shall not exceed the values specified in Table 6.3.2-1 for each operating band supported. The requirement is verified with the test metric of TRP (Link=TX beam peak direction, Meas=TRP grid).

Table 6.3.2-1: Transmit OFF power

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Operating band | Channel bandwidth / Transmit OFF power (dBm) / measurement bandwidth | | | |
|  | 50 MHz | 100 MHz | 200 MHz | 400 MHz |
| n257, n258, n259, n260, n261, n262 | -35 | -35 | -35 | -35 |
|  | 47.58 MHz | 95.16 MHz | 190.20 MHz | 380.28 MHz |

For UE indicating [IE UL Gap], UE will meet OFF power requirement defined in this clause for the band for which UL transmission is stopped in the activated UL gap.

End of Change 4

Start of Change 5

## A.2.3 Reference measurement channels for TDD

For UL RMCs defined below, TDD slot pattern defined in Table A.2.3-1 will be used for the requirements requiring at least one sub frame (1ms) for the measurement period. For other requirements, TDD slot patterns defined for reference sensitivity tests in Table A.3.3.1-1 will be used.

Table A.2.3-1: Additional reference channels parameters for TDD

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | | Value | |
|  | | SCS 60 kHz (µ=2) | SCS 120 kHz (µ=3) |
| TDD Slot Configuration pattern (Note 1) | | DDDSUUUU | 7DS8U |
| Special Slot Configuration (Note 2) | | S=4D+6G+4U | S=12D+2G |
| *referenceSubcarrierSpacing* | | 60 kHz | 120 kHz |
| UL-DL configuration | *dl-UL-TransmissionPeriodicity* | 2 ms | 2 ms |
|  | *nrofDownlinkSlots* | 3 | 7 |
|  | *nrofDownlinkSymbols* | 4 | 12 |
|  | *nrofUplinkSlot* | 4 | 8 |
|  | *nrofUplinkSymbols* | 4 | 0 |
| Indexes of active UL slots | | mod(slot index, 40) = {36,…,39} | mod(slot index, 80) = {72,…,79} |
| Indexes of active UL slots for UL Gap test | | mod(slot index, 40) = {12,…,15, 36,…,39} | mod(slot index, 80) = {24,…,31 ,72,…,79} |
| Indexes of the UL slots for UL Gap when UL gap pattern configuration 3 (IE name for configurations) is configured | | mod(slot index,40)={7, 28} | mod(slot index, 80) = {15,56} |
| Indexes of the UL slots for UL Gap when UL gap pattern configuration 1 (IE name for configurations) is configured | | mod(slot index,160)={20, 21, 22,23, 28, 29,30,31} | mod(slot index, 320) = {8, … ,15} |
| NOTE 1: D denotes a slot with all DL symbols; S denotes a slot with a mix of DL, UL and guard symbols; U denotes a slot with all UL symbols. The field is for information.  NOTE 2: D, G, U denote DL, guard and UL symbols, respectively. The field is for information. | | | |

End of Change 5