**3GPP TSG-RAN WG4 Meeting # 109 R4-2318118**

**Chicago, USA, November 13 – November 17, 2023**

**Agenda item:** 7.21&7.22

**Source:** Moderator (China Unicom)

**Title:** Topic summary for [109][112] HPUE\_Basket\_FDD

**Document for:** Information

# Introduction

Thread [112] includes the following topics:

1. Topic #1 Issues for (Agenda 7.21)
2. Topic #2 Issues for (Agenda 7.22)

# Topic #1: HPUE for CA with PC2 on FDD carrier

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318270 | China Unicom | *Revised WID Reserved for post-meeting approval* |
| R4-2318271 | China Unicom | *BigCR Reserved for post-meeting approval* |
| R4-2318272 | China Unicom | *TR Reserved for post-meeting approval* |

## Open issues summary

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

None.

# Topic #2: HPUE for FDD single band

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318273 | China Unicom | *Revised WID Reserved for post-meeting approval* |
| R4-2318274 | China Unicom | *BigCR Reserved for post-meeting approval* |
| R4-2318275 | China Unicom | *TR Reserved for post-meeting approval* |
| R4-2318253 | Murata Manufacturing | **Proposal**: The RSD of PC2 n13 and n14 are proposed highlighted in Table 2. |
| R4-2318355 | Skyworks Solutions | CR to R18 TS38.101-1 to introduce PC2 UTRA ACLR |
| R4-2318749 | Apple | Proposal: Discuss whether 0.5dB relaxation for outer allocations can be justified for PC2. |
| R4-2318750 | Apple | Observation: For 10MHz channel a region is defined for the upper channel edge and given the A-MPR ‘A4’. Similar case is found for 5MHz channel. For PC3 the power back-off allowance is 3dB. In [2] the difference between PC3 and PC2 is provided and only indicate a max delta of 3dB. However, the simulations in [2] and in our simulations indicate far larger power back-off need which are up to 11-13dB.Proposal 1: It is encouraged to check whether an oversight was made and the wrong A-MPR allowance was assigned for PC3.Proposal 2: It is proposed to correct the error in PC3 region so that allocations with RBstart = 0 are included.Proposal 3: Consider the Tables 4 and 5 when defining A-MPR for PC2. |
| R4-2318752 | Apple | Observation 1: Band 28/n28 RF specs and coexistence requirements have been derived on the basis of the dual duplexer architecture. It is not possible to fulfill the band 28/n28 RF requirements with a single duplexer architecture.Observation 2: A dual duplexer configuration for band 28/n28 is limited to 30MHz channel bandwidth.Proposal 1: For introducing single duplexer assumptions on band n28 all the Tx and Rx requirements (Coexistence, Blocking etc.) need to be evaluated. Coexistence requirements need to be checked whether those are still applicable. Potential changes need to consider impact on legacy UEs. |
| R4-2319779 | Skyworks Solutions | **Proposal:*** NS\_17 A-MPR does not consider any help from the UL filter allowing full band n28 duplexer for both PC3 and PC2
* No A-MPR is needed for NS\_17 PC3 for the 3, 5 and 10MHz channels
* It is further verified for that for 3MHz and 5MHz, PC2 NS\_17 does not require A-MPR
* A-MPR is required for PC2 NS\_15 and 10MHz channel.
 |
| R4-2319808 | Skyworks Solutions | CR to R18 TS38.101-1 to Correct NS17 and NS18 emission requirement table |
| R4-2320652 | Qualcomm | **Proposal 1: Adopt the A-MPR regions and A-MPR values in Table 1 and Table 2 for NS\_46 for PC2 operation** **Proposal 2: Allow PC2 capable UEs to reduce their output power 23 dBm – max(MPR,4) dB in case PC2 needs to fall back to PC3 operation and transmit more than 54 RB. Apply this for both SC-FDMA and CP-OFDM and all modulation orders.****Observation 1: Current specification has an error and NS\_18 emission requirement does not capture 25 MHz bandwidth.** **Proposal 3: Take A-MPR values in Tables 3 and 4 as baseline for NS\_17 for n28 PC2, verify the values further to cover all operating modes.****Proposal 4: Take A-MPR values in Tables 5 and 6 as baseline for NS\_17 for n28 PC2, verify the values further to cover all operating modes.****Observation 2: If necessary, a new NS can be added for -42 dBm/8MHz UE-to-UE coex requirement****Proposal 5: Adopt the A-MPR regions and A-MPR values in Table 7 and Table 8 for NS\_07 for PC2 operation**  |
| R4-2320653 | Qualcomm | DraftCR for Adding PC2 requirements for band n7 |
| R4-2320668 | Huawei, HiSilicon | **Observation 1: For the additional requirements indicated by NS\_17, the minimum guard band is 8MHz between the protected frequency range and the UL carrier. The latter is confined within 718-748MHz.****Observation 2: As per UE co-existence requirements (with NOTE 15), the spurious/out-of-band emissions shall not exceed -26.2dBm/6MHz for the frequency range from 662-694MHz. The minimum guard band is 9MHz from the lower edge of band n28 UL (i.e. 703MHz). This requirement shall be met for any valid channel bandwidth for band n28.****Observation 3: As per UE co-existence requirements (with NOTE 34), the worst-case spurious emission requirement is similar to that of NS\_17, except that certain RB restriction is imposed for 10MHz BW.****Observation 4: As per UE co-existence requirements (with NOTE 35), the spurious/out-of-band emissions shall not exceed -42dBm/8MHz for the frequency range from 470-694MHz. The minimum guard band is 9MHz from the lower edge of band n28 UL (i.e. 703MHz). This requirement is applicable for 10MHz BW only.** **Observation 5: The attenuation of 12dB resulting from a dual type duplexer was assumed when defining the existing PC3 A-MPR for NS\_17.****Proposal 1: The feasibility of single full-band duplexer for band n28 should be checked by considering that:** **- No filter attenuation would be available for the protected frequency range of 470-710MHz specified for both NS\_17 and UE coexistence;** **- Sufficient attenuation would be needed for the protected range of 470-694MHz (-42dBm/8MHz), 662-694MHz (-26.2dBm/6MHz) and 758-773MHz (-32/1MHz).** |
| R4-2320669 | Huawei, HiSilicon | **Observation 1: RB restrictions (<=54 RB) are applied for BW=15/20MHz when the carrier centre frequency is within certain range. The underlying power class assumption is PC3.****Observation 2: The PC3 A-MPR is only specified for BW>20MHz.****Proposal 1: Subject to further evaluation by measurements, consider the following PC2 A-MPR values for NS\_46:****Proposal 2: For BW=40MHz, consider to define a new region (e.g. 4.14<=RBend\*12\*SCS<5.04) with PC2 A-MPR = PC3 A5 + 3, instead of expanding the region for A4.****Proposal 3: Align the carrier centre frequency range for BW=25MHz with that for PC3 when defining the A-MPR requirements, namely 2534.5 ≤ FC ≤ 2557.5MHz.****Proposal 4: For BW=10 to 25MHz plus 50MHz, modify the A-MPR regions as follows:****Proposal 5: Further check if A-MPR is needed for BW=10MHz.****Proposal 6: Further check the A-MPR for BW=25MHz, since the regions are very different from those for PC3.****Proposal 7: For BW=15/20MHz, if the exception case happens that more than 54 RB is scheduled after power class fallback to PC3, the requirement on the lower bound of the configured maximum output power PCMAX\_L is unspecified, while the existing requirement for PCMAX\_H is unchanged.** |
| R4-2320670 | Huawei, HiSilicon, China Unicom | DraftCR for Adding PC2 requirements for band n5 |
| R4-2320671 | Huawei, HiSilicon, China Unicom | DraftCR for Adding PC2 requirements for band n8 |

## 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 2-1 Receiver Sensitivity Degradation

*Sub-topic description:*

*Open issues and candidate options before meeting:*

**Issue 2-1-1: 1Tx sensitivity degradation**

* Proposals

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating Band | Source | 5MHz(dB) | 10MHz(dB) | 15MHz(dB) | 20MHz(dB) | 25MHz(dB) | 30 MHz (dB) | 35 MHz (dB) | 40MHz(dB) | 45 MHz (dB) | 50MHz(dB) |
| n13 | Skyworks(R4-2300652) | 0.8 | 0.8 |  |  |  |  |  |  |  |  |
| Huawei, HiSilicon(R4- 2316472) | 0.9 | 1.0 |  |  |  |  |  |  |  |  |
| Murata (R4-2318253) | 0.7 | 0.8 |  |  |  |  |  |  |  |  |
| Average (Moderator) | 0.8 | 0.9 |  |  |  |  |  |  |  |  |
| n14 | Skyworks (R4-2311152) | 0.4 | 0.8 |  |  |  |  |  |  |  |  |
| Apple (R4-2311251) | 0.3 | 0.6 |  |  |  |  |  |  |  |  |
| Huawei, HiSilicon(R4- 2316472) | 0.9 | 1.0 |  |  |  |  |  |  |  |  |
| Murata (R4-2318253) | 0.7 | 0.8 |  |  |  |  |  |  |  |  |
| Average (Moderator) | 0.6 | 0.8 |  |  |  |  |  |  |  |  |

* Recommended WF
	+ To check if it is agreeable to take the average values as agreement for n13 and n14.

Agreement:

* **For 1Tx sensitivity degradation**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating Band | 5MHz(dB) | 10MHz(dB) | 15MHz(dB) | 20MHz(dB) | 25MHz(dB) | 30 MHz (dB) | 35 MHz (dB) | 40MHz(dB) | 45 MHz (dB) | 50MHz(dB) |
| n13 | 0.8 | 0.9 |  |  |  |  |  |  |  |  |
| n14 | 0.6 | 0.8 |  |  |  |  |  |  |  |  |

**Issue 2-1-2: 2Tx sensitivity degradation**

* Proposals

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating Band | Source | 5MHz(dB) | 10MHz(dB) | 15MHz(dB) | 20MHz(dB) | 25MHz(dB) | 30 MHz (dB) | 35 MHz (dB) | 40MHz(dB) | 45 MHz (dB) | 50MHz(dB) |
| n13 | Skyworks(R4-2300652) | 1.7 | 1.7 |  |  |  |  |  |  |  |  |
| Apple(R4-2305364) | 0.5 | 0.5 |  |  |  |  |  |  |  |  |
| Huawei, HiSilicon(R4- 2316472) | 2.0 | 2.0 |  |  |  |  |  |  |  |  |
| Murata (R4-2318253) | 0.7 | 1.0 |  |  |  |  |  |  |  |  |
| Average (Moderator) | 1.2 | 1.3 |  |  |  |  |  |  |  |  |
| n14 | Skyworks (R4-2311152) | 0.8 | 1.3 |  |  |  |  |  |  |  |  |
| Apple (R4-2311251) | 0.8 | 0.8 |  |  |  |  |  |  |  |  |
| Huawei, HiSilicon(R4- 2316472) | 2.0 | 2.0 |  |  |  |  |  |  |  |  |
| Murata (R4-2318253) | 0.7 | 1.0 |  |  |  |  |  |  |  |  |
| Average (Moderator) | 1.1 | 1.3 |  |  |  |  |  |  |  |  |

* Recommended WF
	+ To check if it is agreeable to take the average values as agreement for n13 and n14.

AT&T: for 2Tx n14 and n13, should we have the similar values?

Huawei: In our model, we assume the worse case. We assume PC3 to derive the noise level.

Agreement:

* **For 2Tx sensitivity degradation**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Operating Band | 5MHz(dB) | 10MHz(dB) | 15MHz(dB) | 20MHz(dB) | 25MHz(dB) | 30 MHz (dB) | 35 MHz (dB) | 40MHz(dB) | 45 MHz (dB) | 50MHz(dB) |
| n13 | 1.2 | 1.3 |  |  |  |  |  |  |  |  |
| n14 | 1.1 | 1.3 |  |  |  |  |  |  |  |  |

### Sub-topic 2-2 A-MPR

*Sub-topic description: Four issues are covered under this sub-topic:*

**Issue 2-2-1: NS\_06**

**Issue 2-2-2: NS\_07 (A-MPR for n13 PC2)**

**Issue 2-2-3: NS\_46 (A-MPR for n7 PC2)**

**Issue 2-2-4: A-MPR and related issues for n28 PC2**

*Open issues and candidate options before meeting:*

**Issue 2-2-1: NS\_06**

* Proposal: Discuss whether 0.5dB relaxation for outer allocations can be justified for PC2. (R4-2318749)
* Recommended WF
	+ TBA

Qualcomm: looking at Apple simulation, 3MHz is not included. It could be further checked.

Huawei: we are OK to further check 3MHz channel bandwidth.

AT&T: on 3MHz, we are fine to further check. We would like to see 0dB relaxation for LTE.

**Issue 2-2-2: NS\_07 (A-MPR for n13 PC2)**

**[Moderator Note: Proposal 1-3 are from R4-2318750, Proposal 4 from R4-2320652.]**

* Proposal 1: It is encouraged to check whether an oversight was made and the wrong A-MPR allowance was assigned for PC3. [Considering analysis in R4-2318750 and R4-2316475]
* Proposal 2: It is proposed to correct the error in PC3 region so that allocations with RBstart = 0 are included.
* Proposal 3: Consider the Tables 4 and 5 when defining A-MPR for PC2.

Table 4: A-MPR regions for NS\_07 (PC2)

|  |  |  |  |
| --- | --- | --- | --- |
| Channel Bandwidth, MHz | Carrier Frequency, MHz | Regions | A-MPR |
|  |  | RBstart\*12\*SCSMHz | LCRB\*12\*SCSMHz |  |
| 5 MHz | 782 ≤ Fc ≤ 784.5 | ≥0 | ≥ 1.8 | A3 |
| 5 MHz | 779.5 ≤ Fc < 782 | ≤ 0.9 | ≥ 0 | A1 |
|  |  | > 0.9, ≤ 1.26 | ≥1.26 | A2 |
|  |  | > 1.26, ≤ 3.42 | ≥ 1.8 | A3 |
| >3.42 | ≤ 0.36 | A4 |
| >1.26, ≤2.16 | ≥1.26, <1.8 | A5 |
| >3.06 | >0.36 | A5 |
| 10 MHz | Fc = 782 | ≤ 2.34 | ≥ 0 | A1 |
|  |  | >2.34, ≤ 3.24 | ≥ 1.44 | A2 |
|  |  | > 3.24, ≤ 6.48 | ≥ 3.24 | A3 |
|  |  | > 6.48 | ≤ 0.36 | A4 |
|  |  | >3.24, ≤6.48 | ≥1.8, <3.24 | A5 |
|  |  | >6.48 | >0.36 | A5 |

Table 5: A-MPR for NS\_07 (PC2)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Modulation/Waveform | A1 | A2 | A3 | A4 | A5 |
|  | Outer/Inner | Outer/Inner | Outer/Inner | Outer/Inner | Outer/Inner |
| DFT-s-OFDM PI/2 BPSK | 12 + 3 | 9 + 2.5 | 6 + 2.5 | 3 + 2.5 | 3 |
| DFT-s-OFDM QPSK | 12 + 3 | 9 + 2.5 | 6 + 2.5 | 3 + 2.5 | 3 |
| DFT-s-OFDM 16 QAM | 12 + 3 | 9 + 2.5 | 6 + 2.5 | 3 + 2.5 | 3 |
| DFT-s-OFDM 64 QAM | 12 + 3 | 9 + 2.5 | 6 + 2.5 | 3 + 2.5 | 3 |
| DFT-s-OFDM 256 QAM | 12 + 3 | 9 + 2.5 | 6 + 2.5 | 3 + 2.5 | 3 |
| CP-OFDM QPSK | 14 + 3 | 10 + 2.5 | 7 + 2.5 | 3 + 2.5 | 3 |
| CP-OFDM 16 QAM | 14 + 3 | 10 + 2.5 | 7 + 2.5 | 3 + 2.5 | 3 |
| CP-OFDM 64 QAM | 14 + 3 | 10 + 2.5 | 7 + 2.5 | 3 + 2.5 | 3 |
| CP-OFDM 256 QAM | 14 + 3 | 10 + 2.5 | 7 + 2.5 | 3 + 2.5 | 3 |

Proposal 4: **Adopt the A-MPR regions and A-MPR values in Table 7 and Table 8 for NS\_07 for PC2 operation**

Table 7: A-MPR regions for NS\_07 for PC2

|  |  |  |  |
| --- | --- | --- | --- |
| Channel Bandwidth, MHz | Carrier Frequency, MHz | Regions | A-MPR |
|  |  | RBstart\*12\*SCSMHz | LCRB\*12\*SCSMHz |  |
| 5 MHz | 782 ≤ Fc ≤ 784.5 | >0 | ≥ 1.8 | A3 |
| 5 MHz | 779.5 ≤ Fc < 782 | ≤ 0.9 | ≥ 0 | A1 |
|  |  | > 0.9, ≤ 1.26 | ≥1.26 | A2 |
|  |  | > 1.26, ≤ 3.42 | ≥ 1.8 | A3 |
|  |  | >3.42 | ≤ 0.36 | A4 |
| 10 MHz | Fc = 782 | ≤ 2.34 | ≥ 0 | A1 |
|  |  | >2.34, ≤ 3.24 | ≥ 1.44 | A2 |
|  |  | > 3.24, ≤ 6.48 | ≥ 3.24 | A3 |
|  |  | > 6.48 | ≤ 0.36 | A4 |

Table 8: A-MPR for NS\_07 for PC2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Modulation/Waveform | A1 | A2 | A3 | A4 |
|  | Outer/Inner | Outer/Inner | Outer/Inner | Outer/Inner |
| DFT-s-OFDM PI/2 BPSK | 12 | 9 | 8 | 6 |
| DFT-s-OFDM QPSK | 12 | 9 | 8 | 6 |
| DFT-s-OFDM 16 QAM | 12 | 9 | 8 | 6 |
| DFT-s-OFDM 64 QAM | 12 | 9 | 8 | 6 |
| DFT-s-OFDM 256 QAM | 12 | 9 | 8 | 6 |
| CP-OFDM QPSK | 14 | 10 | 9 | 6 |
| CP-OFDM 16 QAM | 14 | 10 | 9 | 6 |
| CP-OFDM 64 QAM | 14 | 10 | 9 | 6 |
| CP-OFDM 256 QAM | 14 | 10 | 9 | 6 |

* Recommended WF
	+ TBA

Qualcomm: the correction may not be needed for proposal 1. For proposal 2, the correction is needed. We need seek compromise for proposal 3 and 4.

Huawei: based on our simulation results, we support proposal 3. The real measurement may be different from the simulations. We need further evaluate.

Apple: We are also fine to consider different proposals.

**Issue 2-2-3: NS\_46 (A-MPR for n7 PC2)**

**[Moderator Note: Proposal 1-7 are from R4-2320669, Proposal 8-9 from R4-2320652.]**

* Proposal 1**: Subject to further evaluation by measurements, consider the following PC2 A-MPR values for NS\_46:**

Table 1: A-MPR for NS\_46 for PC2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Modulation/Waveform | A4 | A5 | A6 | A7 | A8 | A9 | A10 |
|   | Outer/Inner | Outer/Inner | Outer/Inner | Outer/Inner | Outer/Inner | Outer/Inner | Outer/Inner |
| DFT-s-OFDM     | PI/2 BPSK | [5+2.5] | [2+0.5] | [3.5+2] | [6+2] | [10+2.5] | [6] | [2.5] |
| QPSK | [5+2.5] | [2+0.5] | [3.5+2] | [6+2] | [10+2.5] | [6] | [2.5] |
| 16 QAM | [5+2.5] | [2+0.5] | [3.5+2] | [6+2] | [10+2.5] | [6] | [2.5] |
| 64 QAM | [5+2.5] |  [2+0.5] | [3.5+2] | [6+2] | [10+2.5] | [6] | [3] |
| 256 QAM |  [5+2.5] |   | [3.5+2]  | [6+2] | [10+2.5] | [6] |  |
| CP-OFDM    | QPSK | [5+2.5] | [3.5] | [5.5+1] | [7+2] | [11+2] | [7.5] | [4] |
| 16 QAM | [5+2.5] | [3.5] | [5.5+1] | [7+2] | [11+2] | [7.5] | [4] |
| 64 QAM | [5+2.5] | [3.5] | [5.5+1] | [7+2] | [11+2] | [7.5] | [4] |
| 256 QAM |  [5+2.5]  |   |   | [7+2] | [11+2] | [7.5] |  |

Note: The values are shown in the form of addition to PC3 A-MPR, except for A9 and A10, which are new for PC2.

* Proposal 2**: For BW=40MHz, consider to define a new region (e.g. 4.14<=RBend\*12\*SCS<5.04) with PC2 A-MPR = PC3 A5 + 3, instead of expanding the region for A4.**
* Proposal 3**: Align the carrier centre frequency range for BW=25MHz with that for PC3 when defining the A-MPR requirements, namely 2534.5 ≤ FC ≤ 2557.5MHz.**
* Proposal 4**: For BW=10 to 25MHz plus 50MHz, modify the A-MPR regions as follows:**

|  |  |  |  |
| --- | --- | --- | --- |
| Channel Bandwidth, MHz | Carrier Center Frequency, Fc, MHz | Regions | A-MPR |
|  |  | RBend\*12\*SCSMHz | LCRB\*12\*SCSMHz |  |
| 10 MHz | [TBC] ≤ FC ≤ 2565 | ≥ 7.92 | ≥ 5.4 | [TBC] |
| ≥ 7.92 | < 5.4 | [TBC] |
| 15 MHz | [2560.5] ≤ FC ≤ 2562.5 | ≥ 11.16 | ≥ 5.4 | [A6] |
| ≥ 11.16 | < 5.4 | A10 |
| 20 MHz | [2552] ≤ FC ≤ 2560 | ≥12.6, < 15.3 | ≥ 10.8 | [A6] |
| ≥ 15.3 | > 0 | A9 |
| ≥ 14.4, < 15.3 | < 5.4 | A10 |
| 25 MHz | 2534.5 ≤ FC ≤ 2557.5 | < 14.4 | >max (0, 12\*SCS\*RBend - 2.7) | A5 |
|  |  | ≥ 14.4, <18.9 | > 9.9 | [A6] |
|  |  | ≥ 18.9 | ≥ 7.2 | A9 |
|  |  | ≥ 17.64 | < 7.2 | A10 |
| 50 MHz | 2525 ≤ FC ≤ 2545 | ≥0, <9 | >0 | A4 |
|  |  | ≥9, <21.6 | >max (0, 12\*SCS\*RBend - 7.2) | A5 |
|  |  | ≥21.6, <31.5 | >18 | A6 |
|  |  | ≥31.5, <39.6 | >16.2 | A7 |
|  |  | ≥39.6 | >0 | A8 |
|  |  | > 33.84, < 39.6 | ≤ 16.2 | A10 |

* Proposal 5**: Further check if A-MPR is needed for BW=10MHz.**
* Proposal 6**: Further check the A-MPR for BW=25MHz, since the regions are very different from those for PC3.**
* Proposal 7**: For BW=15/20MHz, if the exception case happens that more than 54 RB is scheduled after power class fallback to PC3, the requirement on the lower bound of the configured maximum output power PCMAX\_L is unspecified, while the existing requirement for PCMAX\_H is unchanged.**
* Proposal 8:  **Adopt the A-MPR regions and A-MPR values in Table 1 and Table 2 for NS\_46 for PC2 operation**

Table 1: A-MPR regions for NS\_46 for PC2

|  |  |  |  |
| --- | --- | --- | --- |
| Channel Bandwidth, MHz | Carrier Center Frequency, Fc, MHz | Regions | A-MPR |
|  |  | RBend\*12\*SCSMHz | LCRB\*12\*SCSMHz |  |
| 10 MHz | 2550 ≤ FC ≤ 2565 | ≥ 7.92 | > 0 | A9 |
| ≥ 7.92 | < 5.4 | A10 |
| 15 MHz | 2545 ≤ FC ≤ 2562.5 | ≥ 11.16 | > 0 | A9 |
| ≥ 11.16 | < 5.4 | A10 |
| 20 MHz | 2540 ≤ FC ≤ 2560 | ≥12.6, < 15.3 | ≥ 10.8 | A7 |
| ≥ 15.3 | > 0 | A9 |
| ≥ 14.4 | < 5.4 | A10 |
| 25 MHz | 2534.5 ≤ FC ≤ 2557.5 | < 14.4 | >max (0, 12\*SCS\*RBend - 2.7) | A5 |
|  |  | ≥ 14.4, <18.9 | > 9.9 | A7 |
|  |  | ≥ 18.9 | ≥ 7.2 | A9 |
|  |  | ≥ 17.64 | < 7.2 | A10 |
| 30 MHz | 2515 ≤ FC ≤ 2555 | ≥0, <1.44 | >0 | A4 |
|   |   | ≥1.44, <13.5 | >max (0, 12\*SCS\*RBend -1.8) | A5 |
|   |   | ≥13.5, <19.8 | >11.52 | A6 |
|   |   | ≥19.8, <25.92 | >6.3 | A7 |
|   |   | ≥25.92 | >0 | A8 |
|  |  | > 20.7 , < 25.92 | ≤ 6.3 | A10 |
| 35 MHz | 2517.5 ≤ FC ≤ 2552.5 | ≥0, <3.42 | >0 | A4 |
|  |  | ≥3.42, <15.84 | >max (0, 12\*SCS\*RBend - 3.06) | A5 |
|  |  | ≥15.84, <22.68 | >12.6 | A6 |
|  |  | ≥22.68, <28.8 | >9.0 | A7 |
|  |  | ≥28.8 | >0 | A8 |
|  |  | > 24.3 , < 28.8 | ≤ 9.0 | A10 |
| 40 MHz | 2520 ≤ FC ≤ 2550 | ≥0, <4.5 | >0 | A4 |
|  |  | ≥4.5, <18 | >max (0, 12\*SCS\*RBend - 4.5) | A5 |
|  |  | ≥18, <25.74 | >13.5 | A6 |
|  |  | ≥25.74, <32.4 | >12.6 | A7 |
|  |  | ≥32.4 | >0 | A8 |
|  |  | > 27.9 , < 32.4 | ≤ 12.6 | A10 |
| 50 MHz | 2525 ≤ FC ≤ 2545 | ≥0, <9 | >0 | A4 |
|  |  | ≥9, <21.6 | >max (0, 12\*SCS\*RBend - 7.2) | A5 |
|  |  | ≥21.6, <31.5 | >18 | A6 |
|  |  | ≥31.5, <39.6 | >16.2 | A7 |
|  |  | ≥39.6 | >0 | A8 |
|  |  | > 33.84, < 39.6 | ≤ 16.2 | A10 |

Table 2: A-MPR for NS\_46 for PC2

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Modulation/Waveform | A4 | A5 | A6 | A7 | A8 | A9 | A10 |
|   | Outer/Inner | Outer/Inner | Outer/Inner | Outer/Inner | Outer/Inner | Outer/Inner | Outer/Inner |
| DFT-s-OFDM | PI/2 BPSK | 6.5 | 2.5 | 3.5 | 6 | 10 | 6.5 | 3.5 |
|   | QPSK | 6.5 | 2.5 | 3.5 | 6 | 10 | 6.5 | 3.5 |
|   | 16 QAM | 6.5 | 2.5 | 3.5 | 6 | 10 | 6.5 | 3.5 |
|   | 64 QAM | 6.5 |  2.5 | 3.5 | 6 | 10 | 6.5 | 3.5 |
|   | 256 QAM |  6.5 |   |   | 6 | 10 | 6.5 |  |
| CP-OFDM | QPSK | 6.5 | 3.5 | 5.5 | 7 | 11 | 8 | 4.5 |
|   | 16 QAM | 6.5 | 3.5 | 5.5 | 7 | 11 | 8 | 4.5 |
|   | 64 QAM | 6.5 | 3.5 | 5.5 | 7 | 11 | 8 | 4.5 |
|   | 256 QAM |  6.5  |   |   | 7 | 11 | 8 |  |

* Proposal 9: **Allow PC2 capable UEs to reduce their output power 23 dBm – max(MPR,4) dB in case PC2 needs to fall back to PC3 operation and transmit more than 54 RB. Apply this for both SC-FDMA and CP-OFDM and all modulation orders.**
* Recommended WF
	+ TBA

Qualcomm: the behavior in the situation where PC2 UE applies the power requirements of PC3 when falling back can be addressed.

Huawei: it is complicated issue. On power class fallback issue, in the current spec, when the fallback happens, PC3 requirements apply. That requirement includes 54RB restriction. This behavior cannot really be defined in the existing requirements. The upper bound should be reduced for fallback and for lower bound we cannot define requirements. Following Qualcomm proposal, it means we redefine the requirements.

Qualcomm: our intention is not to change the legacy requirements. We are OK to change the requirement for such behavior and ask RAN5 to consider it.

**Issue 2-2-4: A-MPR and related issues for n28 PC2**

* Proposal 1: (R4-2318752) For introducing single duplexer assumptions on band n28 all the Tx and Rx requirements (Coexistence, Blocking etc.) need to be evaluated. Coexistence requirements need to be checked whether those are still applicable. Potential changes need to consider impact on legacy UEs.
* Proposal 2: (R4-2320668) The feasibility of single full-band duplexer for band n28 should be checked by considering that:

 - No filter attenuation would be available for the protected frequency range of 470-710MHz specified for both NS\_17 and UE coexistence;

 - Sufficient attenuation would be needed for the protected range of 470-694MHz (-42dBm/8MHz), 662-694MHz (-26.2dBm/6MHz) and 758-773MHz (-32/1MHz).

* Proposal 3: (R4-2319779)
	+ NS\_17 A-MPR does not consider any help from the UL filter allowing full band n28 duplexer for both PC3 and PC2
	+ No A-MPR is needed for NS\_17 PC3 for the 3, 5 and 10MHz channels
	+ It is further verified for that for 3MHz and 5MHz, PC2 NS\_17 does not require A-MPR
	+ A-MPR is required for PC2 NS\_15 and 10MHz channel.
* Proposal 4:  **Take A-MPR values in Tables 3 and 4 as baseline for NS\_17 for n28 PC2, verify the values further to cover all operating modes.**

 Table 3: A-MPR regions for NS\_17 for PC2

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

Table 4: 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 5: **Take A-MPR values in Tables 5 and 6 as baseline for NS\_17 for n28 PC2, verify the values further to cover all operating modes.**

Table 5: A-MPR regions for NS\_18 for PC2

|  |  |  |  |
| --- | --- | --- | --- |
| Channel Bandwidth, MHz | Frequency range of UL transmission bandwidth configuration, MHz | Regions | A-MPR |
|  |  | RBstart\*12\*SCSMHz | LCRB\*12\*SCSMHz |  |
| 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 |

Table 6: A-MPR for NS\_18 for 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 | ≤ [3.5] | N/A | ≤ [7] | ≤ [3.5] | ≤ [9] | ≤ [4] | ≤ [2] |
|  | QPSK | ≤ [3.5] |  | ≤ [7] | ≤ [3.5] | ≤ [9] | ≤ [4] | ≤ [2] |
|  | 16 QAM | ≤ [4] |  | ≤ [8] | ≤ [3.5] | ≤ [9] | ≤ [5] | ≤ [2] |
|  | 64 QAM | ≤ [4.5] |  | ≤ [9] | ≤ [3.5] | ≤ [9] | ≤ [5.5] | ≤ [2.5] |
|  | 256 QAM | ≤ [6.5] |  | ≤ [10] | ≤ [3.5] | ≤ [9] | ≤ [5.5] |  |
| CP-OFDM | QPSK | ≤ [5.5] |  | ≤ [9.5] | ≤ [5] | ≤ [10.5] | ≤ [6] | ≤ [4] |
|  | 16 QAM | ≤ [5.5] |  | ≤ [10] | ≤ [5] | ≤ [10.5] | ≤ [6] | ≤ [4] |
|  | 64 QAM | ≤ [6] |  | ≤ [10] | ≤ [5] | ≤ [10.5] | ≤ [6] | ≤ [4] |
|  | 256 QAM | ≤ [9] |  | ≤ [11.5] | ≤ [5] | ≤ [10.5] | ≤ [7.5] |  |

* Recommended WF
	+ TBA

Skyworks: we need decide whether we need revisit PC3 or for PC2 case with fallback to PC3 we will have different values.

Apple: we do not think it is good idea for PC2 alone. It is unclear how it works with all the redefined requirements.

Qualcomm: We are also OK to check it further. For NS\_17, A-MPR needs be specified. We do not see the need to change PC3 spec.

Apple: co-existence requirements is not new requirements. UE needs comply with such requirements without any A-MPR. Only dual duplexer can provide filter to comply with the requirements.

Qualcomm: we disagree with Apple statement about dual duplexer.

Huawei: We need further feasibility study on the fallback dual duplexer. 0dB attenuation cannot be changed. We share Apple comments.

### Sub-topic 2-3 CRs and draft CRs

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 2-3-1: CRs and draft CRs**

* Proposal 1: R4-2318355 CR to R18 TS38.101-1 to introduce PC2 UTRA ACLR
* Proposal 2: R4-2319808 CR to R18 TS38.101-1 to Correct NS17 and NS18 emission requirement table
* Proposal 3: R4-2320653 DraftCR for Adding PC2 requirements for band n7
* Proposal 4: R4-2320670 DraftCR for Adding PC2 requirements for band n5
* Proposal 5: R4-2320671 DraftCR for Adding PC2 requirements for band n8
* Recommended WF
	+ Companies may check whether the CRs and draft CRs are agreeable.