**3GPP TSG-WG4 Meeting #102-e *R4-2206506***

**Electronic Meeting, Feb 21- Mar 03, 2022**

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| --- |
| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
|  |
|  | **38.101-1** | **CR** | **1023** | **rev** | **1** | **Current version:** | **17.4.0** |  |
|  |
| *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:***  |  CR for TS 38.101-1: contiguous CA with UL MIMO for power class 2 |
|  |  |
| ***Source to WG:*** | Huawei, HiSilicon |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | NR\_RF\_FR1\_enh-Core |  | ***Date:*** | 2022-02-12 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
|  |  |
| ***Reason for change:*** | To complete the requirements for Intra-band UL CA with UL MIMO. |
|  |  |
| ***Summary of change:*** | The big CR is based on endosed CR in R4-2119516 and R4-2202299.**R4-2119516**Make changs of clauses for intra-band UL contiguous CA for UL MIMO as sub-clauses for CA with UL MIMO. **R4-2202299**Specify the PC2 MPR requirements for Intra-band UL CA with UL MIMO. |
|  |  |
| ***Consequences if not approved:*** | PC2 Intra-band UL CA with UL MIMO is not supported.  |
|  |  |
| ***Clauses affected:*** | 4.3, 6.2H, 6.2A.2.1, 6.2H.1.1, 6.2H.1.2, 6.3H, 6.4H, 6.5H |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  |  |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS 38.521-1 |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** | Remove the change for IE update of txDirectCurrentLocation in 6.4H.1.2, which is not relevant to the big CR. |

## **<Start of Change>**

## 4.3 Specification suffix information

Unless stated otherwise the following suffixes are used for indicating at 2nd level clause, shown in Table 4.3-1.

Table 4.3-1: Definition of suffixes

|  |  |
| --- | --- |
| Clause suffix | Variant |
| None | Single Carrier |
| A | Carrier Aggregation (CA) |
| B | Dual-Connectivity (DC) |
| C | Supplement Uplink (SUL) |
| D | UL MIMO |
| E | V2X |
| F | Shared spectrum channel access |
| G | Tx Diversity (TxD) |
| H | Carrier Aggregation(CA) with UL MIMO |

A terminal which supports the above features needs to meet both the general requirements and the additional requirement applicable to the additional clause (suffixes A to F) in clauses 5, 6 and 7. Where there is a difference in requirement between the general requirements and the additional clause requirements (suffixes A to F) in clauses 5, 6 and 7, the tighter requirements are applicable unless stated otherwise in the additional clause.

A terminal which supports more than one feature in clauses 5, 6 and 7 shall meet all of the separate corresponding requirements.

For a terminal that supports SUL for the band combination specified in Table 5.2C-1, the current version of the specification assumes the terminal is configured with active transmission either on UL carrier or SUL carrier at any time in one serving cell and the UE requirements for single carrier shall apply for the active UL or SUL carrier accordingly.

For a terminal that supports operation in shared spectrum, the current version of this specification assumes in the uplink sub-bands within a wideband channel shall be contiguously allocated to the UE. The uplink requirements for one or more non-transmitted sub-bands between two transmitted sub-bands does not form a part of the current version of this specification.

## **<Next Change>**

#### 6.2A.2.1 UE maximum output power reduction for Intra-band contiguous CA

For intra-band contiguous carrier aggregation the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2A.1.1-1 with contiguous RB allocation is specified in Table 6.2A.2.1-1 for UE power class 3 CA bandwidth classes B and C. The MPR with contiguous RB allocation is specified in Table 6.2A.2.1-1a for power class 2 CA bandwidth classes B and C when the signalling is absent for *dualPA-Architecture* IE, and for power class 2 CA bandwidth class C when the signalling is indicated for *dualPA-Architecture* IE. The MPR with contiguous RB allocation is specified in Table 6.2A.2.1-1b for power class 2 CA bandwidth classes B and C with TxD supported.

In case the modulation format is different on different component carriers then the MPR is determined by the rules applied to higher order of those modulations.

Unless otherwise specified, pi/2 BPSK in following A-MPR tables refers to both variants of pi/2 BPSK referenced in 6.2.2 tables 6.2.2-1.

Table 6.2A.2.1-1: Contiguous RB allocation for Power Class 3

|  |  |  |
| --- | --- | --- |
| Modulation | MPR for bandwidth class B(dB) | MPR for bandwidth class C(dB) |
|  | inner | outer | inner | outer |
| DFT-s-OFDM | Pi/2 BPSK | 1.0 | 3.5 | 2.5 | 7 |
|  | QPSK | 1.0 | 3.5 | 2.5 | 7 |
|  | 16QAM | 1.5 | 3.5 | 2.5 | 7 |
|  | 64QAM | 3.0 | 4.0 | 5 | 7 |
|  | 256QAM | 5.5 | 6.0 | 7 | 7.5 |
| CP-OFDM | QPSK | 2.0 | 4.0 | 3.5 | 8 |
|  | 16QAM | 2.5 | 4.0 | 3.5 | 8 |
|  | 64QAM | 3.5 | 4.0 | 5 | 8 |
|  | 256QAM | 6.5 | 6.5 | 7 | 8 |

Table 6.2A.2.1-1a: Contiguous RB allocation for Power Class 2

|  |  |  |
| --- | --- | --- |
| Modulation | MPR for bandwidth class B(dB) | MPR for bandwidth class C(dB) |
|  | inner | Outer1 | inner | outer |
| DFT-s-OFDM | Pi/2 BPSK | 2.0 | 4.01 | 2.5 | 7 |
|  | QPSK | 2.0 | 4.01 | 2.5 | 7 |
|  | 16QAM | 2.5 | 4.01 | 2.5 | 7 |
|  | 64QAM | 3.0 | 4.51 | 5 | 7 |
|  | 256QAM | 5.5 | 6.0 | 7 | 7.5 |
| CP-OFDM | QPSK | 2.5 | 5.01 | 3.5 | 8 |
|  | 16QAM | 3.0 | 5.01 | 3.5 | 8 |
|  | 64QAM | 3.5 | 5.01 | 5 | 8 |
|  | 256QAM | 6.5 | 6.5 | 7 | 8 |
| NOTE 1: When 1 RB or 2 RB are allocated at the lower edge of lowest CC or upper edge of upper CC, MPR for outer is 5.5 dB. |

Table 6.2A.2.1-1b: Contiguous RB allocation for Power Class 2 with dual Tx2

|  |  |  |
| --- | --- | --- |
| Modulation | MPR for bandwidth class B(dB) | MPR for bandwidth class C(dB) |
|  | inner | Outer1 | inner | outer |
| DFT-s-OFDM | Pi/2 BPSK | 3.0 | 5.01 | 3.5 | 8 |
| QPSK | 3.0 | 5.01 | 3.5 | 8 |
| 16QAM | 3.5 | 5.01 | 3.5 | 8 |
| 64QAM | 4.0 | 5.51 | 6 | 8 |
| 256QAM | 6.5 | 7.0 | 8 | 8.5 |
| CP-OFDM | QPSK | 3.0 | 5.51 | 4.0 | 8.5 |
| 16QAM | 3.5 | 5.51 | 4.0 | 8.5 |
| 64QAM | 4.0 | 5.51 | 5.5 | 8.5 |
| 256QAM | 7.0 | 7.0 | 7.5 | 8.5 |
| NOTE 1: When 1 RB or 2 RB are allocated at the lower edge of lowest CC or upper edge of upper CC, MPR for outer is 5.5 dB.NOTE 2: UE indicating TxDsupported |

For CA bandwidth class B and bandwidth class C with contiguous RB allocation, the following parameters are defined to specify valid RB allocation ranges for Inner and Outer RB allocations:

An RB allocation is contiguous if LCRB1 = 0 or LCRB2 = 0 or (LCRB1 ≠ 0 and LCRB2 ≠ 0 and RBStart1 + LCRB1 = NRB1 andRBStart2 = 0), where RBStart1, LCRB1, and NRB1 are for CC1, RBStart2, LCRB2, and NRB2 are for CC2, CC1 is the component carrier with lower frequency.

In contiguous CA, a contiguous allocation is an inner allocation if

RBStart,Low ≤ RBStart\_CA ≤ RBStart,High,and NRB\_alloc ≤ ceil(NRB,agg /2),

where

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

RBStart,High = NRB,agg – RBStart,Low – NRB,alloc,

with

NRB\_alloc= LCRB1 ∙ 2^µ1 + LCRB2 ∙ 2^µ2

NRB\_alloc= (NRB1 - RBStart1)∙ 2^µ1 + (RBStart2 + LCRB2 ) ∙ 2^µ2,

NRB,agg=NRB1∙2^µ1+ NRB2∙2^µ2.

If LCRB1 =0, RBStart\_CA = NRB1∙2^µ1+ RBStart2∙2^µ2,

if LCRB1 > 0, RBStart\_CA = RBStart1∙2^µ1.

A contiguous allocation that is not an Inner contiguous allocation is an Outer contiguous allocation.

For intra-band contiguous carrier aggregation the allowed Maximum Power Reduction (MPR) for the maximum output power in Table Table 6.2A.1.1-1 with non-contiguous RB allocation is specified in Table 6.2A.2.1-2 for UE power class 3 CA bandwidth classes B and C. The MPR with non-contiguous RB allocation is specified in Table 6.2A.2.1-3 for power class 2 CA bandwidth classes B and C when the signalling is absent for *dualPA-Architecture* IE, and for power class 2 CA bandwidth classe C when the signalling is indicated for *dualPA-Architecture* IE. The MPR with non-contiguous RB allocation is specified in Table 6.2A.2.1-4 for power class 2 CA bandwidth classes B and C with TxD supported.

Table 6.2A.2.1-2: non-contiguous RB allocation for Power Class 3

|  |  |  |
| --- | --- | --- |
| Modulation | MPR for bandwidth class B(dB) | MPR for bandwidth class C(dB) |
|  | inner | Outer11 | Outer22 | inner | Outer11 | Outer22 |
| DFT-s-OFDM | Pi/2 BPSK | 2 | 5.5 | 11.5 | 2.5 | 6 | 13 |
|  | QPSK | 2 | 5.5 |  | 2.5 | 6 |  |
|  | 16QAM | 2.5 | 5.5 |  | 3 | 6 |  |
|  | 64QAM | 4.5 | 6 |  | 5 | 6 |  |
|  | 256QAM | 6 | 6.5 |  | 6.5 | 6.5 |  |
| CP-OFDM | QPSK | 2.5 | 6.5 | 12 | 3.5 | 7 | 14 |
|  | 16QAM | 3 | 7 |  | 3.5 | 7 |  |
|  | 64QAM | 5 | 7 |  | 5 | 7 |  |
|  | 256QAM | 7.5 | 7.5 |  | 7.5 | 7.5 |  |
| NOTE 1: Outer 1 MPR for Pi/2 BPSK and QPSK is reduced by 2dB for aggregated allocation bandwidth > 10MHz NOTE 2: Outer 2 MPR is reduced by 4.5dB for aggregated allocation bandwidth > 10MHz |

Table 6.2A.2.1-3: non-contiguous RB allocation for Power Class 2

|  |  |  |
| --- | --- | --- |
| Modulation | MPR for bandwidth class B(dB) | MPR for bandwidth class C(dB) |
|  | inner | Outer12 | Outer23 | Inner | Outer12 | Outer23 |
| DFT-s-OFDM | Pi/2 BPSK | 31 | 6.5 | 13 | 31 | 7.5 | 13.5 |
|  | QPSK | 31 | 6.5 |  | 31 | 7.5 |  |
|  | 16QAM | 31 | 6.5 |  | 31 | 7.5 |  |
|  | 64QAM | 5 | 6.5 |  | 5 | 7.5 |  |
|  | 256QAM | 6.5 | 7 |  | 6.5 | 7.5 |  |
| CP-OFDM | QPSK | 3.51 | 7 | 14 | 3.51 | 8 | 14.5 |
|  | 16QAM | 3.51 | 7 |  | 3.51 | 8 |  |
|  | 64QAM | 5 | 7 |  | 5 | 8 |  |
|  | 256QAM | 7.5 | 7.5 |  | 7.5 | 8 |  |
| NOTE 1: the allowed MPR is [4]dB for aggregated allocation bandwidth < [2MHz]. NOTE 2: Outer 1 MPR for Pi/2 BPSK and QPSK is reduced by 2dB for aggregated allocation bandwidth > 10MHz NOTE 3: Outer 2 MPR is reduced by 4.5dB for aggregated allocation bandwidth > 10MHz |

Table 6.2A.2.1-4: non-contiguous RB allocation for Power Class 2 with dual Tx4

|  |  |  |
| --- | --- | --- |
| Modulation | MPR for bandwidth class B(dB) | MPR for bandwidth class C(dB) |
|  | inner | Outer12 | Outer23 | Inner | Outer12 | Outer23 |
| DFT-s-OFDM | Pi/2 BPSK | 41 | 7.5 | 14 | 41 | 8.5 | 14.5 |
|  | QPSK | 41 | 7.5 |  | 41 | 8.5 |  |
|  | 16QAM | 41 | 7.5 |  | 41 | 8.5 |  |
|  | 64QAM | 6 | 7.5 |  | 6 | 8.5 |  |
|  | 256QAM | 7.5 | 8 |  | 7.5 | 8.5 |  |
| CP-OFDM | QPSK | 4.51 | 8 | 15 | 4.51 | 9 | 15.5 |
|  | 16QAM | 4.51 | 8 |  | 4.51 | 9 |  |
|  | 64QAM | 6 | 8 |  | 6 | 9 |  |
|  | 256QAM | 8.5 | 8.5 |  | 8.5 | 9 |  |
| NOTE 1: the allowed MPR is [4]dB for aggregated allocation bandwidth < [2MHz]. NOTE 2: Outer 1 MPR for Pi/2 BPSK and QPSK is reduced by 2dB for aggregated allocation bandwidth > 10MHz NOTE 3: Outer 2 MPR is reduced by 4.5dB for aggregated allocation bandwidth > 10MHzNOTE 4: UE indicating TxDsupported |

For CA bandwidth classes B and C with non-contiguous RB allocation, the following parameters are defined to specify valid RB allocation ranges for Inner, Outer1 and Outer2 RB allocations:

Non-Contiguous RB allocation is defined as RBStart1 + LCRB1 < NRB1, orRBStart2 > 0, when both uplink CCs are activated and allocated with RB(s), where RBStart1, LCRB1, and NRB1 are for CC1, RBStart2, LCRB2, and NRB2 are for CC2, CC1 is the component carrier with lower frequency.

In contiguous CA, a non-contiguous RB allocation is a non-contiguous Inner RB allocation if the following conditions are met:

RBStart,Low ≤ RBStart\_CA ≤ RBStart,High and NRB\_alloc ≤ ceil((BWChannel\_CA / 3 – BWgap ) / 0.18MHz),

where

NRB\_alloc = (NRB1 - RBStart1)∙ 2^µ1 + (RBStart2 + LCRB2 ) ∙ 2^µ2, RBStart\_CA = RBStart1∙2^μ1

RBStart,Low = max(1, floor(NRB\_alloc + (BWgap – BWGB,low)/0.18MHz))

RBStart,High = floor((BWChannel\_CA – 2 ∙ BWgap – BWGB,low)/0.18MHz – 2 ∙ NRB\_alloc)

BWGB,low =Foffset,low – (NRB1∙12+1)∙SCS1/2

BWgap is the bandwidth of the gap between NRB1 and NRB2 possible allocations of CC1 and CC2 respectively.

In contiguous CA, a non-contiguous RB allocation is a non-contiguous outer 1 RB allocation if the following conditions are met:

RBStart,Low ≤ RBStart\_CA ≤ RBStart,High and NRB\_alloc ≤ ceil((3 BWChannel\_CA / 5 – BWgap) / 0.18MHz)

where

RBStart,Low = max(1, 2 ∙ NRB\_alloc – floor( (BWChannel\_CA – 2 ∙ BWgap + BWGB,low)/0.18MHz)),

RBStart,High = floor((2 ∙ BWChannel\_CA – 3 ∙ BWgap – BWGB,low) / 0.18MHz – 3 ∙ NRB\_alloc)

NRB\_alloc , RBStart\_CA , BWgap and BWGB,low are as defined for the Inner region.

In contiguous CA, a non-contiguous allocation is an Outer 2 allocation if it is neither a non-contiguous Inner allocation nor an Outer 1 allocation.

## **<Next Change>**

## 6.2H Transmitter power for CA with UL MIMO

## 6.2H.1 Transmitter power for intra-band UL contiguous CA for UL MIMO

### 6.2H.1.1 UE maximum output power for intra-band UL contiguous CA for UL MIMO

For intra-band UL contiguous CA and UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the maximum output power is defined as the sum of the maximum output power from both UE antenna connectors and all UL CCs. The period of measurement shall be at least one sub frame (1 ms), as sspecifed in Table 6.2H.1.1-1. The requirements shall be met with the UL MIMO configurations specified in Table 6.2D.1-2 and 6.2D.1-3 for 2 layer configuration and ULFPTx configuration respectively.

Table 6.2H.1.1-1: UE Power Class for intra-band UL contiguous CA for UL MIMO in closed loop spatial multiplexing scheme

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR CA Configuration | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
| CA\_n41C |  |  | 26 | +2/-31 | 23 | +2/-31 |  |  |
| CA\_n78C |  |  | 26 | +2/-3 | 23 | +2/-3 |  |  |
| NOTE 1: If all transmitted resource blocks over all component carriers are confined within FUL\_low and FUL\_low + 4 MHz or/and FUL\_high – 4 MHz and FUL\_high, the maximum output power requirement is relaxed by reducing the lower tolerance limit by 1.5 dBNOTE 2: PPowerClass is the maximum UE power specified without taking into account the tolerance |

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2A.1 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling.

### 6.2H.1.2 UE maximum output power reduction for intra-band UL contiguous CA for UL MIMO

For intra-band UL contiguous CA and UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the allowed Maximum Power Reduction (MPR) for the maximum output power in Table 6.2H.1.1-1 is specified in Table 6.2A.2.1-1, Table 6.2A.2.1-2 for power class 3 CA; Table 6.2A.2.1-1b, Table 6.2A.2.1-4 for power class 2 CA.

The requirements shall be met with UL MIMO configurations defined in Table 6.2D.1-2 and 6.2D.1-3 for 2 layer configuration and ULFPTx configuration respectively. For the UE maximum output power modified by MPR, the power limits specified in clause 6.2H.1.4 apply.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2A.2 apply for the power class as indicated by the *ue-PowerClass* field in capability signaling.

### 6.2H.1.3 UE additional maximum output power reduction for intra-band UL contiguous CA for UL MIMO

For intra-band UL contiguous CA and UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the A-MPR values specified in clause 6.2A.3 shall apply to the maximum output power specified in Table 6.2H.1.1-1. The requirements shall be met with UL MIMO configurations defined in Table 6.2D.1-2 and 6.2D.1-3 for 2 layer configuration and ULFPTx configuration respectively.

For the UE maximum output power modified by A-MPR, the power limits specified in clause 6.2H.1.4 apply.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.4 apply for the power class as indicated by the *ue-PowerClass* field in capability signaling.

### 6.2H.1.4 Configured transmitted power for intra-band UL contiguous CA for UL MIMO

For UE supporting intra-band UL contiguous CA with UL MIMO, the transmitted power is configured per each UE.

The definitions of configured maximum output power PCMAX,*c*, the lower bound PCMAX\_L,*c*, and the higher bound PCMAX\_H,*c* specified in clause 6.2A.4 shall apply to UE supporting intra-band UL contiguous CA with UL MIMO, where

- PPowerClass, ΔPPowerClass and ∆TC,c are specified in clause 6.2A.4 unless otherwise stated;

- MPR, AMPR is specified in clause 6.2H.1.2 and 6.2H.1.3;

The measured configured maximum output power PUMAX,*c* for serving cell *c* shall be within the following bounds:

PCMAX\_L,*c*– MAX{TL, T LOW(PCMAX\_L,*c*)} ≤ PUMAX,*c* ≤ PCMAX\_H,*c*+ T HIGH(PCMAX\_H,*c*)

where TLOW(PCMAX\_L,*c*) and THIGH(PCMAX\_H,*c*) are defined as the tolerance and applies to PCMAX\_L,*c* and PCMAX\_H,*c* separately, while TL is the absolute value of the lower tolerance in Table 6.2.1-1 for the applicable operating band.

For UE supporting intra-band UL contiguous CA with UL MIMO, the tolerance is specified in Table 6.2H.4-1.

Table 6.2H.1.4-1: PCMAX,*c* tolerance for intra-band UL contiguous CA with UL MIMO

|  |  |  |
| --- | --- | --- |
| PCMAX(dBm) | ToleranceTLOW(PCMAX)(dB) | ToleranceTHIGH(PCMAX)(dB) |
| 21 ≤ PCMAX ≤ 23 | 2.0 |
| 20 ≤ PCMAX < 21 | 2.5 |
| 19 ≤ PCMAX < 20 | 3.5 |
| 18 ≤ PCMAX < 19 | 4.0 |
| 13 ≤ PCMAX < 18 | 5.0 |
| 8 ≤ PCMAX < 13 | 6.0 |
| -40 ≤ PCMAX < 8 | 7.0 |

## **<Next Change>**

## 6.4H Transmit signal quality for CA with UL MIMO

## 6.4H.1 Transmit signal quality for intra-band UL contiguous CA for UL MIMO

### 6.4H.1.1 Frequency error for intra-band UL contiguous CA for UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the basic measurement interval of modulated carrier frequency is 1 UL slot. The mean value of basic measurements of UE modulated carrier frequency at each transmit antenna connector on each CC shall be accurate to within ± 0.1 PPM observed over a period of 1 ms of cumulated measurement intervals compared to the carrier frequency received from the NR Node B.

### 6.4H.1.2 Transmit modulation quality for intra-band UL contiguous CA for UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the transmit modulation quality requirements are specified at each transmit antenna connector on each CC.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.4A.2 apply.

The transmit modulation quality is specified in terms as specified in 6.4D.2.

In case the parameter 3300 or 3301 is reported from UE via the parameter *txDirectCurrentLocation* in *UplinkTxDirectCurrentList* IE (as defined in TS 38.331 [7]), carrier leakage measurement requirement in clause 6.4H.1.2.2 and 6.4H.1.2.3 shall be waived, and the RF correction with regard to the carrier leakage and IQ image shall be omitted during the calculation of transmit modulation quality.

6.4H.1.2.1 Error Vector Magnitude

For intra-band UL contiguous CA and UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the Error Vector Magnitude requirements specified in Table 6.4A.2.1-1 which is defined in clause 6.4A.2.1 apply at each transmit antenna connector. The requirements shall be met with the UL MIMO configurations specified in Table 6.2H.1.1-2

6.4H.1.2.2 Carrier leakage

For UE supporting intra-band UL contiguous CA and UL MIMO, the Relative Carrier Leakage Power requirements specified in Table 6.4A.2.2-1 which is defined in clause 6.4A.2.2 apply at each transmit antenna connector.

6.4H.1.2.3 In-band emissions

For UE supporting intra-band UL contiguous CA and UL MIMO, the In-band Emission requirements specified in Table 6.4A.2.3-1 which is defined in clause 6.4A.2.3 apply at each transmit antenna connector.

### 6.4H.1.3 Time alignment error for intra-band UL contiguous CA for UL MIMO

### For intra-band UL contiguous CA and UE(s) with multiple transmit antenna connectors supporting UL MIMO, this requirement applies as specified in 6.4D.3: The time alignment error (TAE) is defined as the average frame timing difference between any two transmissions on different transmit antenna connectors for each CC. For UE(s) with multiple transmit antenna connectors, the Time Alignment Error (TAE) shall not exceed 130 ns.

### 6.4H.1.4 Coherent UL MIMO requirement for intra-band UL contiguous CA for UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the coherent UL MIMO requirement are specified on each CC as in 6.4D.4.

## **<Next Change>**

## 6.5H Output RF spectrum emissions for CA with UL MIMO

## 6.5H.1 Output RF spectrum emissions for intra-band UL contiguous CA for UL MIMO

## 6.5H.1.1 Occupied bandwidth for intra-band UL contiguous CA for UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the requirements for occupied bandwidth specified in clause 6.5A.1 apply to the sum of the powers from both UE transmit antenna connectors and all UL CCs. The requirements shall be met with UL MIMO configurations described in clause 6.2H.1.1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.5A.1 apply.

### 6.5H.1.2 Out of band emission for intra-band UL contiguous CA for UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the requirements for Out of band emissions resulting from the modulation process and non-linearity in the transmitters is defined as the sum of the emissions from both UEtransmit antenna connectors and all UL CCs, the requirements in subclasuse 6.5A.2 apply. The requirements shall be met with UL MIMO configurations described in clause 6.2H.1.1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.5A.2 apply.

6.5H.1.3 Spurious emission for intra-band UL contiguous CA for UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the requirements for Spurious emissions is defined as the sum of the emissions from both UE transmit antenna connectors and all UL CCs, the requirements specified in subclasuse 6.5A.3 apply. The requirements shall be met with the UL MIMO configurations described in clause 6.2H.1.1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.5A.3 apply.

### 6.5H.1.4 Transmit intermodulation for intra-band UL contiguous CA for UL MIMO

For UE supporting intra-band UL contiguous CA and UL MIMO, the transmit intermodulation requirements are specified at each transmit antenna connector and the wanted signal is defined as the sum of output powers from both UE transmit antenna connectors, the requirements specified in clause 6.5A.4 apply. The requirements shall be met with the UL MIMO configurations described in clause 6.2H.1.1.

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.5A.4 apply.

## **<End of Change>**