**3GPP TSG-WG4 Meeting #94-e *R4-200XXXX***

**Electronic Meeting, 24th February – 6th March, 2020**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
|  |
|  | **38.101-1** | **CR** | **<CR#>** | **rev** | **<Rev#>** | **Current version:** | **16.2.0** |  |
|  |
| *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:***  | : UL MIMO and TX diversity for NR-V2X |
|  |  |
| ***Source to WG:*** | [Huawei, HiSilicon] |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | 5G\_V2X\_NRSL-Core |  | ***Date:*** | 2020-2-3 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***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 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-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
|  |  |
| ***Reason for change:*** | Introduce UL MIMO and TX div requirements for NR-V2X in TS 38.101-1. |
|  |  |
| ***Summary of change:*** | Specify the UL MIMO and TX div requirements for NR V2X.  |
|  |  |
| ***Consequences if not approved:*** | UL MIMO and TX div features will not be supported by NR V2X. |
|  |  |
| ***Clauses affected:*** | 4.3, 5.2E, 6.2.1, 6.2E, 6.2E.1, 6.2E.2, 6.2E.3, 6.2E.4, 6.3E.1, 6.3E.2, 6.3E.3, 6.3E.4, 6.4E.1, 6.4E.2, 6.5E.1, 6.5E.2, 6.5E.3, 6.5E.4, |
|  |  |
|  | **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:*** |  |

## **<Start of Changes added with TX div content >**

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 Communication |

A terminal which supports the above features needs to meet both the general requirements and the additional requirement applicable to the additional clause (suffix A, B, C, D, and E) in clauses 5, 6 and 7. Where there is a difference in requirement between the general requirements and the additional clause requirements (suffix A, B, C, D, and E) 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 SUL, the current version of the specification assumes the terminal is not configured with UL MIMO on SUL carrier.

## **<Next Change added this section with TX div content >**

5.2E Operating bands for V2X Communication

NR V2X Communication is designed to operate in the the operating bands defined in Table 5.2E-1.

**Table 5.2E-1 V2X operating band**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **E‑UTRA Operating Band** | **E-UTRA V2X Operating Band** | **V2X UE transmit** | **V2X UE receive** | **Duplex Mode** | **Interface** |
| **FUL\_low – FUL\_high** | **FDL\_low – FDL\_high** |
| 47 | 47 | 5855 MHz |  | 5925 MHz | 5855 MHz |  | 5925 MHz | HD | PC5 |

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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 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 | 31 | +2/-3 |  |  | 23 | ±23 |
| n18 |  |  |  |  | 23 | ±2 |
| n20 |  |  |  |  | 23 | ±23 |
| n25 |  |  |  |  | 23 | ±2 |
| n28 |  |  |  |  | 23 | +2/-2.5 |
| n30 |  |  |  |  | 23 | ±2 |
| n34 |  |  |  |  | 23 | ±2 |
| n38 |  |  |  |  | 23 | ±2 |
| n39 |  |  |  |  | 23 | ±2 |
| n40 |  |  |  |  | 23 | ±2 |
| n41 |  |  | 26 | +2/-33 | 23 | ±23 |
| n47 |  |  |  |  | 23 | ±2 |
| n48 |  |  |  |  | 23 | +2/-3 |
| n50 |  |  |  |  | 23 | ±2 |
| n51 |  |  |  |  | 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 toleranceNOTE 2: Powerclass 3 is default power class unless otherwise statedNOTE 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 |

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## 6.2E Transmitter power for V2X Communication

### 6.2E.1 UE maximum output power for V2X Communication

For power class 2 NR V2X UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the maximum output power for any transmission bandwidth within the channel bandwidth is specified in Table 6.2E.1-1. The requirements shall be met with the UL MIMO configurations specified in Table 6.2D.1-2. For NR V2X UE supporting UL MIMO, the maximum output power is measured as the sum of the maximum output power at each UE antenna connector. The period of measurement shall be at least one sub frame (1 ms).

For V2X UE supporting Transmit Diversity, if the UE transmits on two connectors at the same time, the maximum output power for any transmission bandwidth within the channel bandwidth is specified in Table 6.2E.1-1. The maximum output power is measured as the sum of the maximum output power at each UE antenna connector. The period of measurement shall be at least one sub frame (1ms).

Table 6.21-1: NR V2X UE Power Class for UL-MIMO in closed loop spatial multiplexing scheme

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR band | Class 1 (dBm) | Tolerance (dB) | Class 2 (dBm) | Tolerance (dB) | Class 3 (dBm) | Tolerance (dB) | Class 4 (dBm) | Tolerance (dB) |
| n38 |  |  |  |  | 23 | +2/-3 |  |  |
| n47 |  |  |  |  | 23 | +2/-3 |  |  |

If the UE transmits on one antenna connector at a time, the requirements in Table 6.2.1-1 shall apply to the active antenna connector.

## **<Next Change>**

### 6.2E.2 UE maximum output power reduction for V2X Communication

For NR V2X UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the allowed Maximum Power Reduction (MPR) values specified in Table [TBD] shall apply to the maximum output power specified in Table 6.21-1. The requirements shall be met with UL MIMO configurations defined in Table 6.2D.1-2. For UE supporting UL MIMO, the maximum output power is measured as the sum of the maximum output power at each UE antenna connector.

For the UE maximum output power modified by MPR, the power limits specified in clause 6.2E.4 apply.

## **<Next Change>**

### 6.2E.3 UE additional maximum output power reduction for V2X Communication

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the A-MPR values specified in clause 6.2.3 shall apply to the maximum output power specified in Table 6.21-1. The requirements shall be met with the UL MIMO configurations specified in Table 6.2D.1-2. For UE supporting UL MIMO, the maximum output power is measured as the sum of the maximum output power at each UE antenna connector. Unless stated otherwise, an A-MPR of 0 dB shall be used.

For the UE maximum output power modified by A-MPR, the power limits specified in clause 6.2E.4 apply.

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### 6.2E.4 Configured output power for V2X Communication

For NR V2X UE supporting UL MIMO, the transmitted power is configured per each UE.

For NR V2X UE with two transmit antenna connectors in closed-loop spatial amultiplexing scheme, the tolerance is specified in Table 6.24-1. The requirements shall be met with UL MIMO configurations specified in Table 6.2D.1-2.

For V2X UE supporting Transmit Diversity, the transmitted power is configured per each UE.

If the UE transmits on two antenna connectors at the same time, the tolerance is specified in Table 6.24-2 for PC3 V2X UE.

Table 6.2E.4-1: PCMAX,*c* tolerance in closed-loop spatial multiplexing scheme

|  |  |  |
| --- | --- | --- |
| PCMAX,*c*(dBm) | ToleranceTLOW(PCMAX\_L,*c*) (dB) | ToleranceTHIGH(PCMAX\_H,*c*) (dB) |
| PCMAX,*c* = 26 | 3.0 | 2.0 |
| 23 ≤ PCMAX,*c* < 26 | 3.0 | 2.0 |
| 22 ≤ PCMAX,*c* < 23 | 5.0 | 2.0 |
| 21 ≤ PCMAX,*c* < 22 | 5.0 | 3.0 |
| 20 ≤ PCMAX,*c* < 21 | 6.0 | 4.0 |
| 16 ≤ PCMAX,*c* < 20 | 5.0 |
| 11 ≤ PCMAX,*c* < 16 | 6.0 |
| -40 ≤ PCMAX,*c* < 11 | 7.0 |

**Table 6.2E.4-2: PCMAX,*c* tolerance in Transmit Diversity scheme for PC3 V2X UE**

|  |  |  |
| --- | --- | --- |
| **PCMAX,*c*(dBm)** | **ToleranceTLOW(PCMAX\_L,*c*) (dB)** | **ToleranceTHIGH(PCMAX\_H,*c*) (dB)** |
| PCMAX,*c* =23 | TBD | TBD |
| 22 ≤ PCMAX,*c* < 23 | TBD | TBD |
| 21 ≤ PCMAX,*c* < 22 | TBD | TBD |
| 20 ≤ PCMAX,*c* < 21 | TBD | TBD |
| 16 ≤ PCMAX,*c* < 20 | TBD |
| 11 ≤ PCMAX,*c* < 16 | TBD |
| -40 ≤ PCMAX,*c* < 11 | TBD |

If the UE transmits on one antenna connector at a time, the requirements in Table 6.2.4-1 apply to the active antenna connector.

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### 6.3E.1 Minimum output power for V2X Communication

For NR V2X UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the minimum output power is defined as the sum of the mean power at each transmit connector in one sub-frame (1 ms). The minimum output power shall not exceed the values specified for single carrier.

For V2X UE supporting Transmit Diversity, if the UE transmits on two antenna connectors at the same time, the minimum output power is defined as the sum of the mean power at each transmit connector in one sub-frame (1ms). The minimum output power shall not exceed the values specified for single carrier.

If the UE transmits on one antenna connector at a time, the requirements specified for single carrier shall apply to the active antenna connector.

 **<Next Change>**

### 6.3E.2 Transmit OFF power for V2X Communication

The transmit OFF power is defined as the mean power at each transmit antenna connector in a duration of at least one sub-frame (1 ms) excluding any transient periods.

The transmit OFF power at each transmit antenna connector shall not exceed the values specified for single carrier.

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### 6.3E.3 Transmit ON/OFF time mask for V2X Communication

For NR V2X UE supporting UL MIMO, the ON/OFF time mask requirements apply at each transmit antenna connector.

For UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the general ON/OFF time mask requirements specified in clause 6.3E.3 apply to each transmit antenna connector. The requirements shall be met with the UL MIMO configurations described in clause 6.2D.1.

For V2X UE supporting Transmit Diversity, the ON/OFF time mask requirements apply at each transmit antenna connector.

If the UE transmits on one antenna connector at a time, the general ON/OFF time mask requirements apply to the active antenna connector.

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### 6.3E.4 Power control for V2X Communication

For V2X UE supporting Transmit Diversity, if the UE transmits on two antenna connectors at the same time, the power control tolerance for single carrier shall apply to the sum of output power at each transmit antenna connector.

If the UE transmits on one -antenna connector at a time, the requirements for single carrier shall apply to the active antenna connector.

#### 6.3E.4.1 in licensed band Power control for V2X Communication con-current operation

For NR V2X UE supporting UL MIMO, the power control tolerance for single carrier shall apply to the sum of output power at each transmit antenna connector.

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## 6.4E Transmit signal quality for V2X Communication

### 6.4E.1 Frequency error for V2X Communication

For NR V2X UE supporting UL MIMO, the UE modulated carrier frequency at each transmit antenna connector shall be accurate to within ±0.1 PPM observed over a period of 0.5 ms in case of using GNSS synchronization source. The same requirements applied over a period of 0.5 ms compared to the relative frequency in case of using the NR gNode B or V2X UE sidelink synchronization signals.

For V2X UE supporting Transmit Diversity, if the UE transmits on two antenna connectors at the same time, the UE modulated carrier frequency at each transmit antenna connector shall be accurate to within ±0.1 PPM observed over a period of one time slot (0.5 ms) in case of using GNSS synchronization source. The same requirements applied over a period of one time slot (0.5 ms) compared to the relative frequency in case of using the NR Node B or V2X UE sidelink synchronization signals.

If the UE transmits on one antenna connector at a time, the requirements for single carrier shall apply to the active antenna connector.

### 6.4E.2 Transmit modulation quality for V2X Communication

For NR V2X UE supporting UL MIMO, the transmit modulation quality requirements for single carrier shall apply to each transmit antenna connector.

For V2X UE supporting Transmit Diversity, if the UE transmits on two antenna-connectors at the same time, the transmit modulation quality requirements for single carrier shall apply to each transmit antenna connector.

If V2X UE transmits on one-antenna connector at a time, the requirements specified for single carrier apply to the active antenna connector.

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## 6.5E Output RF spectrum emissions for V2X Communication

### 6.5E.1 Occupied bandwidth for V2X Communication

For NR V2X UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the occupied bandwidth at each transmitter antenna shall be less than the channel bandwidth specified in table 6.5.1-1. The requirements shall be met with UL MIMO configurations described in clause 6.2D.1.

For V2X UE supporting Transmit Diversity, if the UE transmits on two antenna connectors at the same time, the requirements for occupied bandwidth is specified at each transmit antenna connector and the occupied bandwidth at each transmitter antenna shall be less than the channel bandwidth specified for single carrier.

If V2X UE transmits on one antenna connector at a time, the requirements specified for single carrier shall apply to the active antenna connector.

### 6.5E.2 Out of band emission for V2X Communication

For NR V2X UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements specified for single carrier shall apply to each transmit antenna connector. The requirements shall be met with UL MIMO configurations described in clause 6.2D.1.

For V2X UE supporting Transmit Diversity, if the UE transmits on two antenna connectors at the same time, the requirements specified for single carrier apply to each transmit antenna connector.

If V2X UE transmits on one antenna connector at a time, the requirements specified for single carrier shall apply to the active antenna connector.

## **<Next Change>**

### 6.5E.3 Spurious emission for V2X Communication

For NR V2X UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements specified for single carrier shall apply to each transmit antenna connector. The requirements shall be met with the UL MIMO configurations described in clause 6.2D.1.

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### 6.5E.4 Transmit intermodulation for V2X Communication

For NR V2X UE with two transmit antenna connectors in closed-loop spatial multiplexing scheme, the requirements specified for single carrier shall apply to each transmit antenna connector. The requirements shall be met with the UL MIMO configurations described in clause 6.2D.1.

For V2X UE supporting Transmit Diversity, if the UE transmits on two antenna connectors at the same time, the requirements specified for single carrier shall apply to each transmit antenna connector. If the UE transmits on one antenna connector, the requirements specified for single carrier shall apply to the active antenna connector.

## **<End of Changes>**