**3GPP TSG-WG4 Meeting #95-e *R4-2008452***

**Electronic Meeting, 25 May – 5 June, 2020**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
|  |
|  | **38.101-3** | **CR** | **0287** | **rev** | **1** | **Current version:** | **16.3.0** |  |
|  |
| *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 38.101-3: Introduction of NR V2X cross RAT requirements |
|  |  |
| ***Source to WG:*** | Huawei, HiSilicon, [LG Electronics,CATT] |
| ***Source to TSG:*** | R4 |
|  |  |
| ***Work item code:*** | 5G\_V2X\_NRSL-Core |  | ***Date:*** | 2020-05-16 |
|  |  |  |  |  |
| ***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:*** | Con-current operation for band combinations with Uu and SL as well as TDM operation between LTE SL and NR SL operation should be defined in TS 38.101-3. |
|  |  |
| ***Summary of change:*** | Cross RAT requirements are specified based on endorsed CRs in RAN4#94e-bis meeting. Clean up and corrections are also made for the requirements based on endorsed CRs. |
|  |  |
| ***Consequences if not approved:*** | Con-current operation for NR V2X are not supported in Rel-16. |
|  |  |
| ***Clauses affected:*** | 3.1, 3.3, 4.3, 5.2E, 5.3E, 5.4E, 5.5E, 6.2E, 6.3E, 6.4E, 6.5E, 7.3E, 7.4E, 7.5E, 7.6E, 7.7E, 7.8E |
|  |  |
|  | **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>**

## 3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

**Aggregated Channel Bandwidth**: The RF bandwidth in which a UE transmits and receives multiple contiguously aggregated carriers.

**Carrier aggregation**: Aggregation of two or more component carriers in order to support wider transmission bandwidths.

**Carrier aggregation band**: A set of one or more operating bands across which multiple carriers are aggregated with a specific set of technical requirements.

**Carrier aggregation bandwidth class**: A class defined by the aggregated transmission bandwidth configuration and maximum number of component carriers supported by a UE.

**Carrier aggregation configuration**: A combination of CA operating band(s) and CA bandwidth class(es) supported by a UE.

**Con-current operation**: The simultaneous transmission and reception of sidelink and Uu interfaces while operation is agnostic of the service used on each interface.

**Contiguous carriers**: A set of two or more carriers configured in a spectrum block where there are no RF requirements based on co-existence for un-coordinated operation within the spectrum block.

**Contiguous resource allocation**: A resource allocation of consecutive resource blocks within one carrier or across contiguously aggregated carriers. The gap between contiguously aggregated carriers due to the nominal channel spacing is allowed.

**Contiguous spectrum**: Spectrum consisting of a contiguous block of spectrum with no sub-block gaps.

**Inter-band carrier aggregation:** Carrier aggregation of component carriers in different operating bands.

NOTE: Carriers aggregated in each band can be contiguous or non-contiguous.

**Intra-band contiguous carrier aggregation**: Contiguous carriers aggregated in the same operating band.

**Intra-band non-contiguous carrier aggregation**: Non-contiguous carriers aggregated in the same operating band.

**Sub-block**: This is one contiguous allocated block of spectrum for transmission and reception by the same UE. There may be multiple instances of sub-blocks within an RF bandwidth.

**Sub-block bandwidth**: The bandwidth of one sub-block.

**Sub-block gap**: A frequency gap between two consecutive sub-blocks within an RF bandwidth, where the RF requirements in the gap are based on co-existence for un-coordinated operation.

**UE transmission bandwidth configuration**: Set of resource blocks located within the UE channel bandwidth which may be used for transmitting or receiving by the UE.

**Vehicular UE:** A UE embedded in a vehicle, permanently connected to an embedded antenna system that radiates externally for NR operating bands.

NOTE: Vehicular UE does not refer to other UE form factors placed inside the vehicle.

### **<Next Change>**

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

ACLR Adjacent Channel Leakage Ratio

ACS Adjacent Channel Selectivity

A-MPR Additional Maximum Power Reduction

BCS Bandwidth Combination Set

CA Carrier Aggregation

CC Component Carrier

DC Dual Connectivity

EIRP Equivalent Isotropically Radiated Power

EN-DC E-UTRA/NR DC

EVM Error Vector Magnitude

FDM Frequency Division Multiplexing

FR Frequency Range

ENBW The aggregated bandwidth of an E-UTRA sub-block and an adjacent NR sub-block

ITS Intelligent Transportation System

ITU-R Radiocommunication Sector of the International Telecommunication Union

MBW Measurement bandwidth defined for the protected band

MPR Allowed maximum power reduction

MSD Maximum Sensitivity Degradation

MCG Master Cell Group

NR New Radio

NS Network Signalling

NSA Non-Standalone, a mode of operation where operation of an other radio is assisted with an other radio

OOB Out-of-band

OOBE Out-of-band emission

OTA Over The Air

PRB Physical Resource Block

PSCCH Physical Sidelink Control CHannel

PSSCH Physical Sidelink Shared CHannel

RE Resource Element

REFSENS Reference Sensitivity

RF Radio Frequency

Rx Receiver

SCG Secondary Cell Group

SCS Subcarrier spacing

SEM Spectrum Emission Mask

SL Sidelink

SUL Supplementary uplink

TDM Time Division Multiplex

Tx Transmitter

UE User Equipment

UL MIMO Up Link Multiple Antenna transmission

ULSUP Uplink sharing from UE perspective

V2X Vehicle to Everything

# 4 General

## 4.1 Relationship between minimum requirements and test requirements

The present document is interwork specification for NR UE, covering RF characteristics and minimum performance requirements. Conformance to the present specification is demonstrated by fulfilling the test requirements specified in the conformance specification 3GPP TS 38.521-3 [5].

The Minimum Requirements given in this specification make no allowance for measurement uncertainty. The test specification TS 38.521-3 [5] defines test tolerances. These test tolerances are individually calculated for each test. The test tolerances are used to relax the minimum requirements in this specification to create test requirements. For some requirements, including regulatory requirements, the test tolerance is set to zero.

The measurement results returned by the test system are compared - without any modification - against the test requirements as defined by the shared risk principle.

The shared risk principle is defined in Recommendation ITU‑R M.1545 [6].

## 4.2 Applicability of minimum requirements

a) In this specification the Minimum Requirements are specified as general requirements and additional requirements. Where the Requirement is specified as a general requirement, the requirement is mandated to be met in all scenarios

b) For specific scenarios for which an additional requirement is specified, in addition to meeting the general requirement, the UE is mandated to meet the additional requirements.

c) The spurious emissions power requirements are for the long-term average of the power. For the purpose of reducing measurement uncertainty it is acceptable to average the measured power over a period of time sufficient to reduce the uncertainty due to the statistical nature of the signal

d) Terminal that supports EN-DC configuration shall meet E-UTRA requirements as specified in TS 36.101 [4] and NR requirements as in TS 38.101-1 [2] and TS 38.101-2 [3] unless otherwise specified in this specification

e) All the requirements for intra-band contiguous and non-contiguous EN-DC apply under the assumption of the same uplink-downlink and special subframe configurations in the E-UTRA and slot format indicated by UL-DL-configurationCommon and UL-DL-configurationDedicated in the NR for the EN-DC.

f) For EN-DC combinations with CA configurations for E-UTRA and/or NR, all the requirements for E-UTRA and/or NR all the requirements for E-UTRA and/or NR intra-band contiguous and non-contiguous CA apply under the assumption of the same slot format indicated by UL-DL-configurationCommon and UL-DL-configurationDedicated in the PSCell and SCells for NR and the same uplink-downlink and special subframe configurations in Pcell and SCells for E-UTRA.

A terminal which supports an EN-DC configuration shall support:

If any subsets of the EN-DC configuration do not specify its own bandwidth combination sets in 5.3B, then the terminal shall support the same E-UTRA bandwidth combination sets it signals the support for in E-UTRA CA configuration part of E-UTRA – NR DC and shall support the same NR bandwidth combination sets it signals the support for in NR CA configuration part of E-UTRA – NR DC.

Else if one of the subsets of the EN-DC configuration specify its own bandwidth combination sets in 5.3B, then the terminal shall support a product set of channel bandwidth for each band specified by E-UTRA bandwidth combination sets, NR bandwidth combination sets, and EN-DC bandwidth combination sets it singnals the support.A terminal which supports an inter-band EN-DC configuration with a certain UL configuration shall support the all lower order DL configurations of the lower order EN-DC combinations, which have this certain UL configuration and the fallbacks of this UL configuration.

A terminal which supports CA or DC configurations, which include FR2 intra-band CA combinations with multiple subblocks, where at least one of the subblocks consists of a contiguous CA combination, is not required to support all possible fallback combinations but can directly fall back to a single FR2 carrier. Deactivating carriers within the CA or DC combination is still possible.

Terminal that supports inter-band NR-DC between FR1 and FR2 configuration shall meet the requirements for corresponding CA configuration (suffix A), unless otherwise specified.

## 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) between FR1 and FR2 |
| B | Dual-Connectivity (DC) with and without SUL including UL sharing from UE perspective, inter-band NR DC between FR1 and FR2 |
| D | UL MIMO |
| E | V2X |

# 5 Operating bands and channel arrangement

### **<Next Change>**

## 5.2E Operating bands for V2X

### 5.2E.1 Intra-band V2X bands

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

Table 5.2E.1-1: Intra-band V2X operating bands

|  |  |  |
| --- | --- | --- |
| V2X con-current operating band | E-UTRA or NR Band | Interface |
| V2X\_47\_n471 | 47 | PC5 |
| n47 | PC5 |
| NOTE 1: Only single switched SL is supported. |

### 5.2E.2 Inter-band V2X bands

NR V2X operation is designed to operate concurrent with E-UTRA uplink/downlink on the operating bands combinations listed in Table 5.2E.2-1.

Table 5.2E.2-1: Inter-band con-current V2X operating bands

|  |  |  |
| --- | --- | --- |
| E-UTRA-NR V2X Band Combination | E-UTRA or NR Band | Interface |
| V2X\_20\_n38 | 20 | Uu |
| n38 | PC5 |
| V2X\_ n71\_47 | 47 | PC5 |
| n71 | Uu |
| V2X\_n71\_(n) 471 | 47 | PC5 |
| n47 | PC5 |
| n71 | Uu |
| NOTE 1: Only single switched SL in ITS band is supported. |

## 5.3 UE Channel bandwidth

## 5.3A UE Channel bandwidth for CA

### 5.3A.1 Inter-band CA between FR1 and FR2

For inter-band NR CA between FR1 and FR2, a carrier aggregation configuration is a combination of operating bands, each supporting a carrier aggregation bandwidth class as specified in clause 5.3A.5 of TS 38.101-1 [2] and clause 5.3A.4 of TS 38.101-2 [3] independently.

**<Next Change>**

## 5.3E UE Channel bandwidth for V2X

The requirements specified in clause 5.3B are applicable to NR V2X UE.

### 5.3E.1 Intra-band contiguous V2X in FR1

For intra-band contiguous E-UTRA NR V2X UE, an EN-DC bandwidth class in Table 5.3.B-1 are considered to specify the V2X transmission/reception configurations.

Bandwidth combination sets and V2X transmission/reception configurations for intra-band contiguous V2X UE are specified in Table 5.3E.1-1.

Table 5.3E.1-1: E-UTRA-NR V2X configurations and bandwidth combination sets for intra-band contiguous V2X UE

| **V2X configuration** | **SL transmisison band** | Channel bandwidths for E-UTRA carrier (MHz) | Channel bandwidths for NR carrier (MHz) | **Maximum aggregated bandwidth (MHz)** | **Bandwidth combination set** |
| --- | --- | --- | --- | --- | --- |
| V2X\_(n)47AA | E-UTRA Band 47 or NR band n47 | 10 | 10,20,30,40 | 60 | 0 |
| 20 | 10,20,30,40 |

### 5.3E.2 Intra-band non-contiguous V2X in FR1

For intra-band non-contiguous E-UTRA NR V2X UE, an EN-DC bandwidth class in Table 5.3.B-1 are considered to specify the V2X transmission/reception configurations.

Bandwidth combination sets and SL transmission/reception configurations for intra-band non-contiguous V2X are specified in Table 5.3E.2-1.

Table 5.3E.2-1: E-UTRA-NR V2X configurations and bandwidth combination sets for intra-band non-contiguous V2X UE

| **V2X configuration** | **SL transmisison band** | Channel bandwidths for E-UTRA carrier (MHz) | Channel bandwidths for NR carrier (MHz) | **Maximum aggregated bandwidth (MHz)** | **Bandwidth combination set** |
| --- | --- | --- | --- | --- | --- |
| V2X\_47A\_n47A | E-UTRA Band 47 or NR band n47 | 10 | 10,20,30,40 | 60 | 0 |
| 20 | 10,20,30,40 |

### 5.3E.3 Inter-band V2X in FR1

For inter-band E-UTRA NR V2X UE, the each channel bandwidth for inter-band V2X operations in FR1 is specified in TS 36.101 [4] and TS 38.101-1 [2], respectively.

## 5.4 Void

## 5.4A Channel arrangement for CA

The channel arrangement for CA operations in FR1 and FR2 as specified in TS 38.101-1 [2] and TS 38.101-2 [3], respectively.

**<Next Change>**

## 5.4E Channel arrangement for V2X operation in FR1

The channel arrangement for intra-band or inter-band V2X operations in FR1 is specified in TS 36.101 [4] and TS 38.101-1 [2], respectively.

### 5.4E.1 Channel spacing

For intra-band E-UTRA NR V2X operation with two carriers, the nominal channel spacing between E-UTRA carrier and an adjacent NR carrier is defined as following:

- For NR operating bands with 15 kHz channel raster,

 Nominal Channel spacing = (BWE-UTRA\_Channel + BWNR\_Channel)/2+{-5kHz, 0kHz, 5kHz}

where BWE-UTRA\_Channel and BWNR\_Channel are the channel bandwidths of the E-UTRA and NR carriers, ∆FRaster is the band dependent channel raster granularity defined in TS38.101-1[2]. The channel spacing can be adjusted depending on the channel raster to optimize performance in a particular deployment scenario.

For intra-band non-contiguous E-UTRA NR V2X the channel spacing between E-UTRA and NR carriers shall be larger than the nominal channel spacing defined in this clause.

### 5.4E.2 Channel raster

For intra-band contiguous or non-contiguous V2X operation with two carriers, the each channel raster of E-UTRA V2X carrier or NR V2X carrier is applied, respectively.

## 5.5 Configuration

## 5.5A Configuration for CA

#### 5.5A.1 Inter-band CA configurations between FR1 and FR2

The configurations for operating bands for CA including Band n41 also apply for the corresponding operating bands for CA with Band n90 replacing Band n41 but with otherwise identical parameters. For brevity the said configuration for operating bands for CA with Band n90 are not listed in the tables below but are covered by this specification.

**<Next Change>**

## 5.5E Configuration for V2X operation

### 5.5E.1 General

The operating bands and bandwidth classes are specified for V2X operation.

### 5.5E.2 Intra-band contiguous V2X operation in FR1

Table 5.5E.2-1: Intra-band contiguous V2X configurations

|  |  |
| --- | --- |
| V2Xconfiguration | SL transmission |
| V2X\_(n)47AA | E-UTRA Band 47 or NR band n47 |
| NOTE 1: Only single switched SL is supported. |

### 5.5E.3 Intra-band non-contiguous V2X operation in FR1

Table 5.5E.3-1: Intra-band non-contiguous V2X configurations

|  |  |
| --- | --- |
| V2Xconfiguration | SL transmission |
| V2X\_47A\_n47A | E-UTRA Band 47 or NR band n47 |
| NOTE 1: Only single switched SL is supported. |

### 5.5E.4 Inter-band V2X operation in FR1

#### 5.5E.4.1 Inter-band V2X configurations within FR1 (two bands)

Table 5.5E.4.1-1: Inter-band V2X configurations

|  |  |
| --- | --- |
| V2Xconfiguration |  V2X transmission configuration |
| V2X\_20A\_n38A | V2X\_20A\_n38A |
| V2X\_ n71A\_47A | V2X\_n71A\_47A |
| NOTE 1: V2X transmission configurations are the configurations supported by the present release of specifications. |

**<Next Change>**

## 6.2E Transmitter power for V2X in FR1

For the V2X operation bands specified in Table 5.2E.1-1.

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

#### 6.2E.1.1 UE maximum output power for Intra-band contiguous V2X

For intra-band contiguous V2X operating UE, the allowed UE maximum output power shall be applied in Table 6.2.2-1[4] for E-UTRA SL transmission or applied in Table 6.2.1-1 [2] for NR SL transmission, respectively.

Table 6.2E.1.1-1: Maximum output power for V2X combination (continuous sub-blocks)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| V2X configuration | Power class 2(dBm) | Tolerance(dB) | Power class 3(dBm) | Tolerance(dB) |
| DC\_(n)47AA |  |  | 23 | +2/-21 |
| 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: Power Class 3 is the default power class unless otherwise stated.NOTE 3: Only single switched UL is supported |

#### 6.2E.1.2 UE maximum output power for Intra-band non-contuous V2X

For intra-band non-contiguous V2X operating UE, the allowed UE maximum output power shall be applied in Table 6.2.2-1[4] for E-UTRA SL transmission or applied in Table 6.2.1-1 [2] for NR SL transmission, respectively.

Table 6.2E.1.2-1: Maximum output power for V2X combination (non-continuous sub-blocks)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| V2X configuration | Power class 2(dBm) | Tolerance(dB) | Power class 3(dBm) | Tolerance(dB) |
| DC\_47A\_n47A |  |  | 23 | +2/-21 |
| 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: Power Class 3 is the default power class unless otherwise stated.NOTE 3: Only single switched UL is supported |

#### 6.2E.1.2 UE maximum output power for Inter-band V2X

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.1.2-1: Con-current V2X UE Power Class

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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\_20A\_n38A |  |  |  |  | 23 | +2/-32 |  |  |
| V2X\_n71A\_47A |  |  |  |  | 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 |

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

#### 6.2E.2.1 UE maximum output power reduction for Intra-band V2X

For intra-band V2X operating UE, maximum output power reduction specified in clause 6.2.3G [4] and in clause 6.2E.2 [2] apply, respectively.

#### 6.2E.2.2 UE maximum output power reduction for Inter-band V2X

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 6.2.3 of TS 36.101 [4] apply for E-UTRA Uu operation in licensed band, and the MPR requirements in subclause 6.2E.2 of TS 38.101-1 [2] apply for NR sidelink operation in Band n47.

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

#### 6.2E.3.1 UE additional maximum output power reduction for Intra-band V2X

For intra-band V2X operating UE, additional maximum output power reduction specified in clause 6.2.4G [4] and in clause 6.2E.3 [2] apply, respectively.

#### 6.2E.3.2 UE additional maximum output power reduction for Inter-band V2X

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 of TS 36.101 [4] apply for E-UTRA Uu operation in licensed band, and the A-MPR requirements in in subclause 6.2E.3 of TS 38.101-1 [2] apply for NR sidelink operation in Band n47.

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

#### 6.2E.4.1 UE configured output power for Intra-band V2X

For intra-band V2X operating UE, each UE configured output power specified in clause 6.2.5G [4] and in clause 6.2E.4 [2] apply, respectively.

#### 6.2E.4.2 UE configured output power for Inter-band V2X

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*,*E-UTRA*and PCMAX,*c*,*V2X*for the configured E-UTRA 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*,*E-UTRA(p)* in subframe *p* for the configured E-UTRA uplink carrier shall be set within the bounds:

PCMAX\_L,*c, E-UTRA* (*p*) ≤ PCMAX,*c, E-UTRA* (*p*) ≤ PCMAX\_H,*c, E-UTRA* (*p*)

where PCMAX\_L,*c,E-UTRA* andPCMAX\_H,*c, E-UTRA* are the limits for a serving cell c as specified in subclause 6.2.5 TS 36.101 [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 of TS 38.101-1 [2].

The total UE configured maximum output power PCMAX (*p,q*) in a subframe *p* of E-UTRA 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,E-UTRA* (*p*)

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

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

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

PUMAX = 10 log10 [pUMAX,*c,E-UTRA* + pUMAX,*c,V2X*],

where pUMAX,*c,E-UTRA*  denotes the measured output power of serving cell *c* for the configured E-UTRA 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).*

## 6.3 Output power dynamics

Output power dynamics for EN-DC operations in FR1 and FR2 as specified in TS 38.101-1 [2] and TS 38.101-2 [3], respectively. E-UTRA as specified in TS 36.101 [4]. For intra-band contiguous EN-DC operation in FR1, minimum output power requirements specified in clause 6.3.1 of TS 38.101-1 [2] and clause 6.3.2 of TS 36.101 [4] shall only apply when the power of all NR and E-UTRA carriers are set to minimum value. Similarly, OFF power requirements specified in clause 6.3.2 of TS 38.101-1 [2] and clause 6.3.3 of TS 36.101 [4] shall only apply when the power of all NR and E-UTRA carriers are OFF. The OFF power condition in transmit ON/OFF time mask requirements specified in clause 6.3.3 of TS 38.101-1 [2] and clause 6.3.4 of TS 36.101 [4] is applicable only when all NR and E-UTRA carriers are OFF. If both E-UTRA and NR transition between ON and OFF states simultaneously, the longer transient time shall apply to both. If either E-UTRA or NR is OFF and the other carrier transitions from OFF to ON, then the transiet time associated with that carrier applies.

**<Next Change>**

6.3E Output power dynamics for V2X operation in FR1

### 6.3E.1 General

The E-UTRA SL and NR SL switching time mask defines the observation period between E-UTRA subframe and NR slot/mini-slot boundary. Both E-UTRA subframe and NR slot/mini-slot have ON power transmissions. The ON power is defined as the mean power over the symbol duration excluding any transient period. For E-UTRA subframe or NR slot/mini-slot having OFF power transmission, the general time mask for E-UTRA or NR shall apply.

For intra-band V2X operation, the output power dynamics specified in clause 6.3.2G, 6.3.3G, 6.3.4G and 6.3.5G [4] shall be applied for E-UTRA SL transmission or the output power dynamics specified in clause 6.3E [2] shall be applied for NR SL transmission, respectively.

For the inter-band con-current NR V2X operation, output power dynamics requirement specified in subclause 6.3 of TS 36.101 [4] shall apply for the E-UTRA uplink in licensed band and the requirements specified in subclause 6.3E of TS 38.101-1 [2] shall apply for the sidelink in NR Band n47.

### 6.3E.2 Output power dynamics for intra-band V2X operation

For intra-band V2X operation bands UE specified in subclause 5.3E.1 and 5.3E.2, the maximum UL switching time masks in Figure 6.3E.2-1 and Figure 6.3E.2-2 shall apply.



Figure 6.3E.2-1: Time mask for switching between NR V2X SL and E-UTRA V2X SL



Figure 6.3E.2-2: Time mask for switching between E-UTRA V2X SL and NR V2X SL

## 6.4 Void

## 6.4A Transmit signal quality for CA

**<Next Change>**

## 6.4E Transmit signal quality for V2X operation in FR1

6.4E.1 Frequency error for V2X

For intra-band V2X operating UE, the requirement shall apply on each component carrier as defined in clause 6.5.1G in TS 36.101 [4] and in clause 6.4E.1 in TS 38.101-1 [2], respectively.

For the inter-band con-current NR V2X operation, the requirements specified in subclause 6.4.1 of TS 36.101 [4] shall apply for the E-UTRA uplink in licensed band and the requirements specified in subclause 6.4E.1 of TS 38.101-1 [2] shall apply for the sidelink in NR Band n47.

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

#### 6.4E.2.1 Transmit modulation quality for Intra-band V2X

##### 6.4E.2.2.1 Error Vector Magnitude

For intra-band V2X operating UE, the requirement shall apply on each SL transmission as defined in clause 6.5.2G.1 in TS 36.101 [4] and in clause 6.4E.2.1 in TS 38.101-1 [2], respectively.

For the inter-band con-current NR V2X operation, the requirements specified in subclause 6.5.2 of TS 36.101 [4] shall apply for the E-UTRA uplink in licensed band and the requirements specified in subclause 6.4E.2.1 of TS 38.101-1 [2] shall apply for the sidelink in NR Band n47.

##### 6.4E.2.2.2 Carrier leakage

For intra-band V2X operating UE, the requirement shall apply on each SL transmission as defined in clause 6.5.2G.2 in TS 36.101 [4] and in clause 6.4E.2.2 in TS 38.101-1 [2], respectively.

##### 6.4E.2.2.3 In-band emissions

For intra-band V2X operating UE, the requirement shall apply on each SL transmission as defined in clause 6.5.2G.3 in TS 36.101 [4] and in clause 6.4E.2.3 in TS 38.101-1 [2], respectively.

#### 6.4E.2.2 Transmit modulation quality for Inter-band V2X

For inter-band V2X with transmission assigned to one E-UTRA band and one NR band, the requirements shall apply on each component carrier as defined in clause 6.5.2 in TS 36.101 [4] and in clause 6.4.2 in TS 38.101-1 [2], respectively, with all component carriers active. If multiple component carriers are assigned to one E-UTRA band, the requirements in clauses 6.5.2A in TS 36.101 [4] apply for those component carriers.

## 6.5 Void

## 6.5A Output RF spectrum emissions for CA

**<Next Change>**

## 6.5E Output RF spectrum emissions for V2X operation in FR1

### 6.5E.1 Occupied bandwidth

6.5E.1.1 Intra-band V2X

For intra-band V2X, the occupied bandwidth specified in clause 6.6.1G in TS36.101 [4] and specified in clause 6.5E.1 in TS 38.101-1 [2] apply for each frequency range respectively.

#### 6.5E.1.2 inter-band V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 6.6.1 of TS 36.101 [4] shall apply for the E-UTRA uplink in licensed band and the requirements specified in subclause 6.5E.1 of TS 38.101-1 [2] shall apply for the sidelink in NR Band n47.

### 6.5E.2 Out-of-band emissions

#### 6.5E.2.1 Intra-band V2X

For intra-band V2X, out-of-band emissions specified in clause 6.6.2G in TS36.101 [4] and specified in clause 6.5E.2 in TS 38.101-1 [2] apply for each frequency range respectively.

#### 6.5E.2.2 Inter-band V2X con-current operation

For the inter-band con-current NR V2X operation, the general SEM/additional SEM requirements and ACLR specified in subclause 6.6.2 of TS 36.101 [4] shall apply for the E-UTRA uplink in licensed band and the general SEM/additional SEM and ACLR requirements specified in subclause 6.5E.2 of TS 38.101-1 [2] shall apply for the sidelink in NR Band n47.

### 6.5E.3 Spurious emissions

#### 6.5E.3.1 Intra-band V2X

##### 6.5E.3.1.1 General spurious emissions

For intra-band V2X, the general spurious emissions requirements specified in clause 6.6.3.1 of TS 36.101 [4] and clause 6.5E.3.1 of TS 38.101-1 [2] apply for each frequency range respectively.

##### 6.5E.3.1.2 Spurious emission band UE co-existence

For intra-band V2X, the spurious emissions band UE co-existence requirements specified in clause 6.6.3.2 of TS 36.101 [4] and clause 6.5E.3.2 of TS 38.101-1 [2] apply for each frequency range respectively.

#### 6.5E.3.2 Inter-band V2X con-current operation

##### 6.5E.3.2.1 General spurious emissions

For inter-band V2X, the general spurious emissions requirements specified in clause 6.6.3.1 of TS 36.101 [4] and clause 6.5E.3.1 of TS 38.101-1 [2] apply for each frequency range respectively.

##### 6.5E.3.2.2 Spurious emission band UE co-existence

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 E-UTRA uplink in licensed band and sidelink in NR 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\_20\_n38  | E-UTRA Band 1, 3, 8, 22, 31, 32, 33, 34, 40, 43, 50, 51, 65, 67, 68, 72, 74, 75, 76 | FDL\_low | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 42, 52 | FDL\_low | - | FDL\_high | -50 | 1 | 1 |
| E-UTRA Band 20 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| V2X\_n71\_47\_ | E-UTRA Band 4, 5, 12, 13, 14, 17, 24, 26, 30, 48, 53, 66, 85 | FDL\_low  | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 2, 25, 41, 70 | FDL\_low | - | FDL\_high | -50 | 1 | 1 |
| E-UTRA Band 29 | FDL\_low | - | FDL\_high | -38 | 1 | 2 |
| E-UTRA Band 71 | FDL\_low  | - | FDL\_high | -50 | 1 | 2 |
| 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. |

### 6.5E.4 Transmit intermodulation

#### 6.5E.4.1 Intra-band V2X

For intra-band V2X, transmit intermodulation requirements specified in clause 6.7.1G of TS 36.101 [4] and clause 6.5E.4 of TS 38.101-1 [2] apply for each frequency range respectively.

#### 6.5E.4.2 Inter-band V2X con-current operation

For the inter-band con-current NR V2X operation, the requirements specified in subclause 6.7.1 of TS 36.101 [4] shall apply for the E-UTRA uplink in licensed band and the requirements specified in subclause 6.5E.4 of TS 38.101-1 [2] shall apply for the sidelink in NR Band n47.

### **<Next Change>**

## 7.3E Reference sensitivity for V2X operation in FR1

### 7.3E.1 General

For V2X operation, REFSENS requirements defined in TS 38.101-1 [2] and TS 36.101 [4] apply to all downlink bands of V2X configurations listed in clause 5.5E, unless sensitivity degradation exception is allowed in this clause of this specification, clause 7.3E in TS 38.101-1 [2] or clause 7.3.1G in TS 36.101 [4].

In case of intra-band V2X, the each REFSENS requirements specified in clause 7.3.1G of TS 36.101 [4] and clause 7.3E.2 of TS 38.101-1 [2] apply when all SL reception CCs are activated at same time.

### 7.3E.2 Reference sensitivity for V2X

#### 7.3E.2.1 Intra-band contiguous V2X

#### 7.3E.2.2 Intra-band non-contiguous V2X

#### 7.3E.2.3 Inter-band V2X con-current operation

When UE is configured for NR V2X reception on V2X carrier con-current with E-UTRA 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 with parameters specified in Table 7.3E.2-1. Also the E-UTRA 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 E-UTRA downlink inter-band con-current configuration in Table 7.3E.2-2, the minimum requirement for reference sensitivity shall be increased by the amount given in ΔRIB,c in Table 7.3E.2-2 for the corresponding NR V2X/E-UTRA band.

Table 7.3E.2-1: Reference sensitivity for V2X Communication QPSK PREFSENS

|  |  |  |
| --- | --- | --- |
| Inter-band V2X reception |  | Channel bandwidth |
| NR V2X Band | E-UTRA or V2X band | Band | SCS (kHz) | 5 MHz(dBm) | 10 MHz(dBm) | 15 MHz(dBm) | 20 MHz(dBm) | 30 MHz (dBm) | 40 MHz (dBm) | Duplex Mode |
| n38 | 20 | 20 | 15 | -97 | -94 | -91.2 | -90 |  |  | FDD |
| n38 | 15 |  | -96.7 |  | -93.5 |  | -90.6 | TDD |
| 30 |  | -97.3 |  | -93.6 |  | -90.5 |
| 60 |  | -96.9 |  | -94.3 |  | -90.6 |
| n71 | 47 | 47 | 15 |  | -90.4 |  | -87.5 |  |  | FDD |
| n71 | 15 | -97.2 | -94.0 | -91.6 | -86.0 |  |  | HD |
| 30 |  | -94.3 | -91.9 | -87.4 |  |  |
| 60 |  |  |  |  |  |  |

Table 7.3E.2-2: ΔRIB,c (two bands)

|  |  |  |
| --- | --- | --- |
| V2X inter-band con-current band Combination | V2X operating Band | ΔRIB,c [dB] |
| V2X\_20\_n38 | 20 | 0.3 |
| n38 | 0.3 |
| V2X\_n71\_47 | 47 | 0.3 |
| n71 | 0.3 |

The reference sensitivity is defined to be met with Uu uplink assigned to one band (that differs from the V2X operating band) and all E-UTRA downlink carriers active. The Uu uplink resource blocks shall be located as close as possible to V2X operating band but confined within the transmission bandwidth configuration for the channel. The uplink configuration for the NR V2X/E-UTRA operating band is specified in Table 7.3E.2-3 and 7.3E.2-4. The REFSENS of Uu downlink and PC5 sidelink will be tested at the same time.

Table 7.3E.2-3: Uplink configuration for REFSENS of V2X Bands

|  |  |
| --- | --- |
| **Inter-band V2X configuration** | **Uu UL band / Channel BW / NRB / Duplex mode** |
| **V2X band (PC5)** | **V2X band (Uu)** | **V2X band (Uu)** | **Channel Bandwidth (MHz)** | **NRB** | **Duplex Mode** |
| n38 | 20 | 20 | 10 | 50 | FDD |
| 47 | n71 | n71 | 10 | 25 | FDD |

Table 7.3E.2-4: Sidelink TX configuration for REFSENS of NR/E-UTRA Bands

|  |  |
| --- | --- |
| **Inter-band V2X configuration** | **NR SL band / Channel BW / NRB / Duplex mode** |
| **V2X band (PC5)** | **V2X band (Uu)** | **V2X band (PC5)** | **Channel Bandwidth (MHz)** | **NRB** | **Duplex Mode** |
| n38 | 20 | n38 | 10 | 50 | TDD |
| 47 | n71 | n47 | 10 | 50 | HD |

## 7.4 Void

## 7.4A Maximum input level for CA

For inter-band NR CA between FR1 and FR2, the maximum input level specified in TS 38.101-1 [2] and TS 38.101-2 [3] apply for FR1 and FR2 respectively.

### **<Next Change>**

## 7.4E Maximum input level for V2X operation in FR1

For intra-band V2X UE, the maximum input requirements specified in clause 7.4.1G of TS 36.101 [4] and clause 7.4E.2 of TS 38.101-1 [2] apply when all SL reception CCs are activated at same time.

For the inter-band con-current NR V2X operation, the requirements specified in subclause 7.4E of TS 38.101-1 [2] shall apply for the NR sidelink reception in Band n47 and the requirements specified in subclause 7.4.1 of TS 36.101 [4] shall apply for the E-UTRA downlink reception in licensed band while all downlink carriers are active.

## 7.5 Void

## 7.5A Adjacent channel selectivity for CA

For inter-band NR CA between FR1 and FR2, the adjacent channel selectivity specified in TS 38.101-1 [2] and TS 38.101-2 [3] apply for FR1 and FR2 respectively.

### **<Next Change>**

## 7.5E Adjacent channel selectivity for V2X operation in FR1

For intra-band V2X operation, the adjacent channel selectivity specified in clause 7.5.1G in TS 36.101 [4] and specified in clause 7.5E in TS 38.101-1 [2] apply when all SL reception CCs are activated at same time.

For the inter-band con-current NR V2X operation, the requirements specified in subclause 7.5E of TS 38.101-1 [2] shall apply for the NR sidelink reception in Band n47 and the requirements specified in subclause 7.5.1 of TS 36.101 [4] shall apply for the E-UTRA downlink reception in licensed band while all downlink carriers are active.

## 7.6 Void

## 7.6A Blocking characteristics for CA

For inter-band NR CA between FR1 and FR2, the in-band blocking characteristics specified in TS 38.101-1 [2] and TS 38.101-2 [3] apply for FR1 and FR2 respectively. The narrow band blocking and out-of-band blocking specified in TS 38.101-1 [2] apply for FR1.

### **<Next Change>**

## 7.6E Blocking characteristics for V2X in FR1

For intra-band V2X operation, the blocking charateristics specified in clause 7.6.1.1G in TS 36.101 [4] and specified in clause 7.6E in TS 38.101-1 [2] apply when all SL reception CCs are activated at same time.

For inter-band con-current NR V2X operation, the in-band blocking and out of band blocking requirement specified in clause 7.6E in TS38.101-1 [2] shall apply on NR V2X carrier and the requirement specified in clause 7.6 in TS36.101 [4] shall apply for the E-UTRA downlink reception in licensed band while all downlink carriers are active. PInterferer power is increased by ΔRIB,c in the requirement.

No narrow band blocking requirement applied for NR V2X carrier.

## 7.7 Void

## 7.7A Spurious response for CA

For inter-band NR CA between FR1 and FR2, the spurious response specified in TS 38.101-1 [2] apply for FR1.

**<Next Change>**

## 7.7E Spurious response for V2X in FR1

For intra-band V2X operation, the spurious response specified in clause 7.7.1G in TS 36.101 [4] and specified in clause 7.7E in TS 38.101-1 [2] apply when all SL reception CCs are activated at same time.

For the inter-band con-current NR V2X operation, the requirements specified in subclause 7.7E of TS 38.101-1 [2] shall apply for the NR sidelink reception in Band n47 and the requirements specified in subclause 7.7.1 of TS 36.101 [4] shall apply for the E-UTRA downlink reception in licensed band while all downlink carriers are active.

## 7.8 Void

## 7.8A Intermodulation characteristics for CA

For inter-band NR CA between FR1 and FR2, the intermodulation characteristics specified in TS 38.101-1 [2] apply for FR1.

## **<Next Change>**

## 7.8E Intermodulation characteristics for V2X operation in FR1

For intra-band V2X operation, the intermodulation characteristics specified in clause 7.8.1G in TS 36.101 [4] and specified in clause 7.8E in TS 38.101-1 [2] apply when all SL reception CCs are activated at same time.

For inter-band NR V2X con-current operation, the wideband inter-modulation requirement specified in clause 7.8E in TS38.101-1 [2] shall apply on NR V2X carrier and the requirement specified in clause 7.8.1 in TS36.101 [4] shall apply on E-UTRA downlink reception in licensed band while all downlink carriers are active. PInterferer power is increased by ΔRIB,c in the requirement.

## **<End of Change>**