**3GPP TSG-RAN WG4 Meeting # 110bis R4-2405264**

**Changsha, China, 15th - 19th April, 2024**

**Agenda item:** 5.18 & 5.19

**Source:** Moderator (China Unicom)

**Title:** Topic summary for [110bis][111] HPUE\_Basket\_FDD

**Document for:** Information

# Introduction

Thread [111] includes the following topics:

1. Topic #1 Issues for (Agenda 5.18)
2. Topic #2 Issues for (Agenda 5.19)

# 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** |
| R4-2404779 | China Unicom | *TR Reserved for post-meeting approval* |
| R4-2404140 | AT&T | DraftCR 38.101-1 Addition of Single UL PC2 FDD CA Combinations with no MSD |
| R4-2404173 | Apple | **Observation #1**: For the 2TX case, the UL chains for the main path and diversity path are similar. Therefore, to derive the MSD value for this case, we can use the same PC3 UL harmonic level analysis for both paths and assume that the receiver inputs will be subjected to the same level of harmonic interference when both transmitters are ON at the same time to achieve the PC2 output power level.  **Observation #2**: The MSD value for n77 DL due to n25 UL second harmonics increases by 6.4dB for n25 PC2 with 2Tx compared to the value for PC2 with 1Tx.  **Proposal:** Adopt CA\_n25A-n77A MSD Levels proposed in Table 3-1 shown below. |
| R4-2404174 | Apple | **Observation #1**: For the 2TX case, the UL chains for the main path and diversity path are similar. Therefore, to derive the MSD value for this case, we can use the same PC3 UL harmonic level analysis for both paths and assume that the receiver inputs will be subjected to the same level of harmonic interference when both transmitters are ON at the same time to achieve the PC2 output power level.  **Observation #2**: The MSD value for n41 DL due to n8 UL third harmonics increases by 4.1dB for n8 PC2 with 2Tx compared to the value for PC2 with 1Tx.  **Proposal:** Adopt CA\_n8A-n41A MSD Levels proposed in Table 3-1 shown below. |
| R4-2404175 | Apple | **Observation #1**: For the 2TX case, the UL chains for the main path and diversity path are similar. Therefore, to derive the MSD value for this case, we can use the same PC3 UL harmonic level analysis for both paths and assume that the receiver inputs will be subjected to the same level of harmonic interference when both transmitters are ON at the same time to achieve the PC2 output power level.  **Observation #2**: The MSD value for n77 DL due to n71 UL fifth harmonics increases by 2.4dB for n71 PC2 with 2Tx compared to the value for PC2 with 1Tx.  **Proposal:** Adopt CA\_n71A-n77A MSD Levels proposed in Table 3-1 shown below. |
| R4-2404381 | T-Mobile USA | TP for TR 38.850: Corrections for typos |
| R4-2404382 | T-Mobile USA | TP for TR 38.850: DL CA\_n25A-n41A UL n25 PC2 |
| R4-2404383 | T-Mobile USA | TP for TR 38.850: DL CA\_n41A-n66A UL n66 PC2 |
| R4-2404384 | T-Mobile USA | TP for TR 38.850: DL CA\_n71A-n85A UL n71 PC2 |
| R4-2404385 | T-Mobile USA | TP for TR 38.850: DL CA\_n71B UL n71 PC2 |
| R4- 2404879 | Huawei, HiSilicon | **Proposal 1:** Clarify for intra-band contiguous CA whether “the downlink PCC carrier center frequency shall be configured close to uplink operating band than any of the downlink SCC center frequency” is a scheduling restriction for the network.  **Proposal 2:** Clarify for intra-band contiguous CA the REFSENS requirements for SCC, e.g. whether PC2 RSD defined in Table 7.3.2-1c/1d are applicable.  **Proposal 3:** Clarify for intra-band non-contiguous CA the relative position in frequency for PCC and SCC, e.g. which NOTE applies in general, NOTE 4 or NOTE 7.  **Proposal 4:** The assumption that the harmonic interference power is increased by 3dB\*harmonic order may result in over-estimated MSD. Consider adjust the assumption and re-evaluate the MSD caused by 1Tx PC2 FDD UL.  **Proposal 5:** Before a simplified model for 2Tx PC2 MSD is found, use the conventional MSD analysis method based on RF components’ isolation and linearity parameters. |
| R4- 2404880 | Huawei, HiSilicon | **Proposal 1:** For the REFSENS exception due to H3 from n3 UL, set the MSD to [15.9] dB for 1Tx PC2 and [23.6] dB for 2Tx PC2. |
| R4-2405374 | CMCC, Huawei, HiSilicon, ZTE Corporation, Murata | TP for TR 38.850 to introduce PC2 CA\_n8A-n79A with UL n8 |
| R4-2405375 | CMCC, Huawei, HiSilicon, ZTE Corporation, Murata | TP for TR 38.850 to introduce PC2 CA\_n8A-n41A with UL n8 |
| R4-2405447 | Qualcomm | **Proposal 1**: Modify MSD for PC2 1TX CA\_n71(2A) as follows.  **Proposal 2**: Specify MSD for PC2 2TX CA\_n71(2A) as follows. |
| R4-2405448 | Qualcomm | **Proposal 1**: MSD for CA\_n71B PC2 not supporting TX Diversity.  **Proposal 2**: MSD for CA\_n71B PC2 supporting TX Diversity. |
| R4-2405960 | Skyworks Solutions | **Observation:** For PC3 operation of CA\_n39-n41, the Band n41 5MHz CBW MSD test point should be corrected to [11.1]dB.  **Proposal:** For PC2 operation of CA\_n25-n41, adopt the following Band n41 UL3/DL4 Rx harmonic mixing test point. |
| R4-2404762 | Murata | **Observation 1:** The proposed test points in [2] are reasonable.  **Proposal 1:** The following MSD values are proposed to take into consideration for CA\_n71(2A) PC3, PC2(1x26dBm) and PC2(2x23dBm). |
| R4-2405956 | Skyworks Solutions | **Proposal:** Consider adopting the following guidelines to simplify PC2 FDD band dual-TX MSD analyses. |
| R4-2405957 | Skyworks Solutions | **Proposal:** For one-UL single Tx and dual Tx PC2 operation, consider adopting the test points of Table 2 below. |
| R4-2404176 | Apple | **Proposal:** Adopt CA\_n71(2A) MSD Levels proposed in Table 3-1 shown below. |
| R4-2405451 | Qualcomm | Possibilities to use some kind framework MSD for 1TX/2TX PC2 cases from respective PC3 MSD is discussed in this contribution, with the following observations:   * When PC2 1TX PC2 MSD is calculated, the resulting MSD should be aligned with respective PC3 MSD, i.e. using the same architecture, but with PC3 power the MSD should match PC3 MSD reasonably well. * The main difference in 1TX PC3 vs 2TX PC2 is that in PC2 case both branches see same interference * RAN4 should discuss if a generic way to derive the PC2 requirements could be agreed, as it would dramatically easy the work   + 1TX PC2 seems initially quite straightforward, with difference to PC3 being [3]dB increased interference   + 2TX PC2 case requires more work and internal evaluations from companies. Based on the considerations above, there should be possibilities to find consensus * RAN4 should discuss how to identify cases which don’t have MSD specified for PC3, but which could need MSD for 1TX PC2 or 2TX PC2 |

## 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 MSD Analysis

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

**Issue 1-1-1: MSD for PC2 DL\_n25A-n77A-UL\_n25**

**Issue 1-1-2: MSD for PC2 DL\_n8A-n41A-UL\_n8**

**Issue 1-1-3: MSD for PC2 DL\_n71A-n77A-UL\_n71**

**Issue 1-1-4: MSD for PC2 DL\_n71(2A)-UL\_n71**

**Issue 1-1-5: MSD for PC2 DL\_n71B-UL\_n71**

**Issue 1-1-6: MSD for PC2 DL\_n25-n41-UL\_n25**

*Open issues and candidate options before meeting:*

**Issue 1-1-1: MSD for PC2 DL\_n25A-n77A-UL\_n25**

* Proposals
  + Option 1: (R4-2404173)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***UL band*** | ***DL band*** | ***UL BW*** | ***SCS of UL band*** | ***UL RB Allocation*** | ***DL BW*** | ***MSD1*** | ***MSD3*** | ***UL/DL fc condition*** | ***UL/DL harmonic order*** |
| ***(MHz)*** | ***(kHz)*** | ***LCRB*** | ***(MHz)*** | ***(dB)*** | ***(dB)*** |
| *n25* | *n77* | *5* | *15* | *25 (RBstart=0)* | *10* | *26.0* | *32.4* | *NOTE 2* | *UL2/DL1*  *direct hit* |
| *NOTE 2: The requirements should be verified for UL NR-ARFCN of the aggressor (high) band (superscript HB) such that in MHz and  with carrier frequency in the victim (lower) band in MHz and  the channel bandwidth configured in the higher band.*  *NOTE 1: Applicable to UE supporting PC2 with single Tx.*  *NOTE 3: Applicable to UE supporting PC2 with dual Tx.* | | | | | | | | | |

* + Option 2: TBA
* Recommended WF
  + TBA

**Issue 1-1-2: MSD for PC2 DL\_n8A-n41A-UL\_n8**

* Proposals
  + Option 1: (R4-2404174)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***UL band*** | ***DL band*** | ***UL BW*** | ***SCS of UL band*** | ***UL RB Allocation*** | ***DL BW*** | ***MSD1*** | ***MSD3*** | ***UL/DL fc condition*** | ***UL/DL harmonic order*** |
| ***(MHz)*** | ***(kHz)*** | ***LCRB*** | ***(MHz)*** | ***(dB)*** | ***(dB)*** |
| *n8* | *n41* | *5* | *15* | *25 (RBstart=0)* | *10* | *21.2* | *25.3* | *NOTE 2* | *UL3/DL1*  *direct hit* |
| *NOTE 2: The requirements should be verified for UL NR-ARFCN of the aggressor (high) band (superscript HB) such that in MHz and  with carrier frequency in the victim (lower) band in MHz and  the channel bandwidth configured in the higher band.*  *NOTE 1: Applicable to UE supporting PC2 with single Tx.*  *NOTE 3: Applicable to UE supporting PC2 with dual Tx.* | | | | | | | | | |

* + Option 2: For the REFSENS exception due to H3 from n3 UL, set the MSD to [15.9] dB for 1Tx PC2 and [23.6] dB for 2Tx PC2. (R4- 2404880)
* Recommended WF
  + TBA

**Issue 1-1-3: MSD for PC2 DL\_n71A-n77A-UL\_n71**

* Proposals
  + Option 1: (R4-2404175)

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***UL band*** | ***DL band*** | ***UL BW*** | ***SCS of UL band*** | ***UL RB Allocation*** | ***DL BW*** | ***MSD1*** | ***MSD3*** | ***UL/DL fc condition*** | ***UL/DL harmonic order*** |
| ***(MHz)*** | ***(kHz)*** | ***LCRB*** | ***(MHz)*** | ***(dB)*** | ***(dB)*** |
| *n71* | *n77* | *5* | *15* | *25 (RBstart=0)* | *10* | *12.9* | *15.3* | *NOTE 2* | *UL5/DL1*  *direct hit* |
| *NOTE 2: The requirements should be verified for UL NR-ARFCN of the aggressor (high) band (superscript HB) such that in MHz and  with carrier frequency in the victim (lower) band in MHz and  the channel bandwidth configured in the higher band.*  *NOTE 1: Applicable to UE supporting PC2 with single Tx.*  *NOTE 3: Applicable to UE supporting PC2 with dual Tx.* | | | | | | | | | |

* + Option 2: TBA
* Recommended WF
  + TBA

**Issue 1-1-4: MSD for PC2 DL\_n71(2A)-UL\_n71**

* Proposals
  + Option 1: (R4-2405447)

Modify MSD for PC2 1TX CA\_n71(2A) as follows:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CA configuration | SCS  (PCC/SCC)  (kHz) | Aggregated channel bandwidth (PCC+SCC) | Wgap / [MHz] | UL PCC allocation  (LCRB) | ΔRIBNC (dB) | Duplex mode |
| CA\_n71(2A) | 15/15 | 5MHz + 5MHz | Wgap = 25.0 | 5 | 6.0 | FDD |
|  |  |  | Wgap = 5.0 | 20 | 1.4 |  |
|  |  | 10MHz + 5MHz | Wgap = 20.0 | 5 (RBstart = 9) | 6.8 |  |
|  |  |  | Wgap = 5.0 | 20 (RBstart = 9) | 3.8 |  |
|  |  | 15MHz + 10MHz | Wgap = 10.0 | 5 (RBstart = 2) | 25.1 |  |
|  |  |  | Wgap = 5.0 | 20 (RBstart = 19) | 7.5 |  |

Specify MSD for PC2 2TX CA\_n71(2A) as follows

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| CA configuration | SCS  (PCC/SCC)  (kHz) | Aggregated channel bandwidth (PCC+SCC) | Wgap / [MHz] | UL PCC allocation  (LCRB) | ΔRIBNC (dB) | Duplex mode |
| CA\_n71(2A) | 15/15 | 5MHz + 5MHz | Wgap = 25.0 | 5 | 8.8 | FDD |
|  |  |  | Wgap = 5.0 | 20 | 3.4 |  |
|  |  | 10MHz + 5MHz | Wgap = 20.0 | 5 (RBstart = 9) | 9.6 |  |
|  |  |  | Wgap = 5.0 | 20 (RBstart = 9) | 6.1 |  |
|  |  | 15MHz + 10MHz | Wgap = 10.0 | 5 (RBstart = 2) | 29.6 |  |
|  |  |  | Wgap = 5.0 | 20 (RBstart = 19) | 10.5 |  |

* + Option 2: (R4-2404176)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ***CA configuration*** | ***SCS***  ***(PCC/SCC)***  ***(kHz)*** | ***Aggregated channel bandwidth (PCC+SCC)*** | ***UL PCC allocation***  ***(LCRB)*** | ***UL SCC allocation***  ***(LCRB)*** | ***PCC ΔRIBC (dB)*** | ***SCC ΔRIBC (dB)*** | ***Duplex mode*** |
| CA\_71(2A)5 | 15/15 | 5MHz + 20MHz | 4 (RBSTART = 0) | 16 (RBSTART = 90) | - | 27.8 | FDD |
| NOTE 1: All combinations of channel bandwidths defined in Table 5.5A.1-1.  NOTE 2: The carrier center frequency of SCC in the UL operating band is configured closer to the DL operating band.  NOTE 3: The transmitted power over both PCC and SCC shall be set to PUMAX as defined in subclause 6.2A.4.  NOTE 4: The PCC allocation is same as Transmission bandwidth configuration NRB as defined in Table 5.3.2-1.  NOTE 5: Applicable only to BCS 1. | | | | | | | |

* + Option 3: (R4-2404762)

The following MSD values are proposed to take into consideration for CA\_n71(2A) PC3, PC2(1x26dBm) and PC2(2x23dBm).

**Table 3:** Intra-band non-contiguous CA with one uplink configuration for reference sensitivity in FDD bands for 7.3A.2.2-1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **CA configuration** | **SCS** | **Aggregated channel bandwidth (PCC+SCC)** | **Wgap /[MHz]** | **UL PCC allocation** | **ΔRIBNC (dB)** | **Duplex mode** |
| **(kHz)** |
| CA\_n71(2A) | 15/15 | 15MHz + 10MHz | Wgap=10.0 | 5 (RBstart = 2) | 22.2 | FDD |
|
|
| 20MHz + 5MHz(NOTE 11) | Wgap=10.0 | 20 (RBstart = 0) | [27.0] | FDD |
|
| 25MHz + 5MHz(NOTE 11) | Wgap=5.0 | 20 (RBstart = 8) | [27.1] |
|
| NOTE 7: The carrier centre frequency of SCC in the DL operating band is configured closer to the UL operating band. NOTE 11: Bandwidth Combination Set 4/5 | | | | | | |

**Table 4**: intra-band non-contiguous CA with one uplink configuration for reference sensitivity **for PC2 in FDD bands**-Table 7.3A.2.2-1a

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **CA configuration** | **SCS** | **Aggregated channel bandwidth (PCC+SCC)** | **Wgap [MHz]** | **UL PCC allocation** | **ΔRIBNCX (dB)** | **ΔRIBNCY (dB)** | **BCS** | **IMD order** | **Duplex mode** |
| **(kHz)** |
| CA\_n71(2A) | 15/15 | 15MHz + 10MHz | 10 | 5 (RBstart = 2) | [25.1] | [26.3] | All | near full overlap IMD3 | FDD |
|
|
| 20MHz + 5MHz | 10 | 20 (RBstart = 0) | [28.9] | [31.1] | 4/5 only | IMD3 full overlap | FDD |
|
| 25MHz + 5MHz | 5 | 20 (RBstart = 8) | [28.8] | [31.2] |
|
| NOTE X: Applicable to UE supporting PC2 with single Tx.  NOTE Y: Applicable to UE supporting PC2 with dual Tx. | | | | | | | | | |

* Recommended WF
  + TBA

**Issue 1-1-5: MSD for PC2 DL\_n71B-UL\_n71**

* Proposals
  + Option 1: (R4-2405448)

MSD for CA\_n71B PC2 not supporting TX Diversity:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CA configuration** | **SCS**  **(PCC/SCC)**  **(kHz)** | **Aggregated channel bandwidth (PCC+SCC)** | **UL PCC allocation**  **(LCRB)** | **ΔRIBC (dB)** | **Duplex mode** |
| CA\_n71B | 15/15 | 20MHz + 15MHz | 20 (RBSTART = 0) | 7.2 | FDD |

MSD for CA\_n71B PC2 supporting TX Diversity:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **CA configuration** | **SCS**  **(PCC/SCC)**  **(kHz)** | **Aggregated channel bandwidth (PCC+SCC)** | **UL PCC allocation**  **(LCRB)** | **ΔRIBC (dB)** | **Duplex mode** |
| CA\_n71B | 15/15 | 20MHz + 15MHz | 20 (RBSTART = 0) | 10.6 | FDD |

* + Option 2: (R4-2405957)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **CA configuration** | **SCS**  **(kHz)** | **Aggregated channel bandwidth (PCC+SCC)** | **Wgap / [MHz]** | **UL PCC allocation** | **ΔRIBNCX (dB)** | **ΔRIBNCY (dB)** | **Duplex mode** |
| CA\_n71B**Z** | 15/15 | 30 MHz + 5 MHz | Wgap = 10.0 | 20 (RBstart = 0) | 1.1 | 1.6 | FDD |
| NOTE X: Applicable to UE supporting PC2 with single Tx.  NOTE Y: Applicable to UE supporting PC2 with dual Tx.  NOTE Z: Applicable only to BCS 4 and 5 and UEs supporting the optional symmetrical UL/DL bandwidths. | | | | | | | |

* Recommended WF
  + TBA

**Issue 1-1-6: MSD for PC2 DL\_n25-n41-UL\_n25**

* Proposals
  + Option 1: (R4-2405960)

**For PC2 operation of CA\_n25-n41, adopt the following Band n41 UL3/DL4 Rx harmonic mixing test point.**

**Table 2** CA\_n25-n41 power class 2 UL4/DL3 Rx harmonic mixing test points (Table 7.3A.4-4a)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **UL band** | **DL band** | **UL BW** | **SCS of UL band** | **UL RB Allocation** | **DL BW** | **MSD** | **UL/DL fc condition** | **UL/DL harmonic order** |
| **(MHz)** | **(kHz)** | **LCRB** | **(MHz)** | **(dB)** |
| n25 | n41 | 5 | 15 | 25 (RBstart=0) | 5 | 6.1 | NOTE 11 | UL4/DL3 |

* + Option 2: TBA
* Recommended WF
  + TBA

### Sub-topic 1-2 Guidelines for PC2 FDD Dual-TX MSD

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 1-2-1: 2Tx MSD evaluation guidelines**

* Proposals
  + Option 1: Consider adopting the following guidelines to simplify PC2 FDD band dual-TX MSD analyses. (R4-2405956)

*“*

1. *Evaluate the single-Tx PC3 noise level “P1TX” affecting the downlink (DL) band, according to the usual RAN4 conventions, i.e.:*
   1. *RF-FE post PA insertion loss (IL): 4dB*
   2. *PC3 PA linearity calibration point is 20 MHz, 15 kHz, QPSK, DFT-S-OFDM, 100 RB at lower channel edge with 1 dB MPR to meet -30dBc ACLR.*
2. *To account for reverse-IMD due to PA-to-PA coupling under 10dB antenna-to-antenna isolation, the dual-Tx PA noise level “P2TX” may be assumed equal to P2TX= P1TX +0.6dB and equal to PA1 and PA2, ie assume PA12TX=PA22TX.*
3. *Evaluate the main antenna LNA1 total interference level “PINT\_LNA1” referred to the main antenna port as the sum of interference levels from the* ***Figure 1*** *path 1 “PA12TX\_1” and path 2 “PA12TX\_2”,*

*ie. PINT\_LNA1 = PA12TX\_1 + PA12TX\_2 where:*

* 1. *PA12TX\_1 = PA12TX – duplexer Tx-to-Rx rejection + RF-FE IL.*
  2. *PA12TX\_2 = PA22TX – duplexer Tx-to-Ant rejection – antenna-to-antenna isolation.*

1. *According to the assumptions of step 2, the diversity antenna LNA2 total interference level “PINT\_LNA2” is equal to PINT\_LNA1. Thus, the MRC combining gain is lost.*
2. *Evaluate the DL affected band MSD, using step 3 and step 4 PINT\_LNA1 and PINT\_LNA2 and MRC combining.*

*”*

* + Option 2: Before a simplified model for 2Tx PC2 MSD is found, use the conventional MSD analysis method based on RF components’ isolation and linearity parameters. (R4- 2404879)
* Recommended WF
  + TBA

**Issue 1-2-2: MSD for 1TX/2TX PC2**

* Proposals

Some observations for further thinking in the group:

* *When PC2 1TX PC2 MSD is calculated, the resulting MSD should be aligned with respective PC3 MSD, i.e. using the same architecture, but with PC3 power the MSD should match PC3 MSD reasonably well.*
* *The main difference in 1TX PC3 vs 2TX PC2 is that in PC2 case both branches see same interference*
* *RAN4 should discuss if a generic way to derive the PC2 requirements could be agreed, as it would dramatically easy the work*
  + *1TX PC2 seems initially quite straightforward, with difference to PC3 being [3]dB increased interference*
  + *2TX PC2 case requires more work and internal evaluations from companies. Based on the considerations above, there should be possibilities to find consensus*
* *RAN4 should discuss how to identify cases which don’t have MSD specified for PC3, but which could need MSD for 1TX PC2 or 2TX PC2*

### Sub-topic 1-3 Other issues for Inter-band/Intra-band MSD

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 1-3-1: Issues for Inter-band MSD**

* Proposals
  + Proposal 1: Clarify for intra-band contiguous CA whether “the downlink PCC carrier center frequency shall be configured close to uplink operating band than any of the downlink SCC center frequency” is a scheduling restriction for the network.
  + Proposal 2: Clarify for intra-band contiguous CA the REFSENS requirements for SCC, e.g. whether PC2 RSD defined in Table 7.3.2-1c/1d are applicable.
  + Proposal 3: Clarify for intra-band non-contiguous CA the relative position in frequency for PCC and SCC, e.g. which NOTE applies in general, NOTE 4 or NOTE 7.

**Issue 1-3-2: Issues for Intra-band MSD**

* Proposals
  + Proposal 4: The assumption that the harmonic interference power is increased by 3dB\*harmonic order may result in over-estimated MSD. Consider adjust the assumption and re-evaluate the MSD caused by 1Tx PC2 FDD UL.
* Recommended WF
  + TBA

### Sub-topic 1-4 TPs/Draft CRs

*Open issues and candidate options before meeting:*

**Issue 1-4: TPs/Draft CRs**

* Proposals

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2404140 | AT&T | DraftCR 38.101-1 Addition of Single UL PC2 FDD CA Combinations with no MSD |
| R4-2404381 | T-Mobile USA | TP for TR 38.850: Corrections for typos |
| R4-2404382 | T-Mobile USA | TP for TR 38.850: DL CA\_n25A-n41A UL n25 PC2 |
| R4-2404383 | T-Mobile USA | TP for TR 38.850: DL CA\_n41A-n66A UL n66 PC2 |
| R4-2404384 | T-Mobile USA | TP for TR 38.850: DL CA\_n71A-n85A UL n71 PC2 |
| R4-2404385 | T-Mobile USA | TP for TR 38.850: DL CA\_n71B UL n71 PC2 |
| R4-2405374 | CMCC, Huawei, HiSilicon, ZTE Corporation, Murata | TP for TR 38.850 to introduce PC2 CA\_n8A-n79A with UL n8 |
| R4-2405375 | CMCC, Huawei, HiSilicon, ZTE Corporation, Murata | TP for TR 38.850 to introduce PC2 CA\_n8A-n41A with UL n8 |

* Recommended WF
  + TBA

# 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** |
| R4-2404780 | China Unicom | *TR Reserved for post-meeting approval* |
| R4- 2404878 | Huawei, HiSilicon | **Proposal 1-1: Support the 3dB relaxation limit in principle. And continue the HPUE A-MPR work in case-by-case manner, since option 3 may require extra work load.**  **Observation 2-1: The example Table 3-bis is concise and clear. It’s desired for the proponent to clarify how the values are obtained.**  **Proposal 2-1: Define 1Tx PC2 A-MPR for NS\_07 as proposed in [5],**  **Proposal 3-1: Consider to merge the A-MPR proposals from different companies, e.g. to define three A-MPR regions, namely A1, A2 and A3 as below:**  **Proposal 3-2: Define the A-MPR for A3 as follows, with A1 and A2 to be merged from other two proposals [2].**  **Proposal 3-3: For full-band duplexer implementation, define PC3 A-MPR for NS\_17 for both NR and LTE.**  **Proposal 3-4: Define an additional set of A-MPR requirements targeted for full-band duplexer implementations, which can be indicated via modified MPR-Behavior.**  **Proposal 4-1: For BW=10MHz, no A-MPR is defined for PC3, and it’s not necessary to define A-MPR for PC2.**  **Observation 4-1: No PC3 A-MPR is defined for BW=15/20MHz if the following conditions are NOT satisfied:**   * **for carriers of 15 MHz bandwidth when carrier centre frequency is within the range 2560.5 - 2562.5 MHz** * **for carriers of 20 MHz bandwidth when carrier centre frequency is within the range 2552 - 2560 MHz.**   **Proposal 4-2: Align the carrier center frequency ranges with those defined in PC3 A-MPR. More explicitly, use the values shown below:**  **Proposal 5-1: Allow more time for the evaluation of PC2 A-MPR for n26, and aim to finalise the requirements in RAN4#111.** |
| R4-2404193 | Apple | **Proposal 1**: PC2 NS\_07: Agree on the captured regions and A-MPR for single Tx from WF R4-2403629.  **Observation**: PC2 NS\_15: For 5MHz and 10MHz the NS\_15 only specifies A-MPR for the upper frequency range while 15MHz and 20MHz have dedicated A-MPR for the entire band. It has been commented that frequency ranges of 5MHz and 10MHz might need adjustments.  **Proposal 2:** PC2 NS\_15:Discuss the frequency range for 5MHz and 10MHz channel for NS\_15.  **Proposal 3**: PC2 NS\_46: Consider specifying the candidate solution from WF R4-2403629.  **Proposal 4**: Since there is a strong demand from industry to specify full band duplexer requirements it is proposed to create a full-band duplexer work item for Rel-19. This could be done in the next RAN Plenary meeting. The work item shall enable discussion on all the issues for NR, LTE and legacy devices. |
| R4-2405962 | Skyworks | **Observation:** For PC3+PC3, a minimum of 4.5dB back-off is needed to meet NS\_17 requirements, without filter rejection, for DFT-s-OFDM QPSK waveforms. Additional measurements are needed to verify the OBO for CP-OFDM, and to verify the filter rejection requirements to meet the UE-to-UE coexistence requirements. |
| R4-2405712 | 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.  **Proposal 3:** Specify NS\_17 A-MPR for PC2 as shown in Table 4 and Table 5.  **Proposal 4:** There is no need to update PC3 or LTE requirement due to introduction of PC2 operation with specification based on single duplexer. |

## 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 A-MPR

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

**Issue 2-1-1: PC2 A-MPR for n13 NS\_07**

**Issue 2-1-2: PC2 A-MPR for n28 NS\_17**

**Issue 2-1-3: PC2 A-MPR for n7 NS\_46**

**Issue 2-1-4: PC2 A-MPR for n26 NS\_12/13/14/15**

*Open issues and candidate options before meeting:*

**Issue 2-1-1: PC2 A-MPR for n13 NS\_07**

* Proposal for values and regions:
  + Option 1: **Define 1Tx PC2 A-MPR for NS\_07 as proposed in “*R4-2318750 On NS\_07 for PC2, Apple, RAN4#109*”.**
  + Option 2: **Agree on the captured regions and A-MPR for single Tx from WF R4-2403629.**
* General proposals for NS\_07:
  + Proposal 1: **The example Table 3-bis is concise and clear. It’s desired for the proponent to clarify how the values are obtained.**

Table 3-bis: dual-Tx PC2 additional A-MPR relaxation from single-Tx PC2 A-MPR for NS\_07

[in case of Sub-topic 1-1, Option 3]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Modulation/Waveform | A1 | A2 | A3 | A4 | A5 |
|  | Outer/Inner | Outer/Inner | Outer/Inner | Outer/Inner | Outer/Inner |
| All modulations and all waveforms | 1.5 | 1.5 | 1.0 | 0.0 | 0.0 |

* Recommended WF
  + TBA

**Issue 2-1-2: PC2 A-MPR for n28 NS\_17**

* Proposal for values and regions:
  + Option 1: **Consider to merge the A-MPR proposals from different companies, e.g. to define three A-MPR regions, namely A1, A2 and A3 as below:**

Table 2.3-1: A-MPR regions for NS\_17 (assuming full-band duplexer)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 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, < 7.2 | A2 |
| ≥ 0 | >= 7.2 | A3 |

**Define the A-MPR for A3 as follows, with A1 and A2 to be merged from other two proposals [2] (*[2]R4-2401072 Topic summary for [110][113] HPUE Basket FDD, China Unicom, RAN4#110*).**

Table 2.3-2: A-MPR for NS\_17 for PC2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Modulation/Waveform | | A1 | A2 | A3 |
|  | | Outer/Inner | Outer/Inner | Outer/Inner |
| DFT-s-OFDM | PI/2 BPSK | ≤ 3 | ≤ 3.5 | ≤ 5 |
| QPSK | ≤ [3.5/3] | ≤ [4.5/4] | ≤ 5 |
| 16 QAM | ≤ [4/3.5] | ≤ [5/4] | ≤ 5 |
| 64 QAM | ≤ 4 | ≤ [5/4.5] | ≤ 5 |
| 256 QAM |  | ≤ [5/5.5] | ≤ 5.5 |
| CP-OFDM | QPSK | ≤ [5/4.5] | ≤ [6/5.5] | ≤ [5.5] |
| 16 QAM | ≤ 5 | ≤ [6/5.5] | ≤ [5.5] |
| 64 QAM | ≤ 5 | ≤ [6/5.5] | ≤ [5.5] |
| 256 QAM |  |  |  |

* + Option 2: **Specify NS\_17 A-MPR for PC2 as shown in Table 4 and Table 5**

**Table 4: NS\_17 PC2 A-MPR**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 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 5: 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] | ≤ [4] |
| 64 QAM | ≤ [4] | ≤ [4.5] |
| 256 QAM |  | ≤ [5.5] |
| CP-OFDM | QPSK | ≤ [4.5] | ≤ [5.5] |
| 16 QAM | ≤ [5] | ≤ [5.5] |
| 64 QAM | ≤ [5] | ≤ [5.5] |
| 256 QAM |  |  |

* General proposals for NS\_17:
  + Proposal 1: **For full-band duplexer implementation, define PC3 A-MPR for NS\_17 for both NR and LTE.**
  + Proposal 2: **There is no need to update PC3 or LTE requirement due to introduction of PC2 operation with specification based on single duplexer.**
  + Proposal 3: **Define an additional set of A-MPR requirements targeted for full-band duplexer implementations, which can be indicated via modified MPR-Behavior.**
  + Proposal 4: **For PC3+PC3, a minimum of 4.5dB back-off is needed to meet NS\_17 requirements, without filter rejection, for DFT-s-OFDM QPSK waveforms. Additional measurements are needed to verify the OBO for CP-OFDM, and to verify the filter rejection requirements to meet the UE-to-UE coexistence requirements.**
  + Proposal 5: **Since there is a strong demand from industry to specify full band duplexer requirements it is proposed to create a full-band duplexer work item for Rel-19. This could be done in the next RAN Plenary meeting. The work item shall enable discussion on all the issues for NR, LTE and legacy devices.**
* Recommended WF
  + TBA

**Issue 2-1-3: PC2 A-MPR for n7 NS\_46**

* Proposal for values and regions:
  + Option 1: **Consider specifying the candidate solution from WF R4-2403629.**
  + Option 2: **Adopt the A-MPR regions and A-MPR values in Table 1 and Table 2 for NS\_46 for PC2 operation in R4-2405712.**
* General proposals for NS\_46
  + Proposal 1: **For BW=10MHz, no A-MPR is defined for PC3, and it’s not necessary to define A-MPR for PC2.**
  + Proposal 2: **Align the carrier center frequency ranges with those defined in PC3 A-MPR. More explicitly, use the values shown below:**

|  |  |
| --- | --- |
| Channel Bandwidth, MHz | Carrier Center Frequency, Fc, MHz |
|  |  |
| 15 MHz | 2560.5 ≤ FC ≤ 2562.5 |
|
| 20 MHz | 2552 ≤ FC ≤ 2560 |
|
|
| 25 MHz | 2534.5 ≤ FC ≤ 2557.5 |
|  |  |

* + Proposal 3: **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

**Issue 2-1-4: PC2 A-MPR for n26 NS\_12/13/14/15**

* Proposals
  + Proposal 1: **Allow more time for the evaluation of PC2 A-MPR for n26, and aim to finalise the requirements in RAN4#111.**
  + Proposal 2: **Discuss the frequency range for 5MHz and 10MHz channel for NS\_15.**
* Recommended WF
  + TBA

### Sub-topic 2-2 Handling of HPUE with dual Tx

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 2-2: Handling of HPUE with dual Tx**

* Proposal: **Support the 3dB relaxation limit in principle. And continue the HPUE A-MPR work in case-by-case manner, since option 3 [***from Subtopic1-1 from R4-2403629 WF on HPUE for FDD bands, China Unicom, Skyworks, RAN4#110***] may require extra work load.**
* Recommended WF
  + TBA

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