**3GPP TSG-RAN WG4 Meeting #112bisR4-2415216**

**Hefei, China, 14 – 18 October 2024**

**Agenda item:** 5.1

**Source:** Moderator (CMCC)

**Title:** Topic summary for [112bis][112] NR\_n28\_PC2\_40MHz

**Document for:** Information

# Introduction

Thread [115] includes agenda 5.20. The way forward agreed in last meeting is in R4-2414274.

* 5.20.1 General aspects
* 5.20.2 UE RF requirements

# Topic #1: UE RF requirements

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2414982 | OPPO | **Proposal 1: Consider Table 1 as the AMPR region definition and Table 2 as the PC3 AMPR requirements.**  Table 1 AMPR region definition   |  |  |  |  |  | | --- | --- | --- | --- | --- | | CBW, MHz | Tx BW, MHz | Regions | | A-MPR | | RBstart \*12\*SCS (MHz) | LCRB \*12\*SCS (MHz) | | 40MHz | 703-743 | > 12\*scs\* LCRB + 5.04 | > max (0, -12\*scs\*RBstart + 12\*scs\*N -3.6) | A7 | | > 0 | > 12\*scs\* RBstart + 6.48 | A8 | | <= 11.52 | <= 6.48 | A9 | | <= 12\*scs\* Y + 5.04  >= 12\*scs\* Y - 6.48 | > 6.48 | A10 |   Table 2 AMPR for 1T PC3   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | DFT-S-OFDM | | | | CP-OFDM | | | | | A7 | A8 | A9 | A10 | A7 | A8 | A9 | A10 | | Pi/2 BPSK | 2 | 9 | 4 | 4 | N/A | N/A | N/A | N/A | | QPSK | 3 | 9 | 4 | 4 | 5.5 | 10 | 6 | 6 | | 16QAM | 3 | 9 | 5 | 5 | 5.5 | 10 | 6 | 6 | | 64QAM | 4 | 10 | 6 | 6 | 5.5 | 10.5 | 6.5 | 6.5 | | 256QAM | 4 | 10 | 6 | 6 | 5.5 | 10.5 | 8.5 | 8.5 |   **Proposal 2: If one AMPR table for PC2 with 1Tx and 2Tx, then AMPR table 5 can be used.**  Table 5 AMPR for both 1T and 2T PC2   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | DFT-S-OFDM | | | | CP-OFDM | | | | | A7 | A8 | A9 | A10 | A7 | A8 | A9 | A10 | | Pi/2 BPSK | 4 | 12 | 6 | 6 | N/A | N/A | N/A | N/A | | QPSK | 4 | 12 | 6 | 6 | 6.5 | 13 | 8 | 8 | | 16QAM | 5 | 12 | 8 | 8 | 6.5 | 13 | 8 | 8 | | 64QAM | 6 | 13 | 8.5 | 8.5 | 6.5 | 13 | 9 | 9 | | 256QAM | 6 | 13 | 8.5 | 8.5 | 6.5 | 13 | 10 | 10 | |
| R4-2414994 | CMCC | Proposal 1: It is proposed to specify single set of requirements for PC2 n28.  Proposal 2: It is proposed to add a new note of UL channel location for UE supporting maximum 40MHz channel bandwidth for n28 as follows:   * For UEs supporting 40MHz, for the 20MHz, 25MHz and 30MHz, the minimum requirements are specified for NR UL transmission bandwidth configuration confined to either 703-743 MHz or 718-748 MHz. For the 40MHz, the minimum requirements are specified for NR UL transmission bandwidth configuration confined to 703-743.04MHz.   Proposal 3: it is proposed to add the exceptional channel raster point of n28 (UL: 723.04MHz, DL: 778.04MHz) to UE RF specification TS 38.101-1 for UE CBW 40MHz, and UE supports n28 40MHz should mandatory support the exceptional channel raster.  Proposal 4: For enhanced channel raster feature, it is proposed to follow the agreement of Rel-18 enhanced channel raster, i.e. n28 mandatory support enhanced channel raster from Rel-18.  Proposal 5: it is proposed that UE 40MHz channel bandwidth is release independent from Rel-15. |
| R4-2415322 | Apple | ***Proposal 1***: Consider Table 1 and Table 2 when specifying NS\_17.  ***Proposal 2***: Consider Table 5 to 7 when specifying NS\_18.  ***Observation 1:*** Based on the analysis above, the PC3 40MHz REFSENS for n28 estimated at -65.9dBm, resulting into a self-desensitization of 23.1dB.  ***Observation 2:*** For PC2 1Tx, the amount of self-desensitization increases to 25.3dB, which translates into an RSD value of 2.2dB.  ***Proposal 3:*** For band n28 with 40MHz CBW, we propose the following requirements for REFSENS and RSD:   * REFSENS for PC3 = -65.9dBm * PC2 RSD for 1Tx = 2.2dB   ***Proposal 4***: It is proposed to set the ∆MPR for 40MHz channel to 0.5dB. |
| R4-2415442 | Nokia | ***Proposal 1: RAN4 shall consider defining A-MPR for n28 PC2 due to NS\_17 as shown in tables 1 and 2.***  ***Proposal 2: RAN4 shall consider defining A-MPR for n28 PC2 due to NS\_18 as shown in tables 3 and 4.***  ***Proposal 3: RAN4 shall consider defining A-MPR for n28 PC3 due to NS\_18 as shown in tables 5 and 6.*** |
| R4-2415444 | Nokia | ***Observation 1: For PC2 and NS\_17 A-MPR is required for 10 MHz CBW.***  ***Observation 2: For PC2 and NS\_18 A-MPR is required for CBWs of 5 MHz and larger.***  ***Observation 3: For PC3 and NS\_18 A-MPR is required for 40 MHz CBW.*** |
| R4-2415464 | Huawei | **Observation 1: For NS\_17, it has been agreed that no PC2 A-MPR is needed for dual-duplexer implementation.**  **Proposal 1: For full-band duplexer implementation, consider the following PC2 A-MPR requirements for NS\_17:**  **Table 1: A-MPR regions for NS\_17 for PC2**   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **Channel Bandwidth, MHz** | **Carrier Center Frequency, Fc, MHz** | **Regions** | | **A-MPR** | |  |  | **RBstart\*12\*SCS**  **MHz** | **LCRB\*12\*SCS**  **MHz** |  | | 10 MHz | 723 ≤ Fc ≤ 728 | ≤ 0.18 | ≤ 1.44 | A1 | | ≥ 0 | >= 5.4 | A2 |   **Table 2: A-MPR for NS\_17 for PC2**   |  |  |  |  | | --- | --- | --- | --- | | **Modulation/Waveform** | | **A1** | **A2** | |  | | **Outer/Inner** | **Outer/Inner** | | DFT-s-OFDM | PI/2 BPSK | ≤ [3] | ≤ [3.5] | | QPSK | ≤ [3] | ≤ [4] | | 16 QAM | ≤ [3.5] | ≤ [5] | | 64 QAM | ≤ [4] | ≤ [5] | | 256 QAM |  | ≤ [5.5] | | CP-OFDM | QPSK | ≤ [5] | ≤ [5.5] | | 16 QAM | ≤ [5] | ≤ [5.5] | | 64 QAM | ≤ [5] | ≤ [5.5] | | 256 QAM |  |  |   **Proposal 2: Subject to operators’ demand, whether single set or two sets of requirements should be defined can be further discussed by considering both A-MPR and L-L (such as n18+n28) band combination performances.**  **Proposal 3: Take [-66.4] dBm as the REFSENS for 40MHz.**  **Proposal 4: Consider the following values as PC2 RSD: [3.0] dB for 1Tx and [8.4] dB for 2Tx.**  **Proposal 5: For PC3 and PC2 A-MPR for BW=40MHz NS\_18, consider the simulation results provided in the appendix.**  **Proposal 6: To simply the description, modify the existing NOTE 7 for band n28 as follows:**  NOTE 7: For UEs supporting 30MHz max bandwidth, the minimum requirements are specified for NR UL channel bandwidths confined to either 703-733MHz or 718-748MHz for the 20, 25 and 30MHz bandwidth.  **Proposal 7: For UEs supporting 40MHz, add a new note as follows:**  NOTE x: For UEs supporting 40MHz max bandwidth, the minimum requirements are specified for NR UL channel bandwidths confined to either 703-743MHz or 718-748MHz for the 30MHz bandwidth. And for the 40MHz bandwidth, the minimum requirements are specified for NR UL channel bandwidths confined to either 703-743.04MHz.  **Proposal 8: Add the exceptional channel raster point of n28 (UL: 723.04MHz, DL: 778.04MHz) to UE RF specification TS 38.101-1 for UE CBW 40MHz.**  **Proposal 9: Prefer to release independence from Rel-16 if no new signalling is introduced.** |
| R4-2415802 | vivo | **Proposal 1: the following UE coexistence requirements are applicable for 40MHz UE CBW:**   | **NR Band** | **Spurious emission for UE co-existence** | | | | | | | | | | | | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | |  | **Protected band** | | **Frequency range (MHz)** | | | | **Maximum Level (dBm)** | | **MBW (MHz)** | | **NOTE** | | | n28, n83 | | E-UTRA Band 1, 4, 22, 32, 42, 43, 50, 51, 65, 66, 74, 75, 76  NR Band n77, n78, n100, n101, n109 | | FDL\_low | - | FDL\_high | | -50 | | 1 | | 2 | |  | |  | |  |  |  | |  | |  | |  | |  | | E-UTRA Band 2, 3, 5, 7, 8, 18, 19, 20, 25, 26, 27, 31, 34, 38, 39, 40, 41, 52, 71, 72, 73  NR Band n79, n105 | | FDL\_low | - | FDL\_high | | -50 | | 1 | |  | |  | |  | |  |  |  | |  | |  | |  | |  | | Frequency range | | 470 | - | 694 | | -25 | | 8 | | 15 | |  | |  | |  |  |  | |  | |  | |  | |  | | Frequency range | | 662 | - | 694 | | -26.2 | | 6 | | 15 | |  | | Frequency range | | 758 | - | 773 | | -32 | | 1 | | 15 | |  | | Frequency range | | 773 | - | 803 | | -50 | | 1 | |  | |  | |  | |  |  |  | |  | |  | |  |   **Proposal 2: For 40Mhz CBW, to compatible with different implementations, the note is proposed as: “For the 40 MHz bandwidth, the minimum requirements are specified for NR UL carrier frequencies confined to 713-733 MHz”**  **Proposal 3: As 40MHz channel bandwidth located in 703-743MHz and 758-798MHz, the exceptional channel raster point of n28 (UL: 723.04MHz, DL: 778.04MHz) is enough, supporting enhance channel raster in not needed.**  **Proposal 4: To align with gNB, 40MHz UE CBW is proposed to release independent from rel16** |
| R4-2415898 | ZTE | **Observation 1. For n28 30MHz, there are no exception channel raster points defined in TS38.101-1.**  **Observation 2. For n28 40MHz, UE can supported the gNB exception channel raster points with the enhanced channel raster.**  **Observation: The general MPR requirements in the current spec can be met for UL 40MHz channel bandwidth in band n28.**  **Proposal 1: There is no need to include both exceptional channel raster point and enhanced channel raster in TS38.101-1.**  **Proposal 2: For the UL 40MHz bandwidth channel location:**  **- The minimum requirements are specified for NR UL channel bandwidth configuration confined to 703-743 MHz.**  **- Flexible channel allocation for <40MHz channel bandwidth should be allowed.**  **Proposal 3: ΔMPR= 0.5dB for PC3 n28 40MHz.** |
| R4-2415899 | ZTE | **Proposal 1: Without specifying new capability, single set of RF requirements can be applied to either filter implementation.**  **Proposal 2: To use the same ∆MPR as PC3 for PC2 n28 40MHz.** |
| R4-2415981 | Nokia | [**Observation 1: BS 40 MHz channel bandwidth at 723.04 MHz for UL and 778.04 MHz for DL has been already introduced as TEI16 feature.**](file:///C:\Users\zhang\AppData\Local\Temp\9b1bc297-1f8b-4309-af4a-2f652f227daf_R4-2415981.zip.daf\R4-2415981%20n28.docx#_Toc178123415)  [**Proposal 1: 40 MHz channel bandwidth for both BS and UE is only at the raster entry, 723.04 MHz for UL and DL 778.04 MHz for DL.**](file:///C:\Users\zhang\AppData\Local\Temp\9b1bc297-1f8b-4309-af4a-2f652f227daf_R4-2415981.zip.daf\R4-2415981%20n28.docx#_Toc178123416)  [**Observation 2: It is not necessary to specify the specific UE channel raster entry in UE specifications.**](file:///C:\Users\zhang\AppData\Local\Temp\9b1bc297-1f8b-4309-af4a-2f652f227daf_R4-2415981.zip.daf\R4-2415981%20n28.docx#_Toc178123417)  [**Proposal 2: UE supporting 40 MHz channel bandwidth in band n28 shall support Enhanced channel raster.**](file:///C:\Users\zhang\AppData\Local\Temp\9b1bc297-1f8b-4309-af4a-2f652f227daf_R4-2415981.zip.daf\R4-2415981%20n28.docx#_Toc178123418)  [**Proposal 3: The channel location limitation for channel bandwidths less than 40 MHz is better not considered in RAN4 core requirement.**](file:///C:\Users\zhang\AppData\Local\Temp\9b1bc297-1f8b-4309-af4a-2f652f227daf_R4-2415981.zip.daf\R4-2415981%20n28.docx#_Toc178123419)  [**Proposal 4: The release independence of 40 MHz for n28 is from Rel-16.**](file:///C:\Users\zhang\AppData\Local\Temp\9b1bc297-1f8b-4309-af4a-2f652f227daf_R4-2415981.zip.daf\R4-2415981%20n28.docx#_Toc178123420) |
| R4-2416458 | QC | Proposal 1: Specify a single set of A-MPR and RSD values independent of implemented filter solution.  Proposal 2: Adopt the A-MPR for NS\_17 as in Table 1 and Table 2 for n28 PC2  Proposal 3: Adopt A-MPR for NS\_18 for both PC3 and PC2 as shown in Table 3 to Table 6.  Proposal 4: Confirm until RAN4#113 whether UE-to-UE co-existence requirements can be met with 40 MHz CBW without A-MPR.  Proposal 5: Adopt RSD for 40 MHz channel bandwidth as in Table 8 and Table 9.  Proposal 6: Delta-MPR of 0.5 dB is sufficient for 40 MHz channel bandwidth both for PC3 and PC2.  Proposal 7: Enable channel raster points for 40 MHz channel bandwidth from 723.00 MHz to 723.04 MHz.  Proposal 8: For UEs supporting 40 MHz channel bandwidth, narrower channel bandwidths can be freely placed within the 40 MHz channel bandwidth as long as they are fully contained within 703 to 743.04 MHz.  Proposal 9: NS\_18 A-MPR is applicable whenever channel bandwidth fully is contained within 703 to 743.04 MHz |
| R4-2416227 | Skyworks | **Proposal 1**: For Band n28, adopt ΔMPR = 0.5dB for PC2 30MHz and 40MHz CBW and for PC3 40MHz CBW.   |  |  |  |  | | --- | --- | --- | --- | | **NR Band** | **Power class** | **Channel bandwidth** | **∆MPR (dB)** | | n28 and n83 | Power class 3  Power class 2 | 30 MHz  40 MHz | 0.5 |   **Observation 1:** A minimum of 20dB Tx filter rejection is needed to meet the UE coexistence requirement in range 758-773MHz.  **Observation 2**: Several Band n28 UL configurations which require more than ~6dB OBO need to be re-evaluated with a 2nd VCC due to PA emission plateau and PA performance for which the MPR1 calibration VCC may no longer reflect the commercial UE performance, especially when OBO >10dB.  **Proposal 2**: Come back at next meeting to improve the accuracy of required OBO for waveforms where large (>10dB) A-MPR is needed, like WF [5] Region A4 configurations.  The Band n28 at 40MHz CBW may be subject to severe self-desense due to ACLR 1 overlap.  **Observation 3:** The measured Tx noise affecting the Rx band is minimum at LCRB~ 100RB and increases for LCRB<100RB or LCRB>100RB. MSD may be evaluated for LCRB = 25RB.  **Observation 4**: The benefits of deploying 40MHz CBW in Band n28 is highly questionable considering the high self-desense that ranges from 22.9dB to 31.4dB for PC3 / PC2 operation. To our knowledge this is the highest single-band self-desense that RAN4 has ever studied for NR.  **Proposal 3**: For Band n28 40MHz CBW operation, consider the following REFSENS requirement proposal for SCS 15kHz:   1. PC3 REFSENS = -66.3dBm 2. PC2 single Tx RSD = 4dB 3. PC2 dual Tx RSD = 8.5dB |

## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1 General issue

**Issue 1-1-1: Single set or two sets requirements**

Option 1 (CMCC, ZTE, QC): single set of A-MPR and RSD requirements for PC2 n28 independent of implemented filter implementation.

Option 2 (Huawei): Subject to operators’ demand, whether single set or two sets of requirements should be defined can be further discussed by considering both A-MPR and L-L (such as n18+n28) band combination performances.

Recommended WF:

Check whether option 1 is agreeable.

Huawei: A-MPR requirements targets at NS\_17. If operators in Japan do not have strong demand, we can accept the moderator’s view. If duplexer does affect the A-MPR and L-L, the performance are different.

Skyworks: Option 1 assumes the full band duplexer filter.

Agreement:

* Single set of A-MPR and RSD requirements for PC2 n28 independent of implemented filter implementation.

### Sub-topic 1-2 RF requirements

**Issue 1-2-1 NS\_17 A-MPR for PC2 for BW<=30MHz**

**Proposal 1 (Apple, R4-2415322):**

Table 1: A-MPR regions for NS\_17 for PC2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channel Bandwidth, MHz** | **Carrier Center Frequency, Fc, MHz** | **Regions** | | **A-MPR** |
|  |  | **RBstart\*12\*SCS**  **MHz** | **LCRB\*12\*SCS**  **MHz** |  |
| 10 MHz | 723 ≤ Fc ≤ 728 | ≤ 0.18 | ≤ 1.44 | A1 |
| ≥ 0 | >= 5.4 | A2 |

Table 2: A-MPR for NS\_17 for PC2

|  |  |  |  |
| --- | --- | --- | --- |
| **Modulation/Waveform** | | **A1** | **A2** |
|  | | **Outer/Inner** | **Outer/Inner** |
| DFT-s-OFDM | PI/2 BPSK | ≤ [3] | ≤ [4] |
| QPSK | ≤ [3] | ≤ [4] |
| 16 QAM | ≤ [3.5] | ≤ [4] |
| 64 QAM | ≤ [4] | ≤ [4.5] |
| 256 QAM |  | ≤ [5.5] |
| CP-OFDM | QPSK | ≤ [5] | ≤ [5.5] |
| 16 QAM | ≤ [5] | ≤ [5.5] |
| 64 QAM | ≤ [5] | ≤ [5.5] |
| 256 QAM |  |  |

**Proposal 2 (Nokia, R4-2415442):**

**Table 1: The proposed A-MPR regions for n28 PC2 NS\_17.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel Bandwidth, MHz | Carrier Center Frequency, Fc, MHz | Regions | | A-MPR |
| RBstart\*12\*SCS  MHz | LCRB\*12\*SCS  MHz |
| 10 MHz | Fc < 728.18 | ≤ 3.1 | ≥ 0.6\*12\*SCS\*RBstart + 5 | A1 |
| ≤ 0.4 | ≤ -2\*12\*SCS\*RBstart + 1.2 | A2 |

**Table 2: The proposed A-MPR values for n28 PC2 NS\_17.**

|  |  |  |  |
| --- | --- | --- | --- |
| Modulation/Waveform | | A1 | A2 |
| Outer/Inner | Outer/Inner |
| DFT-s-OFDM | PI/2 BPSK | 3 | 2 |
| QPSK | 4 | 3 |
| 16 QAM | 4.5 | 3 |
| 64 QAM | 4.5 | 3 |
| 256 QAM |  |  |
| CP-OFDM | QPSK | 5.5 | 4.5 |
| 16 QAM | 5.5 | 5 |
| 64 QAM | 5.5 | 5 |
| 256 QAM |  |  |

**Proposal 3: (Huawei, R4-2415464)**

**For full-band duplexer implementation, consider the following PC2 A-MPR requirements for NS\_17:**

**Table 1: A-MPR regions for NS\_17 for PC2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channel Bandwidth, MHz** | **Carrier Center Frequency, Fc, MHz** | **Regions** | | **A-MPR** |
|  |  | **RBstart\*12\*SCS**  **MHz** | **LCRB\*12\*SCS**  **MHz** |  |
| 10 MHz | 723 ≤ Fc ≤ 728 | ≤ 0.18 | ≤ 1.44 | A1 |
| ≥ 0 | >= 5.4 | A2 |

**Table 2: A-MPR for NS\_17 for PC2**

|  |  |  |  |
| --- | --- | --- | --- |
| **Modulation/Waveform** | | **A1** | **A2** |
|  | | **Outer/Inner** | **Outer/Inner** |
| DFT-s-OFDM | PI/2 BPSK | ≤ [3] | ≤ [3.5] |
| QPSK | ≤ [3] | ≤ [4] |
| 16 QAM | ≤ [3.5] | ≤ [5] |
| 64 QAM | ≤ [4] | ≤ [5] |
| 256 QAM |  | ≤ [5.5] |
| CP-OFDM | QPSK | ≤ [5] | ≤ [5.5] |
| 16 QAM | ≤ [5] | ≤ [5.5] |
| 64 QAM | ≤ [5] | ≤ [5.5] |
| 256 QAM |  |  |

**Proposal 4 (QC, R4-2416458):**

**Table 1: A-MPR regions for NS\_17 for PC2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channel Bandwidth, MHz** | **Carrier Center Frequency, Fc, MHz** | **Regions** | | **A-MPR** |
|  |  | **RBstart\*12\*SCS**  **MHz** | **LCRB\*12\*SCS**  **MHz** |  |
| 10 MHz | 723 ≤ Fc ≤ 728 | ≤ 0.18 | ≤ 1.44 | A1 |
| ≥ 0 | > 5.4 | A2 |

**Table 2: A-MPR for NS\_17 for PC2**

|  |  |  |  |
| --- | --- | --- | --- |
| **Modulation/Waveform** | | **A1** | **A2** |
|  | | **Outer/Inner** | **Outer/Inner** |
| DFT-s-OFDM | PI/2 BPSK | ≤ 3 | ≤ 3.5 |
| QPSK | ≤ 3 | ≤ 4 |
| 16 QAM | ≤ 4 | ≤ 4.5 |
| 64 QAM | ≤ 4 | ≤ 5 |
| 256 QAM |  | ≤ 5.5 |
| CP-OFDM | QPSK | ≤ 4.5 | ≤ 6 |
| 16 QAM | ≤ 5 | ≤ 6 |
| 64 QAM | ≤ 5 | ≤ 6 |

Recommended WF:

* Last meeting agreement: Use following values in Rel-18 WF as starting point:
* **Table 1: A-MPR regions for NS\_17 for PC2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channel Bandwidth, MHz** | **Carrier Center Frequency, Fc, MHz** | **Regions** | | **A-MPR** |
|  |  | **RBstart\*12\*SCS**  **MHz** | **LCRB\*12\*SCS**  **MHz** |  |
| 10 MHz | 723 ≤ Fc ≤ 728 | ≤ 0.18 | ≤ 1.44 | A1 |
| ≥ 0 | > 5.4 | A2 |

* **Table 2: A-MPR for NS\_17 for PC2**

|  |  |  |  |
| --- | --- | --- | --- |
| **Modulation/Waveform** | | **A1** | **A2** |
|  | | **Outer/Inner** | **Outer/Inner** |
| DFT-s-OFDM | PI/2 BPSK | ≤ [3] | ≤ [4] |
| QPSK | ≤ [3] | ≤ [4] |
| 16 QAM | ≤ [3.5] | ≤ [4] |
| 64 QAM | ≤ [4] | ≤ [4.5] |
| 256 QAM |  | ≤ [5.5] |
| CP-OFDM | QPSK | ≤ [5] | ≤ [5.5] |
| 16 QAM | ≤ [5] | ≤ [5.5] |
| 64 QAM | ≤ [5] | ≤ [5.5] |
| 256 QAM |  |  |

* In this meeting, there are some proposals to modify the requirements. Discuss following tables.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channel Bandwidth, MHz** | **Carrier Center Frequency, Fc, MHz** | **Regions** | | **A-MPR** |
|  |  | **RBstart\*12\*SCS**  **MHz** | **LCRB\*12\*SCS**  **MHz** |  |
| 10 MHz | 723 ≤ Fc ≤ 728 | ≤ 0.18 | ≤ 1.44 | A1 |
| ≥ 0 | >= 5.4 | A2 |

**Table 2: A-MPR for NS\_17 for PC2**

|  |  |  |  |
| --- | --- | --- | --- |
| **Modulation/Waveform** | | **A1** | **A2** |
|  | | **Outer/Inner** | **Outer/Inner** |
| DFT-s-OFDM | PI/2 BPSK | ≤ [3] | ≤ [4 or 3.5] |
| QPSK | ≤ [3] | ≤ [4] |
| 16 QAM | ≤ [3.5] | ≤ [4 or 4.5 or 5] |
| 64 QAM | ≤ [4] | ≤ [4.5 or 5] |
| 256 QAM |  | ≤ [5.5] |
| CP-OFDM | QPSK | ≤ [5] | ≤ [5.5 or 6] |
| 16 QAM | ≤ [5] | ≤ [5.5 or 6] |
| 64 QAM | ≤ [5] | ≤ [5.5 or 6] |
| 256 QAM |  |  |

Qualcomm: there are a couple of concerns. A-MPR is more than 3dB increasing compared to PC3. The same reason applies for the CP-OFDM. It is more efficient to take them offline.

Skyworks: These come from measurements. We need consider some higher values.

Huawei: These were discussed in the previous releases.

**Issue 1-2-3 NS\_18 A-MPR for PC2 for BW<=40MHz**

|  |
| --- |
| **Agreement in RAN4#112:**   * Reuse Rel-18 requirement for NS\_18. (refer to R4-2310245) |

**Proposal 1 (QC): Adopt A-MPR for NS\_18 for both PC3 and PC2 as shown in Table 3 to Table 6.**

**Table 3: Additional maximum power reduction (A-MPR)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Network signalling label | Requirements (clause) | NR Band | Channel bandwidth (MHz) | Resources blocks (*N*RB) | A-MPR (dB) |
| NS\_18 | 6.5.3.3.3 | n28, n83 | 5 |  | Table 7, A1 for PC3;  Table 8, A1 for PC2 |
| 10, 15, 20 |  | Table 7, A2 for PC3;  Table 8, A2 for PC2 |
| 25, 30, 40 |  | Table 7, A3, A4, A5 for PC3;  Table 8, A3, A4, A5, A6 for PC2 |

**Table 4: Band n28 25MHz, 30MHz and 40 MHz A-MPR regions for NS\_18**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channel Bandwidth, MHz** | **Carrier Center Frequency, Fc, MHz** | **Regions** | | **A-MPR** |
|  |  | **RBstart\*12\*SCS**  **MHz** | **LCRB\*12\*SCS**  **MHz** |  |
| 25 | 715.5 – 730.54 | >(LCRB\*12\*SCS)/2+3.6 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
|  |  | ≤(LCRB\*12\*SCS)/2+3.6 | ≥5.4 | A4 |
|  |  | ≤6.3 | <5.4 | A5 |
|  |  | >(LCRB\*12\*SCS)/2+3.6  ≤(LCRB\*12\*SCS)/2+5.76 | <Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS)  ≥5.4 | A6 |
| 30 | 718 – 728.04 | >(LCRB\*12\*SCS)/2+5.22 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
|  |  | ≤(LCRB\*12\*SCS)/2+5.22 | ≥5.4 | A4 |
|  |  | ≤7.92 | <5.4 | A5 |
|  |  | >(LCRB\*12\*SCS)/2+5.22  ≤(LCRB\*12\*SCS)/2+7.38 | <Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS)  ≥5.4 | A6 |
| 40 | 723 – 723.04 | >(LCRB\*12\*SCS)/2+8.46 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
| ≤(LCRB\*12\*SCS)/2+8.46 | ≥5.4 | A4 |
| ≤11.16 | <5.4 | A5 |
| >(LCRB\*12\*SCS)/2+8.46  ≤ (LCRB\*12\*SCS)/2+10.8 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS)  ≥5.4 | A6 |

The A-MPR values for PC3 and PC2 are defined as in the table below.

**Table 5: A-MPR for NS\_18 (Power Class 3)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Modulation/Waveform | | A1 (dB) | | A2 (dB) | A3 (dB) | A4 (dB) | A5 (dB) |
|  | | Outer | Inner | Inner/Outer | Outer/Inner | Outer/Inner | Outer/Inner |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 2 | N/A | ≤ 5 | 3 | 8 | 3 |
|  | QPSK | ≤ 2 |  | ≤ 5 | 3 | 8 | 3 |
|  | 16 QAM | ≤ 3 |  | ≤ 6 | 3 | 8 | 3 |
|  | 64 QAM | ≤ 4 |  | ≤ 7 | 3 | 8 | 4.5 |
|  | 256 QAM | ≤ 6 |  | ≤ 9 | 3 | 8 | 5.5 |
| CP-OFDM | QPSK | ≤ 5 |  | ≤ 6.5 | 4.5 | 9.5 | 5 |
|  | 16 QAM | ≤ 5 |  | ≤ 7 | 4.5 | 9.5 | 5 |
|  | 64 QAM | ≤ 5.5 |  | ≤ 8.5 | 4.5 | 9.5 | 5.5 |
|  | 256 QAM | ≤ 8.5 |  | ≤ 11.5 | 4.5 | 9.5 | 7.5 |
| NOTE 1: Void  NOTE 2: Void | | | | | | | |

**Table 6: A-MPR for NS\_18 (Power Class 2)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Modulation/Waveform** | | **A1 (dB)** | | **A2 (dB)** | **A3 (dB)** | **A4 (dB)** | **A5 (dB)** | **A6 (dB)** |
|  | | **Outer** | **Inner** | **Inner/Outer** | **Outer/Inner** | **Outer/Inner** | **Outer/Inner** | **Outer/Inner** |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 3.5 | N/A | ≤ 8 | 3.5 | 10 | 5 | 2 |
|  | QPSK | ≤ 3.5 |  | ≤ 8 | 3.5 | 10 | 5 | 2 |
|  | 16 QAM | ≤ 4 |  | ≤ 9 | 3.5 | 11 | 5 | 2 |
|  | 64 QAM | ≤ 4.5 |  | ≤ 10 | 3.5 | 11 | 6.5 | 2.5 |
|  | 256 QAM | ≤ 6.5 |  | ≤ 11 | 3.5 | 11 | 6.5 |  |
| CP-OFDM | QPSK | ≤ 5.5 |  | ≤ 9.5 | 5 | 11.5 | 7 | 4 |
|  | 16 QAM | ≤ 5.5 |  | ≤ 10 | 5 | 11.5 | 7 | 4 |
|  | 64 QAM | ≤ 6 |  | ≤ 11.5 | 5 | 11.5 | 7 | 4 |
|  | 256 QAM | ≤ 9 |  | ≤ 11.5 | 5 | 11.5 | 7.5 |  |

**Proposal 2 (Nokia): RAN4 shall consider defining A-MPR for n28 PC2 due to NS\_18 as shown in tables 3 and 4, and consider defining A-MPR for n28 PC3 due to NS\_18 as shown in tables 5 and 6.**

Table 3: A-MPR regions for NS\_18 and PC2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel Bandwidth, MHz | Frequency range of UL transmission bandwidth configuration, MHz | Regions | | A-MPR |
|  |  | RBstart\*12\*SCS  MHz | LCRB\*12\*SCS  MHz |  |
| 25 | 703~733 | >(LCRB\*12\*SCS)/2+3.6 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
|  |  | ≤(LCRB\*12\*SCS)/2+3.6 | ≥5.4 | A4 |
|  |  | ≤6.3 | <5.4 | A5 |
|  |  | >(LCRB\*12\*SCS)/2+3.6 ≤(LCRB\*12\*SCS)/2+5.76 | <Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) ≥ 5.4 | A6 |
| 30 | 703~733 | >(LCRB\*12\*SCS)/2+5.22 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
|  |  | ≤(LCRB\*12\*SCS)/2+5.22 | ≥5.4 | A4 |
|  |  | ≤7.92 | <5.4 | A5 |
|  |  | >(LCRB\*12\*SCS)/2+5.22  ≤(LCRB\*12\*SCS)/2+7.38 | <Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) ≥ 5.4 | A6 |
| 40 | 703~743 | ≥ 0 | > 6.0, ≥ 0.9\*12\*SCS\*RBstart – 3 | A4 |
| ≥ 0 | ≤ 6.0, ≤ -4\*12\*SCS\*RBstart + 45 | A5 |

Table 4: A-MPR values for NS\_18 and PC2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Modulation/Waveform | | A1 (dB) | | A2 (dB) | A3 (dB) | A4 (dB) | A5 (dB) | A6 (dB) |
|  | | Outer | Inner | Inner/Outer | Outer/Inner | Outer/Inner | Outer/Inner | Outer/Inner |
| DFT-s-OFDM | Pi/2 BPSK | 1.5 | N/A | 8 | 3.5 | 8 | 2.5 | 2 |
|  | QPSK | 2.5 |  | 8.5 | 3.5 | 8.5 | 3.5 | 2 |
|  | 16 QAM | 3 |  | 8.5 | 3.5 | 9 | 4 | 2 |
|  | 64 QAM | 3.5 |  | 9 | 3.5 | 9 | 4 | 2.5 |
|  | 256 QAM |  |  | 9 | 3.5 | 9 |  |  |
| CP-OFDM | QPSK | 4 |  | 9 | 5 | 9.5 | 5 | 4 |
|  | 16 QAM | 4 |  | 9 | 5 | 9.5 | 5 | 4 |
|  | 64 QAM | 4 |  | 9 | 5 | 9.5 | 5 | 4 |
|  | 256 QAM |  |  | 9 | 5 | 9.5 |  |  |

**Table 5: A-MPR regions for PC3 NS\_18. The new entries are marked with yellow color.**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channel Bandwidth, MHz** | **Frequency range of UL transmission bandwidth configuration, MHz** | **Regions** | | **A-MPR** |
|  |  | **RBstart\*12\*SCS**  **MHz** | **LCRB\*12\*SCS**  **MHz** |  |
| 25 | 703~733 | >(LCRB\*12\*SCS)/2+3.6 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
|  |  | ≤(LCRB\*12\*SCS)/2+3.6 | ≥5.4 | A4 |
|  |  | ≤6.3 | <5.4 | A5 |
| 30 | 703~733 | >(LCRB\*12\*SCS)/2+5.22 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
|  |  | ≤(LCRB\*12\*SCS)/2+5.22 | ≥5.4 | A4 |
|  |  | ≤7.92 | <5.4 | A5 |
| 40 | 703~743 | ≥ 0 | > 6.0, ≥ 0.9\*12\*SCS\*RBstart – 3 | A6 |
| ≥ 0 | ≤ 6.0, ≤ -4\*12\*SCS\*RBstart + 45 | A7 |

**Table 6: A-MPR values for PC3 NS\_18. The new entries are marked with yellow color.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Modulation/Waveform** | | **A1 (dB)** | | **A2 (dB)** | **A3 (dB)** | **A4 (dB)** | **A5 (dB)** | **A6 (dB)** | **A7 (dB)** |
|  | | **Outer** | **Inner** | **Inner/Outer** | **Outer/Inner** | **Outer/Inner** | **Outer/Inner** | **Outer/Inner** | **Outer/Inner** |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 2 | N/A | ≤ 5 | 3 | 8 | 3 | 4.5 | 2 |
|  | QPSK | ≤ 2 |  | ≤ 5 | 3 | 8 | 3 | 5.5 | 2.5 |
|  | 16 QAM | ≤ 3 |  | ≤ 6 | 3 | 8 | 3 | 6 | 3 |
|  | 64 QAM | ≤ 4 |  | ≤ 7 | 3 | 8 | 4.5 | 6 | 3 |
|  | 256 QAM | ≤ 6 |  | ≤ 9 | 3 | 8 | 5.5 | 6 |  |
| CP-OFDM | QPSK | ≤ 5 |  | ≤ 6.5 | 4.5 | 9.5 | 5 | 7 | 4 |
|  | 16 QAM | ≤ 5 |  | ≤ 7 | 4.5 | 9.5 | 5 | 7 | 4 |
|  | 64 QAM | ≤ 5.5 |  | ≤ 8.5 | 4.5 | 9.5 | 5.5 | 7 | 4 |
|  | 256 QAM | ≤ 8.5 |  | ≤ 11.5 | 4.5 | 9.5 | 7.5 | 7 |  |
| NOTE 1: Void  NOTE 2: Void | | | | | | | | | |

**Proposal 3 (Apple): Consider Table 5 to 7 when specifying NS\_18.**

Table 5: **PC3** region definition for 25MHz, 30MHz and 40MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel Bandwidth, MHz | Frequency range of UL transmission bandwidth configuration, MHz | Regions | | A-MPR |
|  |  | RBstart\*12\*SCS  MHz | LCRB\*12\*SCS  MHz |  |
| 25 | 703~733 | >(LCRB\*12\*SCS)/2+3.6 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
|  |  | ≤(LCRB\*12\*SCS)/2+3.6 | ≥5.4 | A4 |
|  |  | ≤6.3 | <5.4 | A5 |
| 30 | 703~733 | >(LCRB\*12\*SCS)/2+5.22 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
|  |  | ≤(LCRB\*12\*SCS)/2+5.22 | ≥5.4 | A4 |
|  |  | ≤7.92 | <5.4 | A5 |
| 40 | 703~743 | >(LCRB\*12\*SCS)/2+8.46 | ≥Max(0, 12\*SCS\*NRB – 1.8 –  RBstart\*12\*SCS) | A3 |
|  |  | ≤(LCRB\*12\*SCS)/2+8.46 | ≥5.4 | A4 |
|  |  | ≤11.16 | <5.4 | A5 |

Table 6: **PC2** region definition for 25MHz, 30MHz and 40MHz channel bandwidth

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel Bandwidth, MHz | Frequency range of UL transmission bandwidth configuration, MHz | Regions (PC2) | | A-MPR |
|  |  | RBstart\*12\*SCS  MHz | LCRB\*12\*SCS  MHz |  |
| 25 | 703~733 | >(LCRB\*12\*SCS)/2+3.6 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
|  |  | ≤(LCRB\*12\*SCS)/2+3.6 | ≥5.4 | A4 |
|  |  | ≤6.3 | <5.4 | A5 |
|  |  | >(LCRB\*12\*SCS)/2+3.6  ≤(LCRB\*12\*SCS)/2+5.76 | <Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS)  ≥5.4 | A6 |
| 30 | 703~733 | >(LCRB\*12\*SCS)/2+5.22 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
|  |  | ≤(LCRB\*12\*SCS)/2+5.22 | ≥5.4 | A4 |
|  |  | ≤7.92 | <5.4 | A5 |
|  |  | >(LCRB\*12\*SCS)/2+5.22  ≤(LCRB\*12\*SCS)/2+7.38 | <Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS)  ≥5.4 | A6 |
| 40 | 703~743 | >(LCRB\*12\*SCS)/2+8.46 | ≥Max(0, 12\*SCS\*NRB – 1.8 –  RBstart\*12\*SCS) | A3 |
|  |  | ≤(LCRB\*12\*SCS)/2+8.46 | ≥5.4 | A4 |
|  |  | ≤11.16 | <5.4 | A5 |
|  |  | >(LCRB\*12\*SCS)/2+8.46  ≤(LCRB\*12\*SCS)/2+11.7 | <Max(0, 12\*SCS\*NRB – 1.8 –  RBstart\*12\*SCS)  ≥5.4 | A6 |

Table 7: **PC2** A-MPR for NS\_18

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Modulation/Waveform** | | **A3 (dB)** | **A4 (dB)** | **A5 (dB)** | **A6 (dB)** |
|  | | **Outer/Inner** | **Outer/Inner** | **Outer/Inner** | **Outer/Inner** |
| DFT-s-OFDM | Pi/2 BPSK | [3+0.5] | [8+2] | [3+1.5] | [0+2.0] |
|  | QPSK | [3+0.5] | [8+2] | [3+1.5] | [0+2.0] |
|  | 16 QAM | [3+0.5] | [8+3] | [3+2] | [1.0+1.0] |
|  | 64 QAM | [3+0.5] | [8+3] | [4.5+1] | [2.5] |
|  | 256 QAM | [3+0.5] | [8+3] | [5.5] | [4.5] |
| CP-OFDM | QPSK | [4.5+0.5] | [9.5+2] | [5+1] | [1.5+2.5] |
|  | 16 QAM | [4.5+0.5] | [9.5+2] | [5+1] | [2.0+2.0] |
|  | 64 QAM | [4.5+0.5] | [9.5+2] | [5.5+0.5] | [3.5+0.5] |
|  | 256 QAM | [4.5+0.5] | [9.5+2] | [7.5] | [6.5] |

Proposal 4 (OPPO): Consider Table 1 as the AMPR region definition and Table 2 as the PC3 AMPR requirements.

Table 1 AMPR region definition for 1T PC3

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CBW, MHz | Tx BW, MHz | Regions | | A-MPR |
| RBstart \*12\*SCS (MHz) | LCRB \*12\*SCS (MHz) |
| 40MHz | 703-743 | >(LCRB\*12\*SCS)/2+8.46 | ≥Max (0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
| ≤(LCRB\*12\*SCS)/2+8.46 | ≥5.4 | A4 |
| ≤11.16 | <5.4 | A5 |

Table 2 AMPR for 1T PC3

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | DFT-S-OFDM | | | CP-OFDM | | |
|  | A3 | A4 | A5 | A3 | A4 | A5 |
| Pi/2 BPSK | 1 | 8 | 5 |  |  |  |
| QPSK | 4 | 8 | 5 | 6 | 10 | 7 |
| 16QAM | 6 | 10 | 6 | 6 | 10 | 7 |
| 64QAM | 6 | 10 | 6 | 6 | 10 | 7 |
| 256QAM | 6 | 10 | 6 | 6 | 10 | 7 |

**Consider Table 3 as the AMPR region definition for PC2 with 1Tx or 2Tx.**

Table 3 AMPR region definition for PC2 with 1Tx or 2Tx

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| CBW, MHz | Tx BW, MHz | Regions | | A-MPR |
| RBstart \*12\*SCS (MHz) | LCRB \*12\*SCS (MHz) |
| 40MHz | 703-743 | >(LCRB\*12\*SCS)/2+8.46 | ≥Max (0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
| ≤(LCRB\*12\*SCS)/2+8.46 | ≥5.4 | A4 |
| ≤11.16 | <5.4 | A5 |
| >(LCRB\*12\*SCS)/2+8.46  ≤(LCRB\*12\*SCS)/2+11.7 | <Max (0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS)  ≥5.4 | A6 |

**If separate AMPR tables for PC2 with 1Tx and 2Tx, then AMPR table 4 and 5 can be used.**

Table 4 AMPR for 1T PC2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | DFT-S-OFDM | | | | CP-OFDM | | | |
|  | A3 | A4 | A5 | A6 | A3 | A4 | A5 | A6 |
| Pi/2 BPSK | 2 | 8 | 5 | 2 |  |  |  |  |
| QPSK | 4 | 10 | 5 | 4 | 6 | 13 | 8 | 6 |
| 16QAM | 5 | 10 | 6 | 5 | 6 | 13 | 8 | 6 |
| 64QAM | 5 | 10 | 6 | 5 | 6 | 14 | 8 | 6 |
| 256QAM | 5 | 10 | 6 | 5 | 6 | 14 | 8 | 6 |

Table 5 AMPR for 2T PC2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | DFT-S-OFDM | | | | CP-OFDM | | | |
|  | A3 | A4 | A5 | A6 | A3 | A4 | A5 | A6 |
| Pi/2 BPSK | 3 | 10 | 5 | 3 |  |  |  |  |
| QPSK | 5 | 13 | 7 | 5 | 6 | 13 | 8 | 6 |
| 16QAM | 6 | 13 | 7 | 6 | 6 | 13 | 8 | 6 |
| 64QAM | 6 | 13 | 7 | 6 | 6 | 13 | 8 | 6 |
| 256QAM | 6 | 13 | 7 | 6 | 6 | 13 | 8 | 6 |

**If one AMPR table for PC2 with 1Tx and 2Tx, then AMPR table 6 can be used.**

Table 6 AMPR for both 1T and 2T PC2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | DFT-S-OFDM | | | | CP-OFDM | | | |
|  | A3 | A4 | A5 | A6 | A3 | A4 | A5 | A6 |
| Pi/2 BPSK | 3 | 10 | 5 | 3 |  |  |  |  |
| QPSK | 5 | 13 | 7 | 5 | 6 | 13 | 8 | 6 |
| 16QAM | 6 | 13 | 7 | 6 | 6 | 13 | 8 | 6 |
| 64QAM | 6 | 13 | 7 | 6 | 6 | 14 | 8 | 6 |
| 256QAM | 6 | 13 | 7 | 6 | 6 | 14 | 8 | 6 |

Proposal 5 (Skyworks): Come back at next meeting to improve the accuracy of required OBO for waveforms where large (>10dB) A-MPR is needed, like WF [R4-2310245] Region A4 configurations.

Recommended WF:

* Last meeting, it was agreed that confirm R18 agreements for PC2 NS\_18 (see R4-2310245).
* Use following proposal as baseline for further discussion.
* Table 6.2.3.1-1: Additional maximum power reduction (A-MPR)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Network signalling label | Requirements (clause) | NR Band | Channel bandwidth (MHz) | Resources blocks (*N*RB) | A-MPR (dB) |
| NS\_18 | 6.5.3.3.3 | n28, n83 | 5 |  | Table 6.2.3.13-1, A1 for PC3; Table 6.2.3.13-2, A1 for PC2 |
| 10, 15, 20 |  | Table 6.2.3.13-1, A2 for PC3; Table 6.2.3.13-2, A2 for PC2 |
| 25, 30, 40 |  | Table 6.2.3.13-1, A3, A4, A5 for PC3;  Table 6.2.3.13-2, A3, A4, A5, A6 for PC2 |

**Table 6.2.3.13-0: Band n28 and n83 25MHz and 30MHz A-MPR regions for NS\_18**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Channel Bandwidth, MHz** | **Carrier Center Frequency, Fc, MHz** | **Regions** | | **A-MPR** |
|  |  | **RBstart\*12\*SCS**  **MHz** | **LCRB\*12\*SCS**  **MHz** |  |
| 25 | 715.5 – 730.54 | >(LCRB\*12\*SCS)/2+3.6 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
|  |  | ≤(LCRB\*12\*SCS)/2+3.6 | ≥5.4 | A4 |
|  |  | ≤6.3 | <5.4 | A5 |
|  |  | >(LCRB\*12\*SCS)/2+3.6  ≤(LCRB\*12\*SCS)/2+5.76 | <Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS)  ≥5.4 | A6 |
| 30 | 718 – 728.04 | >(LCRB\*12\*SCS)/2+5.22 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
|  |  | ≤(LCRB\*12\*SCS)/2+5.22 | ≥5.4 | A4 |
|  |  | ≤7.92 | <5.4 | A5 |
|  |  | >(LCRB\*12\*SCS)/2+5.22  ≤(LCRB\*12\*SCS)/2+7.38 | <Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS)  ≥5.4 | A6 |
| 40 | 723 – 723.04 | >(LCRB\*12\*SCS)/2+8.46 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS) | A3 |
| ≤(LCRB\*12\*SCS)/2+8.46 | ≥5.4 | A4 |
| ≤11.16 | <5.4 | A5 |
| >(LCRB\*12\*SCS)/2+8.46  ≤ (LCRB\*12\*SCS)/2+10.8 | ≥Max(0, 12\*SCS\*NRB – 1.8 – RBstart\*12\*SCS)  ≥5.4 | A6 |

**Table 6.2.3.13-1: A-MPR for NS\_18 (Power Class 3)**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Modulation/Waveform** | | **A1 (dB)** | | **A2 (dB)** | **A3 (dB)** | **A4 (dB)** | **A5 (dB)** |
|  | | **Outer** | **Inner** | **Inner/Outer** | **Outer/Inner** | **Outer/Inner** | **Outer/Inner** |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 2 | N/A | ≤ 5 | 3 | 8 | 3 |
|  | QPSK | ≤ 2 |  | ≤ 5 | 3 | 8 | 3 |
|  | 16 QAM | ≤ 3 |  | ≤ 6 | 3 | 8 | 3 |
|  | 64 QAM | ≤ 4 |  | ≤ 7 | 3 | 8 | 4.5 |
|  | 256 QAM | ≤ 6 |  | ≤ 9 | 3 | 8 | 5.5 |
| CP-OFDM | QPSK | ≤ 5 |  | ≤ 6.5 | 4.5 | 9.5 | 5 |
|  | 16 QAM | ≤ 5 |  | ≤ 7 | 4.5 | 9.5 | 5 |
|  | 64 QAM | ≤ 5.5 |  | ≤ 8.5 | 4.5 | 9.5 | 5.5 |
|  | 256 QAM | ≤ 8.5 |  | ≤ 11.5 | 4.5 | 9.5 | 7.5 |
| NOTE 1: Void  NOTE 2: Void | | | | | | | |

**Table 6.2.3.13-2: A-MPR for NS\_18 (Power Class 2, 1Tx)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Modulation/Waveform** | | **A1 (dB)** | | **A2 (dB)** | **A3 (dB)** | **A4 (dB)** | **A5 (dB)** | **A6 (dB)** |
|  | | **Outer** | **Inner** | **Inner/Outer** | **Outer/Inner** | **Outer/Inner** | **Outer/Inner** | **Outer/Inner** |
| DFT-s-OFDM | Pi/2 BPSK | ≤ 3.5 | N/A | ≤ 8 | 3.5 | 10 | 4.5 | 2 |
|  | QPSK | ≤ 3.5 |  | ≤ 8 | 3.5 | 10 | 4.5 | 2 |
|  | 16 QAM | ≤ 4 |  | ≤ 9 | 3.5 | 11 | 5 | 2 |
|  | 64 QAM | ≤ 4.5 |  | ≤ 10 | 3.5 | 11 | 5.5 | 2.5 |
|  | 256 QAM | ≤ 6.5 |  | ≤ 11 | 3.5 | 11 | 5.5 |  |
| CP-OFDM | QPSK | ≤ 5.5 |  | ≤ 9.5 | 5 | 11.5 | 6 | 4 |
|  | 16 QAM | ≤ 5.5 |  | ≤ 10 | 5 | 11.5 | 6 | 4 |
|  | 64 QAM | ≤ 6 |  | ≤ 11.5 | 5 | 11.5 | 6 | 4 |
|  | 256 QAM | ≤ 9 |  | ≤ 11.5 | 5 | 11.5 | 7.5 |  |

OPPO: way forward can be used as baseline. Is this only for 1T, why doe we need 2T?

Skyworks: we plan to evaluate 2Tx. We can discuss whether we need two requirements or just consider the worst case.

Qualcomm: consider the requirements to cover both 1T and 2T.

**Issue 1-2-3 n28 REFSENS for PC3**

**Agreement in RAN4#112:**

* FFS on PC3 REFSENS based on more companies’ input.
* Following values are proposed in this meeting as starting point.

|  |  |
| --- | --- |
| Source | 40 MHz (dBm) |
| Skyworks(R4-2413062) | -66.3 |
| Qualcomm (R4-2413149) | -65.9 |
| Muruta (R4-2411476) | -67.1 for 15KHz  -67.2 for 30KHz |
| Average | -66.4 |

**Proposal in RAN4#112bis:**

|  |  |
| --- | --- |
| Source | 40 MHz (dBm) |
| Skyworks(R4-2413062, R4-2416227) | -66.3 for 15KHz  -66.4 for 30KHz |
| Qualcomm (R4-2413149) | -65.9 |
| Muruta (R4-2411476) | -67.1 for 15KHz  -67.2 for 30KHz |
| Huawei (R4-2415464) | -66.4 |
| Apple (R4-2415322) | -65.9 |
| Average | -66.3 |

Recommended WF:

* Take as average value -66.3dBm as PC3 REFSENS

ZTE: REFSENS requirements apply for both 15KHz SCS and 30KHz SCS?

Moderator: yes.

Agreement:

* Take as average value -66.3dBm as PC3 REFSENS

**Issue 1-2-4 PC2 RSD for 1Tx and 2Tx for 40MHz**

|  |  |  |
| --- | --- | --- |
| Source | RSD 1Tx (dB) | RSD 2Tx (dB) |
| Skyworks (R4-2416227) | 4 | 8.5 |
| Qualcomm (R4-2416458) | 3 | 7.9 |
| Muruta (R4-2411476) | 2.8 | 8.8 |
| Huawei (R4-2415464) | [3.0] | [8.2] |
| Apple (R4-2415322) | 2.2 |  |

Recommended WF:

* Calculating the average of PC2 REFENSE from different companies, it is recommended that:
  + PC2 RSD for 1Tx is 3 dB, for 2Tx is 8.2 dB

Skyworks: the average is done based on different REFSENS?

Moderator: it is calculated based on PC2 values from companies.

**Agreement:**

* PC2 RSD for 1Tx is 3 dB, for 2Tx is 8.2 dB

**Issue 1-2-5** **∆MPR for 40MHz**

Option 1 (Apple, ZTE, QC, Skyworks): 0.5 dB for 40 MHz channel bandwidth both for PC3 and PC2.

Recommended WF:

* Option 1

Agreement:

* 0.5 dB for 40 MHz channel bandwidth both for PC3 and PC2.

**Issue 1-2-6 General coex requirements for 40MHz**

**Proposal 1 (vivo, R4-2415802): the following UE coexistence requirements are applicable for 40MHz UE CBW:**

| NR Band | Spurious emission for UE co-existence | | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Protected band | | Frequency range (MHz) | | | | Maximum Level (dBm) | | MBW (MHz) | | NOTE | |
| n28, n83 | | E-UTRA Band 1, 4, 22, 32, 42, 43, 50, 51, 65, 66, 74, 75, 76  NR Band n77, n78, n100, n101, n109 | | FDL\_low | - | FDL\_high | | -50 | | 1 | | 2 |
|  | |  | |  |  |  | |  | |  | |  |
|  | | E-UTRA Band 2, 3, 5, 7, 8, 18, 19, 20, 25, 26, 27, 31, 34, 38, 39, 40, 41, 52, 71, 72, 73  NR Band n79, n105 | | FDL\_low | - | FDL\_high | | -50 | | 1 | |  |
|  | |  | |  |  |  | |  | |  | |  |
|  | | Frequency range | | 470 | - | 694 | | -25 | | 8 | | 15 |
|  | |  | |  |  |  | |  | |  | |  |
|  | | Frequency range | | 662 | - | 694 | | -26.2 | | 6 | | 15 |
|  | | Frequency range | | 758 | - | 773 | | -32 | | 1 | | 15 |
|  | | Frequency range | | 773 | - | 803 | | -50 | | 1 | |  |
|  | |  | |  |  |  | |  | |  | |  |

**Proposal 2 (QC, R4-2416458): Confirm until RAN4#113 whether UE-to-UE co-existence requirements can be met with 40 MHz CBW without A-MPR.**

**Table 7: n28 UE coexistence requirements**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| n28, n83 | E-UTRA Band 1, 4, 22, 32, 42, 43, 50, 51, 65, 66, 74, 75, 76  NR Band n77, n78, n100, n101 | FDL\_low | - | FDL\_high | -50 | 1 | 2 |
|  | E-UTRA Band 1 | FDL\_low | - | FDL\_high | -50 | 1 | 19, 25 |
|  | E-UTRA Band 2, 3, 5, 7, 8, 18, 19, 20, 25, 26, 27, 31, 34, 38, 39, 40, 41, 52, 72, 73  NR Band n79 | FDL\_low | - | FDL\_high | -50 | 1 |  |
|  | E-UTRA Band 11, 21 | FDL\_low | - | FDL\_high | -50 | 1 | 19, 24 |
|  | Frequency range | 470 | - | 694 | -42 | 8 | 15, 35 |
|  | Frequency range | 470 | - | 710 | -26.2 | 6 | 34 |
|  | Frequency range | 662 | - | 694 | -26.2 | 6 | 15 |
|  | Frequency range | 758 | - | 773 | -32 | 1 | 15 |
|  | Frequency range | 773 | - | 803 | -50 | 1 |  |
|  | Frequency range | 1884.5 | - | 1915.7 | -41 | 0.3 | 8, 19 |

Qualcomm: the question is whether we need include any clarification on the applicability related to bandwidths.

Vivo: We can use vivo proposal as baseline.

Huawei: we have not seen any need to change the current spec. The note is already clear about the applicable bandwidth.

ZTE: To vivo, why is the last row removed?

Recommended WF:

* TBA

**Issue 1-2-7 channel location**

Proposal 1 (CMCC, R4-2414944): It is proposed to add a new note of UL channel location for UE supporting maximum 40MHz channel bandwidth for n28 as follows:

 For UEs supporting 40MHz, for the 20MHz, 25MHz and 30MHz, the minimum requirements are specified for NR UL transmission bandwidth configuration confined to either 703-743 MHz or 718-748 MHz. For the 40MHz, the minimum requirements are specified for NR UL transmission bandwidth configuration confined to 703-743.04MHz.

Proposal 2 (Huawei, R4-2415464):

* **modify the existing NOTE 7 for band n28 as follows:**

NOTE 7: For UEs supporting 30MHz max bandwidth, the minimum requirements are specified for NR UL channel bandwidths confined to either 703-733MHz or 718-748MHz for the 20, 25 and 30MHz bandwidth.

* **For UEs supporting 40MHz, add a new note as follows:**

NOTE x: For UEs supporting 40MHz max bandwidth, the minimum requirements are specified for NR UL channel bandwidths confined to either 703-743MHz or 718-748MHz for the 30MHz bandwidth. And for the 40MHz bandwidth, the minimum requirements are specified for NR UL channel bandwidths confined to either 703-743.04MHz.

Proposal 3 (vivo, R4-2415802): For 40Mhz CBW, to compatible with different implementations, the note is proposed as: “For the 40 MHz bandwidth, the minimum requirements are specified for NR UL carrier frequencies confined to 713-733 MHz”

Proposal 4 (ZTE, R4-2415898): For the UL 40MHz bandwidth channel location:

- The minimum requirements are specified for NR UL channel bandwidth configuration confined to 703-743 MHz.

- Flexible channel allocation for <40MHz channel bandwidth should be allowed.

Proposal 5 (Nokia, R4-2415981):

* 40 MHz channel bandwidth for both BS and UE is only at the raster entry, 723.04 MHz for UL and DL 778.04 MHz for DL.
* The channel location limitation for channel bandwidths less than 40 MHz is better not considered in RAN4 core requirement.

Proposal 6(QC, R4-2416458):

* For UEs supporting 40 MHz channel bandwidth, narrower channel bandwidths can be freely placed within the 40 MHz channel bandwidth as long as they are fully contained within 703 to 743.04 MHz.
* NS\_18 A-MPR is applicable whenever channel bandwidth fully is contained within 703 to 743.04 MHz

Recommended WF:

* Discuss whether existing NOTE7 for band 28 need to be updated as following:

NOTE 7: For UEs supporting 30MHz max bandwidth, the minimum requirements are specified for NR UL channel bandwidths confined to either 703-733MHz or 718-748MHz for the 20, 25 and 30MHz bandwidth.

* Introduce a new note for UE supporting 40MHz, consider following options:

Option 1: For UEs supporting 40MHz max bandwidth, the minimum requirements are specified for NR UL channel bandwidths confined to either 703-743MHz or 718-748MHz for the 30MHz bandwidth. And for the 40MHz bandwidth, the minimum requirements are specified for NR UL channel bandwidths confined to either 703-743.04MHz.

Option 2: For UEs supporting 40MHz, for the 20MHz, 25MHz and 30MHz, the minimum requirements are specified for NR UL transmission bandwidth configuration confined to either 703-743 MHz or 718-748 MHz. For the 40MHz, the minimum requirements are specified for NR UL transmission bandwidth configuration confined to 703-743.04MHz.

**Ericsson: We are OK with the update of note 7. Network cannot configure 30MHz within 40MHz. There is some restriction in the deployment. In the test, we can test the filter.**

**Qualcomm: need add 20, 25.**

**Huawei: need to check relative to filter.**

**Agreement:**

* **Update the NOTE 7 as follows:**
  + NOTE 7: For UEs supporting 30MHz max bandwidth, the minimum requirements are specified for NR UL channel bandwidths confined to either 703-733MHz or 718-748MHz for the 20, 25 and 30MHz bandwidth.
* **Introduce the new note as follows:**
  + For UEs supporting 40MHz max bandwidth, the minimum requirements are specified for NR UL channel bandwidths confined to either 703-743MHz or 718-748MHz for the [20, 25, and] 30MHz bandwidth. And for the 40MHz bandwidth, the minimum requirements are specified for NR UL channel bandwidths confined to either 703-743.04MHz.

**Issue 1-2-8 channel raster**

|  |
| --- |
| **<Background>:**   * In the enhanced channel raster WI, it had been agreed that UE supports enhanced channel raster as mandatory feature in NR band n28 from Rel-18. * In previous RAN4 discussion about exceptional channel raster, (UL: 144608/DL: 155608) is added to 40MHz BS CBW is added to TS 38.104, the same channel raster point is not added to TS 38.101-1 due to lack of 40MHz UE CBW, however, there is an agreement indicating that it should be added to TS 38.101-1 when UE 40MHz CBW is specified |

Regarding exceptional channel raster:

* Option 1 (Huawei, vivo, QC, CMCC): Add the exceptional channel raster point of n28 (UL: 723.04MHz, DL: 778.04MHz) to UE RF specification TS 38.101-1 for UE CBW 40MHz.
* Option 2 (ZTE, Nokia): No need to include exceptional channel raster, enhanced channel raster is enough

Regarding enhance channel raster

* Option 1 (CMCC): follow the agreement of Rel-18 enhanced channel raster, i.e. n28 mandatory support enhanced channel raster from Rel-18.
* Option 2 (vivo): Do not support enhance channel raster
* Option 3 (ZTE): Support from Rel-16?

Recommended WF:

* Majority companies support to add exceptional channel raster, it is recommended agree on option 1.
* Regarding enhanced channel raster, since the agreement “n28 mandatory support enhanced channel raster from Rel-18” was made in Rel-18 in enhanced channel raster WI, it is recommended not open the discussion.

ZTE: For BS, there is 40MHz. There is misalignment. There is no need to introduce the new additional channel raster.

Nokia: RAN4 works on the general solution.

Qualcomm: “exceptional”, it should be based on enhanced channel raster.

CMCC: if companies are OK to introduce the enhanced channel raster from the earlier release, we are OK.

Huawei: there are two channel raster points which can be used to allow UE only supporting 100KHz raster. We just need to introduce the additional channel raster rather than mandating the UE support of enhanced channel raster.

Ericsson: We agree with Huawei. The exceptional raster points are needed for legacy UEs.

**Agreement:**

* Alt1: Add the exceptional channel raster point of n28 (UL: 723.04MHz, DL: 778.04MHz) to UE RF specification TS 38.101-1 for UE CBW 40MHz.
* Alt2: Cover all the channel raster points of n28 based on the enhanced channel raster to UE RF specification TS 38.101-1 for UE CBW 40MHz.

**Issue 1-2-9 Release independence**

Option 1 (Huawei, vivo, Nokia): Rel-16

Option 2 (CMCC): Rel-15

Recommended WF:

* Related to issue 1-2-8. Discuss issue 1-2-8 first.

Huawei: it depends on the previous issue. If going with Alt1, we are OK with Rel-16.

Nokia: for releases independent, there is no clear statement.

CMCC: need to check if it is necessary to have CR for Rel-16/17.

Ericsson: We have to do U-turn. Start the enhancement channel raster from Rel-18. Then we should go without the exceptional channel raster points. The Rel-16 UE can support 40MHz CBW + enhanced channel raster defined in Rel-18, and then we do not need the exceptional channel raster.