**3GPP TSG RAN WG4 Meeting #94-e R4-2002761**

**Online, 24th Feb. – 6th March., 2020**

### **Agenda Item: 8.4.4.1**

### **Source: LG Electronics**

### **Title: TP on revised MPR simulation assumptions and update NR requirements to cover open issues**

**Document for: Approval**

## Introduction

 In the last RAN4 #93 meetings and e-mail discussion, RAN4 agreed the general MPR simulation assumptions for NR V2X service. Also ON/OFF time mask was updated and proposed the update NR requirements for con-current operation at licensed bands at FR1 based on operator request.

In this paper, we propose the revised MPR simulation assumptions, ON/OFF time mask and update NR RF requirements to support con-current NR V2X operation at licensed band at FR1.

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\* Start of the TP in TR38.886 \*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*

# 8 Transmitter characteristics

*<Unchanged sections are omitted>*

### 8.1.2 UE maximum output power reduction

The following assumption can serve as a starting point for MPR simulation assumptions as shown in Table 8.1.2-1 and Table 8.1.2-2.

Table 8.1.2-1: MPR simulation assumption for NR V2X

|  |  |
| --- | --- |
| **parameter** | **Assumption** |
| **center frequency** | **2.7GHz/5.9GHz** |
| **Bandwidth** | **10/20/30/40MHz** |
| **Maximum output power** | **23dBm** |
| **numerology** | **15 kHz/30kHz/60kHz** |
| **Modulation** | **QPSK/16QAM/64QAM/256QAM** |
| **Waveform** | **CP-OFDM** |
| **Carrier leakage** | **25dBc** |
| **IQ image** | **25dBc** |
| **CIM3** | **45dBc or 60dBc** |
| **PA calibration** | PA calibrated to deliver -30dBc ACLR for a fully allocated RBs in 20MHz QPSK DFT-S-OFDM waveform at 1dB MPR.This is based to share PA between LTE V2X and NR V2X at 5.9GHz as worst case. |

For NR V2X, simultaneous transmission of PSCCH and PSSCH in the same subframe is supported. The following constraints in table 8.1.2-2 can be assumed based on current RAN1’s agreement.

Table 8.1.2-2: MPR simulation assumption based on RAN1’s agreement

|  |  |
| --- | --- |
| **Items** | **Assumption** |
| **Allowed sub-channel sizes** | **• Support {10, 15, 20, 25, 50, 75, 100} PRBs for possible sub-channel size.** |
| Allowed LCRB allocation | 10,15,20,25,30,40,45,50,60,70,75,80,90,100,105,110,120,130,135,140,150,160,165,170,175,180,190,195,200,210 |
| **Regarding PSCCH / PSSCH multiplexing** |  |
| **PSCCH size** | **10RB\*3 Symbols** |
| **PSD offset of X dB between PSCCH and PSSCH** | **0dB** |

For simultaneous transmission of PSFCH, RAN4 assumed as follow

* The baseline MPR simulation assumptions for multiple PSFCH transmission
	+ 1 RB per user
	+ Both Non-contiguous PSFCH RB allocation and contiguous PSFCH allocation are allowed
		- MPR will be derived by non-contiguous PSFCH RB allocation
	+ Total power of all users equals 23dBm
	+ All users have the same power per RB
	+ Simulation parameters as per Table 8.1.2-1 and Table 8.1.2-2
	+ Feedback sequences are per Section 5.2 TS 38.211
	+ The MPR will be specified as a formula or table based on number of allocated RBs.
	+ PSFCH generation shall be based on existing RAN1 agreements
	+ Assumption of N in RAN4 is only for MPR simulation purpose, the final number is up to RAN1 decision

Based on the simulation, RAN4 specify MPR requirements as follow

When UE is configured for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions for NR V2X operating bands specified in Table 8.1-1, this subclause specifies the allowed Maximum Power Reduction (MPR) power for NR V2X physical channels and signals due to PSCCH and PSSCH simultaneous transmission.

#### 8.1.2.1 MPR for Power class 3 V2X UE

For contiguous allocation of PSCCH and PSSCH simultaneous transmission, the allowed MPR for the maximum output power for NR V2X physical channels PSCCH and PSSCH shall be specified as inner/outer RB allocations in Table 8.1.2.1-1 for power class 3.

Table 8.1.2.1-1: Maximum Power Reduction (MPR) for power class 3 NR V2X (Contiguous PSCCH and PSSCH transmission)

|  |  |
| --- | --- |
| **Modulation** | **Channel bandwidth/MPR (dB)** |
| **Outer RB allocations** | **Inner RB allocations** |
| CP-OFDM  | QPSK/16QAM | ≤ [4.0] | ≤ [2.0] |
| 64 QAM | ≤ [4.5] | ≤ [3.5] |
| 256 QAM | ≤ [6.0] |

Where the following parameters are defined to specify valid RB allocation ranges for Outer and Inner RB allocations:

NRB is the maximum number of RBs for a given Channel bandwidth and sub-carrier spacing defined in Table 5.3.2-1 in TS38.101-1.

RBStart,Low = max(1, floor(LCRB/2))

where max() indicates the largest value of all arguments and floor(x) is the greatest integer less than or equal to x.

RBStart,High = NRB – RBStart,Low – LCRB

The RB allocation is an Inner RB allocation if the following conditions are met

RBStart,Low ≤ RBStart ≤ RBStart,High,and

LCRB ≤ ceil(NRB/2)

where ceil(x) is the smallest integer greater than or equal to x.

For non-contiguous allocation for simultaneous PSFCH transmission for NR V2X will be specified as follow

MPR\_PSFCH = CEIL {MA\_PSFCH, 0.5}

Where MA is defined as follows

MA\_PSFCH = TBD ; 0.00< A ≤ TBD

TBD ; TBD< A ≤TBD

TBD ; TBD< A ≤1.00

Where

 A = NRB\_alloc / NRB.

CEIL{MA, 0.5} means rounding upwards to closest 0.5dB.

The allowed MPR for the maximum output power for V2X physical channels PSBCH and PSSS shall be applied the legacy NR Uu requirements in subclause 6.2.2 in TS38.101-1 for the corresponding modulation and transmission bandwidth.

The allowed MPR for the maximum output power for NR V2X physical signal SSSS is FFS.

*<Unchanged sections are omitted>*

### 8.1.7 ON/OFF time mask for NR V2X UE

For NR V2X service, additional requirements on ON/OFF time masks for V2X physical channels and signals are specified in this clause.

#### 8.1.7.1 General time mask for NR V2X UE

The General ON/OFF time mask defines the observation period between the Transmit OFF and ON power and between Transmit ON and OFF power for PSCCH, and PSSCH transmissions in a subframe wherein the last symbol is punctured to create a guard period.

 Figure 8.1.7.1-1: General PSCCH/PSSCH time mask for NR V2X UE

8.1.7.2 PSSS / SSSS / PSBCH time mask The PSSS/SSSS/PSBCH time mask defines the observation period between SSSS and adjacent PSSS/PSBCH symbols in a subframe, with last symbol punctured to create a guard period.



**Figure 8.1.7.3-1: PSSS/SSSS/PBCH time mask for NR V2X UE**

*<Unchanged sections are omitted>*

## 10.2 NR V2X SL operation and LTE/NR Uu operation both in licensed band for FR1

### 10.2.1 Tx requirements for inter-band con-current EN-V2X operation

#### 10.2.1.1 Maximum output power

For the inter-band con-current EN-V2X operation at licensed bands in FR1, the following EN-V2X UE Power Classes define the maximum output power for any transmission bandwidth within the channel bandwidth. The period of measurement shall be at least one sub frame (1ms).

Table 10.2.1.1-1: Con-current EN-V2X UE Power Class for uplink inter-band combination (two bands)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| EN-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) |
| EN V2X\_20A\_n38A |  |  |  |  | 23 | +2/-34 |  |  |
| 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 |

#### 10.2.1.2 UE maximum output power reduction

For the inter-band con-current EN-V2X operation, the allowed maximum power reduction (MPR) for the maximum output power shall be applied per each component carrier based on the legacy MPR requirements per CC for inter-band EN-DC at licensed bands.

#### 10.2.1.3 UE maximum output power with additional requirements

For the inter-band con-current EN-V2X operation, the allowed additional maximum power reduction (A-MPR) for the maximum output power shall be applied per each component carrier based on the legacy A-MPR requirements per CC for inter-band EN-DC at licensed bands.

#### 10.2.1.4 Configured transmitted power

For the inter-band con-current EN-V2X operation, the configured transmitted power requirements for EN-V2X UE shall be applied per each component carrier. The legacy LTE or NR configured transmitted power for inter-band EN DC shall be decided by MPR*c* and A-MPR*c* of each CC*.*

If the total transmitted power is over the power class of the EN-V2X UE or given PEMAX,*c* for NR V2X service, the UE shall compare the priority between the legacy LTE service on licensed band and NR SL V2X service at licensed band. Based on the priority, the configured transmitted power will be decided which transmission will be applied on power scale down or dropping between the legacy LTE Uu transmission and NR V2X SL transmission at licensed band.

#### 10.2.1.5 UE Minimum output power

Expected no need to change the requirements for inter-band con-current EN-V2X UE. The legacy minimum output power requirements will be applied on each CC of LTE or NR bands.

#### 10.2.1.6 Transmit OFF power

Expected no need to change the requirements for inter-band con-current EN-V2X UE. The legacy transmit OFF power requirements will be applied on each CC of LTE or NR bands.

#### 10.2.1.7 ON/OFF time mask

When UE support inter-band con-current EN-V2X operation in Table 10.2-1, the existing general time mask for LTE or NR UE will be applied on LTE or NR Uu operation CC in LTE or NR licensed band and the NR V2X general time mask for NR V2X UE will be applied on NR SL operation CC.

#### 10.2.1.8 Power control

Expected no need to change the requirements for inter-band con-current EN-V2X UE. The legacy power control requirements will be applied on each CC of LTE or NR licensed band the NR V2X power control for NR V2X UE will be applied on NR SL operation CC.

#### Transmit signal quality

##### 10.2.1.9.1 Frequency error

Expected no need to change the requirements for inter-band con-current EN-V2X UE. The legacy frequency error requirements will be applied on each CC of LTE or NR bands.

#####  Transmit modulation quality

###### 10.2.1.9.2.1 Error Vector Magnitude

Expected no need to change the requirements for inter-band con-current EN-V2X UE. The legacy EVM requirements will be applied on each CC of LTE or NR bands.

###### 10.2.1.9.2.2 Carrier leakage

Expected no need to change the requirements for inter-band con-current EN-V2X UE. The legacy carrier leakage requirements will be applied on each CC of LTE or NR bands.

###### 10.2.1.9.2.3 In-band emissions

Expected no need to change the requirements for inter-band con-current EN-V2X UE. The legacy in-band emission requirements will be applied on each CC of LTE or NR bands.

###### 10.2.1.9.2.4 EVM equalizer spectrum flatness

Expected no need to change the requirements for inter-band con-current EN-V2X UE. The legacy spectrum flatness requirements will be applied on each CC of LTE or NR bands.

#### Spectrum emission mask

Expected no need to change the requirements for inter-band con-current EN-V2X UE. The legacy general/additional SEM requirements will be applied on each CC of LTE or NR bands.

####  ACLR requirements

Expected no need to change the requirements for inter-band con-current EN-V2X UE. The legacy ACLR requirements will be applied on each CC of LTE or NR bands.

####  Spurious emission requirements

Expected no need to change the requirements for inter-band con-current EN-V2X UE. The legacy general spurious emission requirements will be applied on each CC of LTE or NR bands.

####  Spurious emission band UE co-existence

This clause specifies the spurious emission requirements of the inter-band con-current V2X operation, for UE-to-UE coexistence to protect legacy protected bands

Table 10.2.1.13-1: Requirements

|  |  |
| --- | --- |
| EN-V2X con-current operating band cofiguration | Spurious emission  |
| Protected band | Frequency range (MHz) | Maximum Level (dBm) | MBW (MHz) | NOTE |
| EN-V2X\_20A\_n38A | E-UTRA Band 1, 2, 3, 4, 5, 8, 10, 12, 13, 14, 17, 20, 22, 27, 28, 29, 30, 31, 32, 33, 34, 40, 42, 43, 50, 51, 52, 65, 66, 67, 68, 72, 74, 75, 76, 85 | FDL\_low  | - | FDL\_high | -50 | 1 |  |
| E-UTRA Band 20 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
| E-UTRA Band 38, 42, 52, 69NR Band n77, n78 | FDL\_low  | - | FDL\_high | -50 | 1 | 1 |
| Frequency range | 758 | - | 788 | -50 | 1 |  |
| Frequency range | 2620 | - | 2645 | -15.5 | 5 | 2, 3, 4 |
| Frequency range | 2645 | - | 2690 | -40 | 1 | 2, 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 6.5.3.1-1 from the edge of the channel bandwidth.NOTE 3: This requirement is applicable for power class 3 UE for any channel bandwidths within the range 2570 - 2615 MHz with the following restriction: for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2605.5 - 2607.5 MHz and for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2597 - 2605 MHz the requirement is applicable only for an uplink transmission bandwidth less than or equal to 54 RB. For power class 2 UE for any channel bandwidths within the range 2570 - 2615 MHz, NS\_44 shall apply. For power class 2 or 3 UE for carriers with channel bandwidth overlapping the frequency range 2615 - 2620 MHz the requirement applies with the maximum output power configured to +19 dBm in the IE P-Max.NOTE 4: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band. |

####  Transmit intermodulation

Expected no need to change the requirements for inter-band con-current EN-V2X UE. The legacy transmit intermodulation requirements will be applied on each CC of LTE or NR bands.

###  Rx requirements for inter-band con-current NR V2X operation

#### REFSENS

For the EN-V2X UE RF receiver requirements, RAN4 can refer the 2DL inter-band CA to define general UE RF Rx requirements for inter-band con-current EN-V2X UE.

The legacy REFSENS requirement will be applied on each CC of NR licensed bands if there was no self-interference problems in own receiver frequency band by own uplink and sidelink transmission.

Table 10.2.2.1-1 and Table 10.2.2.1-2 propose the uplink test configurations for inter-band con-current EN-V2X REFSENS requirements. For the uplink configuration, RAN4 consider 10MHz Channel bandwidth.

Table 10.2.2.1-1: Uplink configuration for reference sensitivity of EN-V2X UE (PC5)

|  |  |
| --- | --- |
| **Inter-band EN-V2X con-current band configuration** | **LTE or NR UL band / Channel BW / NRB / Duplex mode** |
| **EN-V2X band (PC5)** | **LTE or NR band (Uu)** | **LTE or NR UL band** | **Channel Bandwidth (MHz)** | **NRB** | **Duplex Mode** |
| n38 | B20 | B20 | 10 | 50 | FDD |

Table 10.2.2.1-2: SL Tx configuration for reference sensitivity of EN-V2X UE (Uu)

|  |  |
| --- | --- |
| **Inter-band EN-V2X con-current band configuration** | **LTE or NR UL band / Channel BW / NRB / Duplex mode** |
| **V2X band (PC5)** | **LTE or NR band (Uu)** | **NR V2X band (PC5)** | **Channel Bandwidth (MHz)** | **NRB** | **Duplex Mode** |
| n38 | B20 | n38 | 10 | 50 | TDD |

Table 10.2.2.1-3 is proposed the REFSENS requirements with inter-band con-current EN-V2X UE reception.

Table 10.2.2.1-3: Reference sensitivity for EN-V2X QPSK PREFSENS

|  |  |
| --- | --- |
| Inter-band V2X reception | Channel bandwidth |
| V2X Band | LTE or NR band | LTE or NR Band | SCS (kHz) | 10 MHz(dBm) | 15 MHz(dBm) | 20 MHz(dBm) | 25 MHz(dBm) | 30 MHz (dBm) | 40 MHz (dBm) | Duplex Mode |
| n38 | B20 | B20 | 15 | -94 | -91.2 | -90 |  |  |  | FDD |
| n38 | 15 | -96.7 |  | -93.5 |  | -91.7 | -90.6 | TDD |
| 30 | -97.3 |  | -93.6 |  | -91.9 | -90.5 |
| 60 | -96.9 |  | -94.3 |  | -92.7 | -90.6 |

#### Maximum input level

No need to define additional requirements for con-current inter-band V2X operation since NR UE shall meet the requirements per each carrier while all downlink carriers are active.

#### The other Rx requirements

The other Rx requirements for inter-band con-current EN-V2X UE can be reused. The legacy other RX requirement will be applied on each CC of NR licensed bands.

* ACS: Keep the same requirements per CC
* In band Blocking: Keep the same requirements per CC. For the inter-band con-current EN-V2X UE, PInterferer power is increased by ΔRIB,c in the requirement.
* Out-of-Band Blocking: Keep the same requirements per CC. For the inter-band con-current EN-V2X UE, PInterferer power is increased by ΔRIB,c in the requirement.
* Narrow Band Blocking: NR NBB requirements only applied on CC of NR licensed bands.
* Spurious response: Keep the same requirements per CC. For the inter-band con-current EN-V2X UE, PInterferer power is increased by ΔRIB,c in the requirement.
* Wideband inter-modulation: Keep the same requirements per CC. For the inter-band con-current EN-V2X UE, PInterferer power is increased by ΔRIB,c in the requirement.

*<End of Changes>*