**3GPP TSG RAN WG4 #94 meeting R4-200xxxx**

**Athens, Greece, 24th – 28th Feb., 2020**

### **Agenda Item: 9.4.3.2**

### **Source: LG Electronics**

### **Title: A-MPR simulation assumptions and initial results for NR V2X UE at n47**

**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.

In this paper, we propose more detail simulation assumptions for A-MPR requirements to protect adjacent ISM frequencies ranges and CEN DSRC tolling systems.

## Detail simulation assumptions for A-MPR

In rel-14, RAN4 specified A-MPR requirements for LTE V2X SL operation at Band 47 to protect adjacent ISM frequencies ranges and CEN DSRC tolling systems.

The basic A-MPR simulation assumptions for NR V2X UE are same as the MPR simulation parameters as shown in Table 1 and Table 2.

Table 1: Baseline A-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 | 45 or 60 dBc |
| PA calibration | PA calibrated to deliver -30dBc ACLR for a fully allocated RB in 20MHz QPSK DFT-S-OFDM waveform at 1 dB MPR.This is based on assumption to share PA between LTE V2X and NR V2X at 5.9GHz as worst case. |

Table 2: Additional A-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\*3symbol |
| PSD offset of X dB between PSCCH and PSSCH | 0dB |

### **2.1 A-MPR based on A-SEM and A-SE**

In this section, RAN4 need to derive A-MPR requirements to protect adjacent ISM frequency range with the additional A-SEM and A-SE requirements in EN 302 571 standard as shown in Table 3.

For A-SEM and A-SE with NS\_33, the NR V2X UE shall satisfy the following requirements.

Table 3: Additional SEM requirements for 10MHz channel bandwidth in TS36.101

|  |
| --- |
| Spectrum emission limit (dBm EIRP)/ Channel bandwidth |
| ΔfOOB(MHz) | 10 MHz | Measurement bandwidth |
| ± 0-0.5 | [] | 100 kHz |
| ± 0.5-5 | [] | 100 kHz |
| ± 5-10 | [] | 100 kHz |

NOTE 1: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

NOTE 2: Additional SEM for V2X overrides any other requirements in frequency range 5855-5950MHz.

NOTE 3: The EIRP requirement is converted to conducted requirement depend on the supported post antenna connector gain Gpost connector declared by the UE following the principle described in annex I.

Table 4: Additional SE requirements in TS36.101

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 47 | E-UTRA Band 1, 3, 5, 7, 8, 22, 26, 28, 34, 39, 40, 41, 42, 44, 45, 65, 68, 72, 73NR band n77, n78 , n79 | FDL\_low  | - | FDL\_high | -50 | 1 |  |
| Frequency range | 5925 | - | 5950 | -30 EIRP | 1 | 38, 40, 43 |
| Frequency range | 5815 | - | 5855 | -30 EIRP | 1 | 38, 43 |
| NOTE 38: Applicable when NS\_33 or NS\_34 is configured by the pre-configured radio parameters.NOTE 40: 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.NOTE 43: The EIRP requirement is converted to conducted requirement depend on the supported post antenna connector gain Gpost connector declared by the UE following the principle described in annex I. |

Based on the simulation results, the allowed additional Maximum Power Reduction (A-MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) will be specified in TS38.101-1 as below.

Table 5: Additional Maximum Power Reduction (A-MPR) for NR V2X

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Network Signalling value | Requirements (subclause) | NR Band | Channel bandwidth (MHz) | Resources Blocks (*N*RB) | A-MPR (dB) |
| NS\_33 | 6.6.2.2.4 (A-SEM)6.6.3.2 (A-SE) | n47 | 10 | Table 6 |

Table 6: A-MPR for NS\_33

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Carrier frequency(MHz) | Modulation order | Resources Blocks (*N*RB) | Start ResourceBlock | A-MPR (dB) |
| 5860 | QPSK/16-QAM | TBD | TBD | TBD |
| TBD | TBD | TBD |
| TBD | TBD | TBD |
| TBD | TBD | TBD |
| 5870, 5910, 5920 | TBD | TBD | TBD |
| TBD | TBD |
| TBD | TBD |
| 5880, 5890, 5900 | TBD | TBD | TBD |
| TBD | TBD |
| TBD | TBD |

### **2.2 A-MPR to protect CEN DSRC tolling system**

To protect operation of electronic toll collection in the frequency band 5 795 MHz to 5 815 MHz from harmful interference, based on ETSI TS 102 792, RAN4 need to specify the A-MPR requirements. Different co-existence modes to protect CEN DSRC and HDR DSRC are defined in ETSI TS 102 792.

#### 2.2.1 Normal mode

ECC/DEC(08)01 [i.2], ECC/REC(08)01 [i.3], and ETSI EN 302 571 [i.5] regulate output power level and unwanted emissions for ITS stations (see table 2.2.1-1). Operation limited only by these requirements is referred to as normal mode.

Table 2.2.1-1: RX blocking for Normal mode



NOTE: Some ITS-G5A/B/D channels have other limits for the output power level, see ETSI EN 302 571 [i.5], clause 6.3.

#### 2.2.2 Coexistence mode

In coexistence mode additional restrictions apply. These restrictions apply to output power level, unwanted emissions and transmit timing. The restrictions are designed to decrease the interference from ITS stations to a level which implies no harmful performance degradation of CEN DSRC based toll stations.

An ITS station may be designed to operate in coexistence mode all the time.

Four different coexistence modes, designated A, B, C, and D are defined (see table 2.2.2-1). An ITS station shall choose one of these modes when applicable.

Table 2.2.2-1: RX blocking for Coexistence mode



For handling CEN DSRC interference mitigation, RAN4 need to include the additional configured transmitted power requirement and UE to UE coexistence spurious emission requirements for NR V2X UE in TS38.101-1.

The configured maximum output power will be specified as same LTE V2X UE using PRegulatory,c= 10 dBm as follow,

The NR V2X UE is allowed to set its configured maximum output power PCMAX,*c* for carrier f of serving cell *c* in each slot. The configured maximum output power PCMAX,*c* is set within the following bounds:

PCMAX\_L,f,*c* ≤ PCMAX,f,*c* ≤ PCMAX\_H,f,*c* with

 PCMAX\_L,f, *c* = MIN {PEMAX,*c*– TC,*c*, (PPowerClass – ΔPPowerClass) –– MAX(MAX(MPR*c* , A-MPR*c*)+ ΔTIB,c + TC,*c* + ∆TRxSRS, P-MPR*c*), PRegulatory,c }

PCMAX\_H,f, *c* = MIN {PEMAX,*c*, (PPowerClass– ΔPPowerClass), PRegulatory,c }

where

- For the total transmitted power PCMAX,c of PSSCH and PSCCH, PEMAX,c is the value given by IE *maxTxPower*, defined by [TS 38.331], when the UE is not associated with a serving cell on the NR V2X carrier .

- For, PEMAX,*c* is the value given by the IE *maxTxPower* in [TS 38.331] when the UE is not associated with a serving cell on the V2X carrier.

- For, the value is as calculated for  and applying the MPR for SSSS as specified in maximum output power reduction (Section 6.2.2) in TS38.101-1.

- PPowerClass is the maximum UE power specified in Table 6.2.1-1 in TS38.101-1 without taking into account the tolerance specified in the Table 6.2.1-1 in TS38.101-1;

- MPR*c* and A-MPR*c* for serving cell *c* are specified in subclause 6.2.2 and subclause 6.2.3 in TS38.101-1, respectively;

- TIB,c, TC,*c*, ∆TRxSRS, PPoweclass and P-MPR*c* are specified in subclause 6.2.4 in TS38.101-1

- PRegulatory,c= 10 dBm when the CEN DSRC tolling system is nearby NR V2X UE; PRegulatory,c= 33 dBm otherwise.

The maximum output power P*CMAX,PSSCH* and P*CMAX,PSCCH* are derived from PCMAX,c based on 0dB offset between PSSCH and PSCCH.

For the measured configured maximum output power PUMAX,*c* for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions, the same requirement as in subclause 6.2.4 in TS38.101-1 shall be applied.

Also, the additional SE requirement to protect CEN DSRC tolling system will be captured in Spurious Emission band UE co-existence section

When "NS\_33" or “NS 34” is configured from pre-configured radio parameters or the cell and the indication from upper layers has indicated that the UE is within the protection zone of CEN DSRC devices or HDR DSRC devices, the power of any V2X UE emission shall fulfil either one of the two set of conditions.

|  |  |  |
| --- | --- | --- |
|  | Maximum Transmission Power (dBm EIRP) | Emission Limit in Frequency Range 5795-5815 (dBm/MHz EIRP) |
| Condition 1 | 10 | -65 |
| Condition 2 | 10 | -45 |

Based on these analysis results, propose the corresponding TP to capture the required A-MPR levels, configured maximum output power and Spurious emission band UE-to-UE coexistence requirements.

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

# 8 Transmitter characteristics

*<Unchanged sections are omitted>*

### 8.1.3 UE maximum output power with additional requirements

To comply the EN 302 571 standard emission mask, RAN4 need to derive A-MPR requirements considering with the additional A-SEM and A-SE requirements in EN 302 571 standard as shown in Table 8.1.3-1 and Table 8.1.3-2.

NR V2X UE shall satisfy the additional SEM and additional SE requirements when NS\_33 is configured from pre-configured radio parameters or the cell and the indication from upper layers has indicated was informed.

Table 8.1.3-1: Additional SEM requirements for 10MHz channel bandwidth

|  |
| --- |
| Spectrum emission limit (dBm EIRP)/ Channel bandwidth |
| ΔfOOB(MHz) | 10 MHz | Measurement bandwidth |
| ± 0-0.5 | [] | 100 kHz |
| ± 0.5-5 | [] | 100 kHz |
| ± 5-10 | [] | 100 kHz |

NOTE 1: As a general rule, the resolution bandwidth of the measuring equipment should be equal to the measurement bandwidth. However, to improve measurement accuracy, sensitivity and efficiency, the resolution bandwidth may be smaller than the measurement bandwidth. When the resolution bandwidth is smaller than the measurement bandwidth, the result should be integrated over the measurement bandwidth in order to obtain the equivalent noise bandwidth of the measurement bandwidth.

NOTE 2: Additional SEM for V2X overrides any other requirements in frequency range 5855-5950MHz.

NOTE 3: The EIRP requirement is converted to conducted requirement depend on the supported post antenna connector gain Gpost connector declared by the UE following the principle described in annex I.

Table 8.1.3-2: Additional SE requirements

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| n47 | E-UTRA Band 1, 3, 5, 7, 8, 22, 26, 28, 34, 39, 40, 41, 42, 44, 45, 65, 68, 72, 73NR band n77, n78 , n79 | FDL\_low  | - | FDL\_high | -50 | 1 |  |
| Frequency range | 5925 | - | 5950 | -30 EIRP | 1 | 38, 40, 43 |
| Frequency range | 5815 | - | 5855 | -30 EIRP | 1 | 38, 43 |
| NOTE 38: Applicable when NS\_33 or NS\_34 is configured by the pre-configured radio parameters.NOTE 40: 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.NOTE 43: The EIRP requirement is converted to conducted requirement depend on the supported post antenna connector gain Gpost connector declared by the UE following the principle described in annex I. |

The allowed additional Maximum Power Reduction (A-MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) will be specified in TS38.101-1 as below.

Table 8.1.3-3: Additional Maximum Power Reduction (A-MPR) for NR V2X

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Network Signalling value | Requirements (subclause) | NR Band | Channel bandwidth (MHz) | Resources Blocks (*N*RB) | A-MPR (dB) |
| NS\_33 | 6.6.2.2.4 (A-SEM)6.6.3.2 (A-SE) | n47 | 10 | Table 8.1.3-4 |

Table 8.1.3-4: A-MPR for NS\_33

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Carrier frequency(MHz) | Modulation order | Resources Blocks (*N*RB) | Start ResourceBlock | A-MPR (dB) |
| 5860 | QPSK/16-QAM | TBD | TBD | TBD |
| TBD | TBD | TBD |
| TBD | TBD | TBD |
| TBD | TBD | TBD |
| 5870, 5910, 5920 | TBD | TBD | TBD |
| TBD | TBD |
| TBD | TBD |
| 5880, 5890, 5900 | TBD | TBD | TBD |
| TBD | TBD |
| TBD | TBD |

*<Unchanged sections are omitted>*

### 8.1.4 Configured transmitted power for NR V2X UE

The NR V2X UE is allowed to set its configured maximum output power PCMAX,*c* for carrier f of serving cell *c* in each slot. The configured maximum output power PCMAX,*c* is set within the following bounds:

PCMAX\_L,f,*c* ≤ PCMAX,f,*c* ≤ PCMAX\_H,f,*c* with

 PCMAX\_L,f, *c* = MIN {PEMAX,*c*– TC,*c*, (PPowerClass – ΔPPowerClass) –– MAX(MAX(MPR*c* , A-MPR*c*)+ ΔTIB,c + TC,*c* + ∆TRxSRS, P-MPR*c*), PRegulatory,c }

PCMAX\_H,f, *c* = MIN {PEMAX,*c*, (PPowerClass– ΔPPowerClass), PRegulatory,c }

where

- For the total transmitted power PCMAX,c of PSSCH and PSCCH, PEMAX,c is the value given by IE *maxTxPower*, defined by [TS 38.331], when the UE is not associated with a serving cell on the NR V2X carrier .

- For, PEMAX,*c* is the value given by the IE *maxTxPower* in [TS 38.331] when the UE is not associated with a serving cell on the V2X carrier.

- For, the value is as calculated for  and applying the MPR for SSSS as specified in maximum output power reduction (Section 6.2.2) in TS38.101-1.

- PPowerClass is the maximum UE power specified in Table 6.2.1-1 in TS38.101-1 without taking into account the tolerance specified in the Table 6.2.1-1 in TS38.101-1;

- MPR*c* and A-MPR*c* for serving cell *c* are specified in subclause 6.2.2 and subclause 6.2.3 in TS38.101-1, respectively;

- TIB,c, TC,*c*, ∆TRxSRS, PPoweclass and P-MPR*c* are specified in subclause 6.2.4 in TS38.101-1

- PRegulatory,c= 10 dBm when the CEN DSRC tolling system is nearby NR V2X UE; PRegulatory,c= 33 dBm otherwise.

The maximum output power P*CMAX,PSSCH* and P*CMAX,PSCCH* are derived from PCMAX,c based on 0dB offset between PSSCH and PSCCH.

For the measured configured maximum output power PUMAX,*c* for NR V2X sidelink transmissions non-concurrent with NR uplink transmissions, the same requirement as in subclause 6.2.4 in TS38.101-1 shall be applied.

*<Unchanged sections are omitted>*

### 8.1.13 Spurious emission band UE co-existence for V2X UE

This clause specifies the spurious emission requirements for the specified NR V2X band, for coexistence with protected bands

Table 8.1.13-1: Requirements

|  |  |
| --- | --- |
| NR Band | Spurious emission  |
| Protected band | Frequency range (MHz) | Maximum Level (dBm) | MBW (MHz) | NOTE |
| … |  |  |  |  |  |  |  |
| n38 | 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 |  |
| NR Band n78 | FDL\_low  | - | FDL\_high | -50 | 1 |  |
| Frequency range | 2620 | - | 2645 | -15.5 | 5 | 4,5,6 |
| Frequency range | 2645 | - | 2690 | -40 | 1 | 4,5 |
| n47 | E-UTRA Band 1, 3, 5, 7, 8, 22, 26, 28, 34, 39, 40, 41, 42, 44, 45, 65, 68, 72, 73 | FDL\_low  | - | FDL\_high | -50 | 1 |  |
| NR Band n77, n78, n79 | FDL\_low  | - | FDL\_high | -50 | 1 |  |
| Frequency range | 5925 | - | 5950 | -30 EIRP | 1 | 1,2,3 |
| Frequency range | 5815 | - | 5855 | -30 EIRP | 1 | 1,3,7 |
| NOTE 1:Applicable when NS\_33 or NS\_34 is configured by the pre-configured radio parameters.NOTE 2: 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.NOTE 3: The EIRP requirement is converted to conducted requirement depend on the supported post antenna connector gain Gpost connector declared by the UE following the principle described in annex I.NOTE 4: These requirements also apply for the frequency ranges that are less than FOOB (MHz) in Table 6.5.3.1-1 in TS36.101 from the edge of the channel bandwidth.NOTE 5: 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 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 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 6: For these adjacent bands, the emission limit could imply risk of harmful interference to UE(s) operating in the protected operating band.NOTE 7: Resolution BW is 10% of the measurement BW and the result should be integrated to achieve the measurement bandwidth. The sweep time shall be set larger than (symbol length)\*(number of points in sweep) to improve the measurement accuracy. |

In Note 2, the frequency range with -30dBm/MHz will be further discussed

When "NS\_33" or “NS 34” is configured from pre-configured radio parameters or the cell and the indication from upper layers has indicated that the UE is within the protection zone of CEN DSRC devices or HDR DSRC devices, the power of any V2X UE emission shall fulfil either one of the two set of conditions.

|  |  |  |
| --- | --- | --- |
|  | Maximum Transmission Power (dBm EIRP) | Emission Limit in Frequency Range 5795-5815 (dBm/MHz EIRP) |
| Condition 1 | 10 | -65 |
| Condition 2 | 10 | -45 |

*<End of Changes>*