**3GPP TSG-WG4 Meeting #94 *R4-20xxxxx***

**Athens, Greece, February 24th-28th 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:***  | CR for TS 38.101-1: Con-current operation 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 con-current operation for NR-V2X |
|  |  |
| ***Summary of change:*** | Requirements specified for NR V2X con-current operation in FR1 for band combinations of NR Uu in licensed band + NR SL in band n47.  |
|  |  |
| ***Consequences if not approved:*** | Con-current operation for NR V2X will not be supported. |
|  |  |
| ***Clauses affected:*** |  |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  |  |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** | **X** |  |  Test specifications | TS 38.521-3  |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

## **<Start of Change>**

## 5.2E Operating band combination for V2X

NR V2X operation is designed to operate concurrent with NR uplink/downlink on the operating bands combinations listed in Table 5.2E-1.

Table 5.2E-1 Inter-band con-current V2X operating bands

|  |  |  |
| --- | --- | --- |
| V2X con-current operating Band | NR or V2X Operating Band | Interface |
| V2X\_nX-n47 | nX | Uu |
| n47 | PC5 |

## **<Next Change>**

## 5.3E UE channel bandwidth for V2X

For NR V2X inter-band con-current operation in FR1, the NR V2X channel bandwidths for each operating band is specified in Table 5.3E-1.

Table 5.3E-1: Inter-band con-current V2X configurations

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| V2X con-current operating band Configuration  | NR Bands | SCS kHz | 10MHz | 20MHz | 30MHz | 40MHz | 50MHz | Maximum bandwidth [MHz] | Bandwidth combination set |
| V2X\_nXA-n47A | nX | 15 | Yes | Yes |  |  |  | 60 | 0 |
| 30 | Yes | Yes |  |  |  |
| 60 | Yes | Yes |  |  |  |
| n47 | 15 | Yes | Yes | Yes | Yes |  |
| 30 | Yes | Yes | Yes | Yes |  |
| 60 | Yes | Yes | Yes | Yes |  |

## **<Next Change>**

## 6.2E Transmitter power for V2X

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

#### 6.2E.1.1 UE maximum output power for V2X con-current operation

For the inter-band con-current NR V2X operation, the maximum output power is specified in Table 6.2E.1-1. The period of measurement shall be at least one sub frame (1ms).

Table 6.2E.1.1-1: Con-current NR V2X UE Power Class for uplink inter-band combination (two bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR V2X con-current operating band Configuration | Class 1 (dBm)  | Tolerance (dB)  | Class 2 (dBm) | Tolerance(dB)  | Class 3 (dBm) | Tolerance (dB)  | Class 4 (dBm) | Tolerance (dB) |
| V2X\_nXA-n47A |  |  |  |  | 23 | +2/-32 |  |  |
| NOTE 1: The con-current band combinations is used for NR V2X Service.NOTE 2: PPowerClass is the maximum UE power specified without taking into account the tolerance NOTE 3: For inter-band con-current aggregation the maximum power requirement apply to the total transmitted power over all component carriers (per UE).NOTE 4: 4 refers to the transmission bandwidths (Figure 5.6-1) 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 |

## **<Next Change>**

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

#### 6.2E.2.1 UE maximum output power reduction for V2X con-current operation

For the inter-band con-current NR V2X operation, the allowed maximum power reduction (MPR) for the maximum output power shall be applied per each component carrier. The MPR requirements in subclause 6.2.2 apply for NR Uu operation in licensed band, and the MPR requirements in in subclause 6.2E.2 apply for NR sidelink operation in Band n47.

## **<Next Change>**

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

#### 6.2E.3.1 UE additional maximum output power reduction for V2X con-current operation

For the inter-band con-current NR V2X operation, the allowed additional maximum power reduction (A-MPR) for the maximum output power shall be applied per each component carrier. The A-MPR requirements in subclause 6.2.3 apply for NR Uu operation in licensed band, and the A-MPR requirements in in subclause 6.2E.3 apply for NR sidelink operation in Band n47.

## **<Next Change>**

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

#### 6.2E.4.1 Configured transmitted power for V2X con-current operation

When a UE is configured for simultaneous NR V2X sidelink and NR uplink transmissions for inter-band con-current operation, the UE is allowed to set its configured maximum output power PCMAX,*c*,*NR*and PCMAX,*c*,*V2X*for the configured NR uplink carrier and the configured NR V2X carrier, respectively, and its total configured maximum output power PCMAX,c.

The configured maximum output power PCMAX *c*,*NR(p)* in slot *p* for the configured NR uplink carrier shall be set within the bounds:

PCMAX\_L,*c,NR* (*p*) ≤ PCMAX,*c,NR* (*p*) ≤ PCMAX\_H,*c,NR* (*p*)

where PCMAX\_L,*c,NR* andPCMAX\_H,*c,NR* are the limits for a serving cell c as specified in subclause 6.2.4.

The configured maximum output power PCMAX *c*,*V2X (q)* in slot *q* for the configured NR V2X carrier shall be set within the bounds:

PCMAX,*c,V2X* (*q*) ≤ PCMAX\_H,*c,V2X* (*q*)

where PCMAX\_H,*c,V2X* is the limit as specified in subclause 6.2E.4.

The total UE configured maximum output power PCMAX (*p,q*) in a slot *p* of NR uplink carrier and a slot *q* of NR V2X sidelink that overlap in time shall be set within the following bounds for synchronous and asynchronous operation unless stated otherwise:

PCMAX\_L (*p,q*) ≤ PCMAX (*p,q*) ≤ PCMAX\_H (*p,q*)

with

PCMAX\_L (*p,q*) = PCMAX\_L,*c,NR* (*p*)

PCMAX\_H (*p,q*) = 10 log10 [pCMAX\_H,*c,NR*(*p*) + pCMAX\_H,*c,V2X*(*q*)]

where pCMAX\_H*,c,V2X* and pCMAX\_H,*c,NR*are the limits PCMAX\_H,*c,V2X* (*q*) and PCMAX\_H,*c,NR* (*p*) expressed in linear scale.

The measured total maximum output power PUMAX over both the NR uplink and NR V2X carriers is

PUMAX = 10 log10 [pUMAX,*c,NR* + pUMAX,*c,V2X*],

where pUMAX,*c,NR*  denotes the measured output power of serving cell *c* for the configured NR uplink carrier, and pUMAX,*c,V2X* denotes the measured output power for the configured NR V2X carrier expressed in linear scale.

When a UE is configured for synchronous V2X sidelink and uplink transmissions,

PCMAX\_L(*p, q*)  – TLOW (PCMAX\_L(*p, q*)) ≤ PUMAX  ≤ PCMAX\_H(*p, q*) + THIGH (PCMAX\_H(*p, q*))

where PCMAX\_L (*p,q*) and PCMAX\_H (*p,q*) are the limits for the pair (*p,q*) and with the tolerances TLOW(PCMAX) and THIGH(PCMAX) for applicable values of PCMAX specified in Table 6.2E.4-1. PCMAX\_L may be modified for any overlapping portion of slots *(p, q)* and *(p +1, q+1).*

## **<Next Change>**

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

#### 6.3E.1.1 Minimum output power for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 6.3.1 shall apply for the uplink in licensed band and the requirements specified in subclause 6.3E.1 shall apply for the sidelink in Band n47.

## **<Next Change>**

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

#### 6.3E.2.1 Transmit OFF power for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 6.3.2 shall apply for the uplink in licensed band and the requirements specified in subclause 6.3E.2 shall apply for the sidelink in Band n47.

## **<Next Change>**

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

#### 6.3E.3.1 Transmit ON/OFF time mask for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 6.3.3 shall apply for the uplink in licensed band and the requirements specified in subclause 6.3E.3 shall apply for the sidelink in Band n47.

## **<Next Change>**

### 6.3E.4 Power control for V2X

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

For the inter-band con-current NR V2X operation, the requirements specified in subclause 6.3.4 shall apply for the uplink in licensed band and the requirements specified in subclause 6.3E.4 shall apply for the sidelink in Band n47.

## **<Next Change>**

## 6.4E Transmit signal quality for V2X

### 6.4E.1 Frequency error for V2X

#### 6.4E.1.1 Frequency error for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 6.4.1 shall apply for the uplink in licensed band and the requirements specified in subclause 6.4E.1 shall apply for the sidelink in Band n47.

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

#### 6.4E.2.1 Transmit modulation quality for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 6.4.2 shall apply for the uplink in licensed band and the requirements specified in subclause 6.4E.2 shall apply for the sidelink in Band n47.

## **<Next Change>**

## 6.5E Output RF spectrum emissions for V2X

### 6.5E.1 Occupied bandwidth for V2X

#### 6.5E.1.1 Occupied bandwidth for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 6.5.1 shall apply for the uplink in licensed band and the requirements specified in subclause 6.5E.1 shall apply for the sidelink in Band n47.

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

#### 6.5E.2.1 General

#### 6.5E.2.2 Spectrum emission mask

##### 6.5E.2.2.1 Spectrum emission mask for V2X con-current operation

For the inter-band con-current NR V2X operation, the general/additional SEM requirements specified in subclause 6.5.2 shall apply for the uplink in licensed band and the general/additional SEM requirements specified in subclause 6.5E.2 shall apply for the sidelink in Band n47.

#### 6.5E.2.4 Adjacent channel leakage ratio

##### 6.5E.2.4.1 ACLR for V2X con-current operation

For the inter-band con-current NR V2X operation, the ACLR requirement specified in subclause 6.5.2.4 shall apply for the uplink in licensed band and the ACLR requirement specified in subclause 6.5E.2.4 shall apply for the sidelink in Band n47.

## **<Next Change>**

### 6.5E.3 Spurious emission for V2X

#### 6.5E.3.1 General spurious emissions

##### 6.5E.3.1.1 Spurious emissions for UE co-existence for V2X con-current operation

For the inter-band con-current NR V2X operation, the UE-coexistence requirements in Table 6.5E.3.1.1-1 apply for the corresponding inter-band con-current operation with transmission assigned to both uplink in licensed band and sidelink in Band n47.

**Table 6.5E.3.1.1-1: Requirements for inter-band con-current V2X operation**

|  |  |
| --- | --- |
| V2X con-current operating band cofiguration | Spurious emission  |
| Protected band | Frequency range (MHz) | Maximum Level (dBm) | MBW (MHz) | NOTE |
| V2X\_nXA-n47A | E-UTRA Band 1, 5, 7, 8, 26, 28, 34, 39, 40, 44, 45, 65, 87, 88 | FDL\_low  | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 3 | FDL\_low  | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 22, 41, 42, 52NR Band n77, n78 | FDL\_low  | - | FDL\_high | -50 | 1 | 1 |
| Frequency range | 5925 | - | 5950 | -30 | 1 | 3, 4 |
| Frequency range | 5815 | - | 5855 | -30 | 1 | 3 |
| NOTE 1:As exceptions, measurements with a level up to the applicable requirements defined in Table 6.6.3.1-2 are permitted for each assigned E-UTRA carrier used in the measurement due to 2nd, 3rd, 4th [or 5th] harmonic spurious emissions. In case the exceptions are allowed due to spreading of the harmonic emission the exception is also allowed for the first 1 MHz frequency range immediately outside the harmonic emission on both sides of the harmonic emission. This results in an overall exception interval centred at the harmonic emission of (2MHz + N x LCRB x 180kHz), where N is 2, 3 or 4 for the 2nd, 3rd or 4th harmonic respectively. The exception is allowed if the measurement bandwidth (MBW) totally or partially overlaps the overall exception interval.NOTE 2: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.6.3.1-1 and Table 6.6.3.1A-1 from the edge of the aggregated channel bandwidth.NOTE 3: Applicable when NS\_XX is configured by the pre-configured radio parameters for power class 3 V2X UE.NOTE 4: In the frequency range x-5950MHz, SE requirement of -30dBm/MHz should be applied; where x = max (5925, fc + 15), where fc is the channel centre frequency. |

## **<Next Change>**

### 6.5E.4 Transmit intermodulation for V2X

#### 6.5E.4.1 Transmit intermodulation for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 6.5.4 shall apply for the uplink in licensed band and the requirements specified in subclause 6.5E.4 shall apply for the sidelink in Band n47.

## **<Next Change>**

## 7.3E Reference sensitivity for V2X

### 7.3E.1 Reference sensitivity power level for V2X con-current operation

When UE is configured for NR V2X reception on V2X carrier con-current with NR uplink and downlink, NR V2X sidelink throughput for the carrier shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes [TBD] with parameters specified in Table 7.3E.1-1. Also the NR downlink throughput shall be ≥ 95% of the maximum throughput of the reference measurement channels as specified in Annexes A.3.

For the inter-band con-current NR V2X operation, and the UE also supports a NR downlink inter-band con-current configuration in Table 7.3E.1-2, the minimum requirement for reference sensitivity shall be increased by the amount given in ΔRIB,c in Table 7.3E.1-2 for the corresponding NR V2X band.

Table 7.3E.1-1: Reference sensitivity for V2X Communication QPSK PREFSENS

|  |  |
| --- | --- |
| Inter-band V2X reception | Channel bandwidth |
| NR V2X Band | NR band | NR Band | SCS (kHz) | 10 MHz(dBm) | 15 MHz(dBm) | 20 MHz(dBm) | 25 MHz(dBm) | 30 MHz (dBm) | 40 MHz (dBm) | Duplex Mode |
| n47 | Band nX | nX | 15 | TBD | TBD | TBD | TBD |  |  | TDD or FDD |
| 30 | TBD | TBD | TBD | TBD |  |  |
| 60 | TBD | TBD | TBD | TBD |  |  |
| n47 | 15 | TBD |  | TBD |  | TBD | TBD | HD |
| 30 | TBD |  | TBD |  | TBD | TBD |
| 60 | TBD |  | TBD |  | TBD | TBD |

Table 7.3E.1-2: ΔRIB,c (two bands)

|  |  |  |
| --- | --- | --- |
| V2X inter-band con-current band Combination | NR Band | ΔRIB,c [dB] |
| V2X\_nX-n47 | nX | TBD |

The reference sensitivity is defined to be met with NR uplink assigned to one band (that differs from the V2X operating band) and all NR downlink carriers active. The NR uplink resource blocks shall be located as close as possible to NR V2X operating band but confined within the transmission bandwidth configuration for the channel. The uplink configuration for the NR operating band is specified in Table 7.3E.1-3 and 7.3E.1-4. The REFSENS of Uu downlink and PC5 sidelink will be tested at the same time.

Table 7.3E.1-3: Uplink configuration for REFSENS of NR V2X Bands

|  |  |
| --- | --- |
| **Inter-band NR V2X /NR configuration** | **NR UL band / Channel BW / NRB / Duplex mode** |
| **NR V2X band (PC5)** | **NR or V2X operating band (Uu)** | **NR UL/V2X band (Uu)** | **Channel Bandwidth (MHz)** | **NRB** | **Duplex Mode** |
| n47 | nX | TBD | TBD | TBD | TBD |

Table 7.3E.1-4: Sidelink TX configuration for REFSENS of NR V2X Bands

|  |  |
| --- | --- |
| **Inter-band NR V2X /NR configuration** | **NR SL band / Channel BW / NRB / Duplex mode** |
| **NR V2X band (PC5)** | **NR or V2X operating band (Uu)** | **V2X band (PC5)** | **Channel Bandwidth (MHz)** | **NRB** | **Duplex Mode** |
| n47 | nX | n47 | 10 | 52 | HD |

## **<Next Change>**

## 7.4E Maximum input level for V2X

### 7.4E.1 Maximum input level for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 7.4E shall apply for the NR sidelink reception in Band n47 and the requirements specified in subclause 7.4 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

## **<Next Change>**

## 7.5E Adjacent channel selectivity for V2X

### 7.5E.1 Adjacent channel selectivity for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 7.5E shall apply for the NR sidelink reception in Band n47 and the requirements specified in subclause 7.5 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

## **<Next Change>**

### 7.6E.2 In-band blocking for V2X

#### 7.6E.2.1 In-band blocking for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 7.6E2 shall apply for the NR sidelink reception in Band n47 and the requirements specified in subclause 7.6.2 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

## **<Next Change>**

### 7.6E.3 Out-of-band blocking for V2X

#### 7.6E.3.1 Out-of-band blocking for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 7.6E3 shall apply for the NR sidelink reception in Band n47 and the requirements specified in subclause 7.6.3 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

## **<Next Change>**

### 7.6E.4 Narrow band blocking for V2X

#### 7.6E.4.1 Narrow band blocking for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 7.6E4 shall apply for the NR sidelink reception in Band n47 and the requirements specified in subclause 7.6.4 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

## **<Next Change>**

## 7.7E Spurious response for V2X

### 7.7E.1 Spurious response for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 7.7E shall apply for the NR sidelink reception in Band n47 and the requirements specified in subclause 7.7 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

## **<Next Change>**

## 7.8E Intermodulation characteristics for V2X

### 7.8E.1 Intermodulation for V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 7.8E shall apply for the NR sidelink reception in Band n47 and the requirements specified in subclause 7.8 shall apply for the NR downlink reception in licensed band while all downlink carriers are active.

## **<End of Change>**