3GPP TSG-RAN WG4 Meeting #112 R4-2412817

Maastricht, Netherlands,19 – 23 Aug, 2024

**Agenda item:** 7.20.4

**Source:** Moderator (CMCC)

**Title:** Topic summary for [112][115] NR\_n28\_PC2\_40MHz

**Document for:** Information

# Introduction

Thread [115] includes agenda 7.20.1~7.20.3.

* 7.20.1 General and work plan
* 7.20.2 UE RF requirements for PC2 with UL-MIMO
* 7.20.3 UE RF requirements for introducing 40MHz

# Topic #1: General and workplan

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411741 | CMCC | *Work plan* |

## 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 Workplan

* Recommended WF:
	+ Agree on the workplan in R4-2411741.

# Topic #2: 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** |
| R4-2411116 | CATT | Proposal 1: To prevent overlap between the two objectives in the WID, RAN4 should focus on scenarios where the UE channel bandwidth is no greater than 30MHz for the first objective of the WID regarding PC2 requirements.Proposal 2: Apply the same UE RF requirements for PC3 with dual duplexer to PC3 with single duplexer for UE channel bandwidth up to 30MHz.Proposal 3: RAN4 to introduce two sets of UE RF requirements for PC2 where one is associated with dual duplexer architecture and the other is with single duplexer for UE channel bandwidth up to 30MHz.Proposal 4: Introduce a new UE capability [singleDuplexer-n28] to indicate the support of single duplexer architecture for band n28 for UE channel bandwidth up to 30MHz. |
| R4-2411154 | Apple | Proposal 1: Specify NS\_17 A-MPR for PC2 and define the additional power back-off according to Table 1 and Table 2.Table 1: 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 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 |  |   |

 |
| R4-2411742 | CMCC | Proposal 1: RAN4 first to discuss the UE architecture assumption and whether one set or two sets requirements should be defined in Rel-19.Proposal 2: No need to discuss the PC3 and/or LTE requirements for n28. |
| R4-2411879 | ZTE Corporation, Sanechips | Proposal 1: To use the same ∆MPR as PC3 for PC2 n28 40MHz.Proposal 2: The RSD requirements for PC2 n28 40MHz for both 1Tx and 2Tx should be postponed until the corresponding PC3 REFENS requirements are completed. |
| R4-2412042 | Nokia, Nokia Shanghai Bell | 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. |
| R4-2412083 | vivo | Observation: both 40MHz UE CBW and PC2 are optional feature. UE may not support them simultaneously.Proposal 1: To support PC2 with UL-MIMO, 2Tx (PC3+PC3) are needed.Proposal 2: 2Tx (PC3+PC3) with dual duplexers could support PC2 with UL MIMO from 718 to 733MHz.Proposal 3: To compatible with LTE and NR legacy requirements, dualPA-Architecture with dual duplexers are proposed to support PC2 without UL-MIMO. |
| R4-2411291 | KDDI Corporation | Observation 1: Based on the legacy assumptions for A-MPR simulations, the companies’ simulation results show a necessity to introduce A-MPR of n28 PC3 operation in NS\_17 with a full-band duplexer.Observation 2: One company point out that from real UE implementation perspective, some UE products have already implemented full-band b/n28 duplex in Japan around three years ago, so far no issue identified in the field nor in the conformance test assuming existing PC3 regulatory requirements (i.e. A-MPR=0) for DTV protection, and the margin is quite enough particularly for LTE.Observation 3: There is an issue on a contradiction between RAN4 simulation results and real UE implementation for A-MPR of n28 PC3 operation in NS\_17 with a full-band duplexer.Proposal 1: The issue on a contradiction between RAN4 simulation results and real UE implementation for A-MPR of n28 PC3 operation in NS\_17 with a full-band duplexer should be discussed in the new Rel-19 WID.Proposal 2: Even if the issue can’t be fully solved in the new Rel-19 WID, RAN4 should continue related discussions and solve the issue in Rel-19 time flame toward 6G era, in order to avoid to repeat same discussions in 6G. |
| R4-2413061 | Skyworks | Observation: With no A-MPR agreed for NS\_17 PC3 operation, the PC2 A-MPR cannot exceed 3dB.Proposal: For DFT-S-OFDM QPSK, consider adopting the following NS\_17 PC2 A-MPR:* 2.5dB A-MPR for UE supporting PC2 with single-Tx.
* 3.0dB A-MPR for UEs supporting PC2 with dual-Tx.
 |
| R4-2411117 | CATT | Proposal 1: Relative channel bandwidth of 40MHz at the requested UL carrier location is 5.5%, hence new MPR/A-MPR evaluation is required for specifying corresponding ΔMPR values for PC3 and PC2 with a single duplexer architecture.Proposal 2: PA calibration point should be agreed for PC3 and PC2 respectively for further MPR/A-MPR simulation consolidation.Proposal 3: Add the exceptional channel raster point of n28 to UE RF specification TS 38.101-1 for UE CBW 40MHz. |
| R4-2411155 | Apple | Proposal 1: As ∆MPR is already defined for 30MHz channel bandwidth it is encouraged to further discuss delta value for 40MHz channel.Proposal 2: When introducing 40MHz CBW it is proposed to use 25 RBs for SCS=15kHz and 10 RBs for SCS=30kHz placed as close as possible to the downlink operating band.Proposal 3: The small duplex distance makes it challenging to duplexer covering the whole band and RAN4 should discuss the duplexer isolation of full-band duplexer before defining MSD. |
| R4-2411476 | Murata Manufacturing Co Ltd. | ***Proposal 1:*** Approve REFSENS and UL configurations for n28 UL 40MHz for PC3 highlighted in Table 2 and Table 3.Table 2. n28 REFSENS for PC3

| **Operating band / SCS / Channel bandwidth** |
| --- |
| **Operating Band** | **SCS kHz** | **3****MHz(dBm)** | **5****MHz(dBm)** | **10****MHz(dBm)** | **15****MHz(dBm)** | **20****MHz(dBm)** | **25****MHz(dBm)** | **30 MHz (dBm)** | **35 MHz (dBm)** | **40****MHz(dBm)** | **45 MHz (dBm)** | **50****MHz(dBm)** |
| n28 | 15 | -100.2 | -98.5 | -95.5 | -93.5 | -90.8 | -84.2 | -78.5 |  | -67.1 |  |  |
|  | 30 |  |  | -95.6 | -93.6 | -91.0 | -84.2 | -78.6 |  | -67.2 |  |  |

Table 3. Uplink configuration for n28 REFSENS

| **Operating band / SCS (kHz) / Channel bandwidth (MHz) / Duplex mode** |
| --- |
| **Operating Band** | **SCS** | **3** | **5** | **10** | **15** | **20** | **25** | **30** | **35** | **40** | **45** | **50** |
| n28 | 15 | 15 | 25 | 251 | 251 | 251 | 251 | 251 |  | 251 |  |  |
|  | 30 |  |  | 101 | 101 | 101 | 101 | 101 |  | 101 |  |  |
| Note 1: UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.3.2-1). |

***Proposal 2:*** Approve RSD for n28 UL 40MHz for PC2 highlighted in Table 4.Table 4. RSD for PC2 n28 40MHz

|  |  |  |  |
| --- | --- | --- | --- |
| **PC2** | RSD 1Tx | dB | 2.8 |
| RSD 2Tx | dB | 8.8 |

 |
| R4-2411671 | Ericsson | Observation 1: for operations in n28 with PC2, UE RF front-end performance better than that assumed for MPR simulations is required to avoid excessive A-MPR for PC2 and avoid penalizing RB restrictions for implementations with a 40 MHz or full-band duplexer. Observation 2: the current assumptions for A-MPR simulations and specification are not representative of state-of-the-art performance. Updated assumptions for A-MPR simulations that enable compliance with existing RAN4 requirements for PC3 without A-MPR and an A-MPR specification for PC2 not removing the virtues of PC2 should therefore be used.Observation 3: apart from operations with NS\_17, there are also other emissions limits that may require A-MPR according to the current MPR simulation assumptions, thus affecting network operations also outside Japan.Observation 4: existing PC3 implementations with a full-band duplexer meet the NS\_17 limits and the -42 dBm/8 MHz UE-UE coexistence requirement below 694 MHz for 10 MHz channels without A-MPR.Observation 5: for operations in Europe, mobile devices are limited to 23 dBm TRP, which may still require a cell specific P-Max indication to ensure regulatory compliance for PC2 UEs. |
| R4-2411743 | CMCC | Proposal 1: it is proposed to add a new NOTE for n28 40MHz as follows: NOTE X: For UEs supporting 40MHz, for the 20 MHz bandwidth, the minimum requirements are specified for NR UL carrier frequencies confined to either 713-733 MHz or 728-738 MHz. For the 25 MHz bandwidth, the minimum requirements are specified for NR UL carrier frequencies confined to either 715.5-730.5 MHz or 730.5-735.5 MHz. For the 30MHz bandwidth, the minimum requirements are specified for NR UL carrier frequencies confined to 718-728MHz or 733MHz. For the 40MHz bandwidth, the minimum requirements are specified for NR UL transmission bandwidth configuration confined to 703-743MHz.Proposal 2: it is proposed to confirm that UE 40MHz channel bandwidth is release independent from Rel-15. |
| R4-2411878 | ZTE Corporation, Sanechips | **Proposal 1: To update the footnote 7 as:**

|  |  |  |
| --- | --- | --- |
| NR Band | SCS (kHz) | UE Channel bandwidth (MHz) |
| 3 | **5** | **10** | **15** | **20** | **25** | **30** | **35** | **40** | **45** | **50** | **60** | **70** | **80** | **90** | **100** |
| n28 | 15 | 34 | 5 | 10 | 15 | 207 | 257 | 307 |  | 407 |  |  |  |  |  |  |  |
|  | 30 |  |  | 10 | 15 | 207 | 257 | 307 |  | 407 |  |  |  |  |  |  |  |
|  | 60 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| NOTE 7: For the 20 MHz bandwidth, the minimum requirements are specified for NR UL carrier frequencies confined to either 713-723 MHz or 728-738 MHz. For the 25 MHz bandwidth, the minimum requirements are specified for NR UL carrier frequencies confined to either 715.5-720.5 MHz or 730.5-735.5 MHz. For the 30MHz bandwidth, the minimum requirements are specified for NR UL transmission bandwidth configuration confined to either 703-733 or 718-748 MHz. For the 40MHz bandwidth, the minimum requirements are specified for NR UL transmission bandwidth configuration confined to either 703-743 MHz. |

**Proposal 2: ΔMPR= 0.5dB for PC3 n28 40MHz.****Proposal 3: For reference sensitivity, to reuse existing UL configurations for 40MHz.** |
| R4-2411947 | 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.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.Observation 2: It is not necessary to specify the specific UE channel raster entry in UE specifications.Proposal 2: UE supporting 40 MHz channel bandwidth in band n28 shall support Enhanced channel raster. |
| R4-2412084 | vivo | Proposal 1: The feasibility analysis of full band duplexer to support 40MHz and the additional emission requirement of NS\_17 for NR and LTE is needed.Proposal 2: To compatible with LTE and NR legacy requirements, dualPA-Architecture with dual duplexers are proposed to support 40MHz UE CBW.Proposal 3: To align with gNB, 40MHz UE CBW is proposed be the optional feature and release independent from rel16. |
| R4-2413027 | Huawei | Proposal 1: The study and agreements completed in Rel-18 for band n28 can be reused as much as possible, including PC2 RSD, PC2 A-MPR for NS\_18 (BW=5~30MHz).Proposal 2: Both dual-duplexer and full-band duplexer implementations should be supported without compromising the existing network performance.Proposal 3: Allow a UE to report to the network about its underlying duplexer implementation. |
| R4-2413062 | Skyworks Solutions Inc. | **Proposal**: 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

PC2 dual Tx RSD = 8.5dB |
| R4-2413149 | Qualcomm Incorporated | Proposal 1: Specify a single set of A-MPR and RSD values independent of implemented filter solution.Proposal 2: Adopt the RSD in Table 1 and Table 2 for n28 up to 30 MHz channel bandwidths for PC2Proposal 3: Adopt the A-MPR in Table 3 to Table 6 for n28 up to 30 MHz channel bandwidths for PC2Observation 1: NS\_17 and NS\_18 are not applicable in China, and in Europe there is less then 40 MHz spectrum available in n28, however in APAC 40 MHz can be available.Proposal 4: NS\_17 is not required for 40 MHz CBW. Based on spectrum allocations in APAC region, NS\_18 should be included for 40 MHz.Proposal 5: Evaluate whether the general co-ex requirements specified for n28 are applicable for 40 MHz channel bandwidth.Proposal 6: Adopt refsens and RSD for 40 MHz channel bandwidth as in Table 7 to Table 8. |

## 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 General issue

**Issue 2-1-1: UE architecture assumption**

Proposal 1 (vivo):

* The feasibility analysis of full band duplexer to support 40MHz is needed.
* To compatible with LTE and NR legacy requirements, dualPA-Architecture with dual duplexers are proposed to support 40MHz UE CBW.

Proposal 2 (Huawei): Both dual-duplexer and full-band duplexer implementations should be supported without compromising the existing network performance.

Proposal 3 (Qualcomm): Specify a single set of A-MPR and RSD values independent of implemented filter solution.

Proposal 4 (CMCC): RAN4 first to discuss the UE architecture assumption and whether one set or two sets requirements should be defined in Rel-19.

Proposal 5 (Huawei): Allow a UE to report to the network about its underlying duplexer implementation.

Recommended WF:

It is recommended that:

* No need to study the feasibility of UE architecture, companies are encouraged to provide analysis on RF requirements based on their own implementation.
* RAN4 RF requirements should accommodate different UE architecture assumption.
* FFS on whether single set should be defined.

**Issue 2-1-2: A-MPR simulation assumption**

Proposal (KDDI):

* The issue on a contradiction between RAN4 simulation results and real UE implementation for A-MPR of n28 PC3 operation in NS\_17 with a full-band duplexer should be discussed in the new Rel-19 WID.
* Even if the issue can’t be fully solved in the new Rel-19 WID, RAN4 should continue related discussions and solve the issue in Rel-19 time flame toward 6G era, in order to avoid to repeat same discussions in 6G.

Recommended WF:

* MPR simulation assumption is not only related to this n28 WI.
* It is recommended that
	+ Do not discuss A-MPR simulation assumption issue in this WI.
	+ How to handle this issue can be up to RAN4 chair or RAN plenary.

**Issue 2-1-3: Work split between two agendas**

Proposal (CATT): To prevent overlap between the two objectives in the WID, RAN4 should focus on scenarios where the UE channel bandwidth is no greater than 30MHz for the first objective of the WID regarding PC2 requirements.

Recommended WF:

* For UE channel bandwidth <=30MHz, RAN4 already reached some agreements for PC2 n28 in Rel-18, most work in this WI is to discuss 40MHz for both PC2 and PC3.
* Hence, it is recommended that:
	+ Set single agenda for this WI instead of discussing the work split between two agendas.

### Sub-topic 2-2 PC2 requirements for BW<=30MHzs

**Issue 2-2-1 PC2 RSD for 1Tx and 2Tx for BW<=30MHz**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **<Agreement in Rel-18 (R4-2306544)>**:1Tx receiver sensitivity degradation:

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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) |
| n28 | Skyworks(R4-2300652) | 0.3 | 0.3 | 0.3 | 0.8 | 2.3 | 2.7 |  |  |  |  |
| Apple(R4-2300362) | 0 | 1.2 | 1.5 | 1.4 | 1.9 | 2.3 | N/A | N/A | N/A | N/A |
| Huawei, HiSilicon(R4- 2300715) | 0.8 | 0.8 | 0.8 | 1.7 | 3.4 | 3.8 | - | - | - | - |
| Murata(R4-2305393) | 0.9 | 0.7 | 0.9 | 1.3 | 2.2 | 3.2 | - | - | - | - |
| Qualcomm(R4-2302709) | 0.8 | 0.6 | 0.6 | 1.2 | 2.2 | 2.4 | - |  |  |  |
| Average | 0.6  | 0.7  | 0.8  | 1.3  | 2.4  | 2.9  |  |  |  |  |

2Tx receiver sensitivity degradation:

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 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) |
| n28 | Skyworks(R4-2300652) | 0.8 | 0.9 | 1.0 | 2.3 | 5.9 | 6.9 |  |  |  |  |
| Apple(R4-2305364) | 0.5 | 0.5 | 0.5 | 2.1 | 7.3 | 8.4 | N/A | N/A | N/A | N/A |
| Huawei, HiSilicon(R4- 2300715) | 1.4 | 1.4 | 1.4 | 3.1 | 6.4 | 7.1 | - | - | - | - |
| Murata(R4-2305393) | 1.7 | 2.0 | 2.7 | 3.8 | 6.0 | 9.2 | - | - | - | - |
| Qualcomm(R4-2302709) | 1.9 | 1.8 | 2.1 | 4.4 | 7.0 | 7.3 | - |  |  |  |
| MTK(R4-2219869) | 0 | 0 | 0 | 1.9 | 7.2 | 8.2 | - | - | - | - |
| Spreadtrum(R4-2304084) | 1.2 | 1.3 | 1.4 | 3.3 | 6.4 | 8 |  |  |  |  |
| Average | 1.1  | 1.1  | 1.3  | 3.0  | 6.6  | 7.9  |  |  |  |  |

 |

Proposal 1 (Huawei): The study and agreements completed in Rel-18 for band n28 can be reused as much as possible, including PC2 RSD, PC2 A-MPR for NS\_18 (BW=5~30MHz).

Proposal 2 (Qualcomm): Adopt the RSD in Table 1 and Table 2 for n28 up to 30 MHz channel bandwidths for PC2

Table 1: Reference Sensitivity Degradation from PC3 to PC2 for FDD bands for UE not supporting Tx Diversity

| Operating Band | 3MHz(dB) | 5MHz(dB) | 10MHz(dB) | 15MHz(dB) | 20MHz(dB) | 25MHz(dB) | 30 MHz (dB) | 35 MHz (dB) | 40MHz(dB) | 45 MHz (dB) | 50MHz(dB) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| n28 | [0.6] | 0.6 | 0.7 | 0.8 | 1.3 | 2.4 | 2.9 |  |  |  |  |

Table 2 Reference Sensitivity Degradation from PC3 to PC2 for FDD bands for UE supporting Tx Diversity

| Operating Band | 3MHz(dB) | 5MHz(dB) | 10MHz(dB) | 15MHz(dB) | 20MHz(dB) | 25MHz(dB) | 30 MHz (dB) | 35 MHz (dB) | 40MHz(dB) | 45 MHz (dB) | 50MHz(dB) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| n28 | [1.1] | 1.1 | 1.1 | 1.3 | 3.0 | 6.6 | 7.9 |  |  |  |  |

Recommended WF:

* Define RSD requirements as following:

Table 1: Reference Sensitivity Degradation from PC3 to PC2 for FDD bands for UE not supporting Tx Diversity

| Operating Band | 3MHz(dB) | 5MHz(dB) | 10MHz(dB) | 15MHz(dB) | 20MHz(dB) | 25MHz(dB) | 30 MHz (dB) | 35 MHz (dB) | 40MHz(dB) | 45 MHz (dB) | 50MHz(dB) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| n28 | 0.6 | 0.6 | 0.7 | 0.8 | 1.3 | 2.4 | 2.9 |  |  |  |  |

Table 2 Reference Sensitivity Degradation from PC3 to PC2 for FDD bands for UE supporting Tx Diversity

| Operating Band | 3MHz(dB) | 5MHz(dB) | 10MHz(dB) | 15MHz(dB) | 20MHz(dB) | 25MHz(dB) | 30 MHz (dB) | 35 MHz (dB) | 40MHz(dB) | 45 MHz (dB) | 50MHz(dB) |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| n28 | 1.1 | 1.1 | 1.1 | 1.3 | 3.0 | 6.6 | 7.9 |  |  |  |  |

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

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **<Agreement in Rel-18 (R4-2321715)>**:**For NS\_17, some agreements had been reached in Rel-18 in** **R4-2321715*** Take A-MPR values in R4-2320652 (quoted below) as starting point for NS\_17 for n28 PC2, and verify the values further to cover all operating modes.

**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 1 (Qualcomm): Adopt the following A-MPR for n28 up to 30 MHz channel bandwidths for PC2

 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 | ≤ 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 |
| 256 QAM |  |   |

Proposal 2 (Skyworks): For DFT-S-OFDM QPSK, consider adopting the following NS\_17 PC2 A-MPR:

* 2.5dB A-MPR for UE supporting PC2 with single-Tx.
* 3.0dB A-MPR for UEs supporting PC2 with dual-Tx.

Proposal 3 (Apple): Same as Rel-18 agreements.

Recommended WF:

* 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 |  |   |

**Issue 2-2-3 NS\_18 A-MPR for PC2 for BW<=30MHz**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **<Agreement in Rel-18 (R4-2310245)>**:The existing A-MPR regions for PC3 as defined in TS 38.101-1 are adapted for PC2, which are shown as in the tables below. The new tables are applicable for both power classes without impact to the PC3 requirements.**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 |  | 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** | **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 |

The A-MPR values for 1Tx PC2 are defined as in the table below.**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 |  |

Note that BW=25MHz is missing for NS\_18 in Table 6.5.3.3-1 of TS38.101-1 and will be added.**Table 6.5.3.3.3-1: Additional requirements for "NS\_18"**

|  |  |  |
| --- | --- | --- |
| **Frequency range****(MHz)** | **Channel bandwidth (MHz) / Spectrum emission limit (dBm)** | **Measurement bandwidth**  |
|  | 5, 10, 15, 20, 25, 30 |  |
| 692-698 | -26.2 | 6 MHz |

 |

Recommended WF:

* Confirm the above Rel-18 agreements for NS\_18

### Sub-topic 2-3 40MHz requirements for PC3 and PC2

**Issue 2-3-1 Uplink configuration for n28 REFSENS**

Proposal (ZTE, Qualcomm, skyworks, Apple): reuse existing UL configurations for 40MHz.

Recommended WF:

* Adopt the following UL configuration for 40MHz

| Operating band / SCS (kHz) / Channel bandwidth (MHz) / Duplex mode |
| --- |
| Operating Band | SCS | 3 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 60 | 70 | 80 | 90 | 100 | Duplex Mode |
| n28 | 15 | 15 | 25 | 251 | 251 | 251 | 251 | 251 |  | 251 |  |  |  |  |  |  |  | FDD |
|  | 30 |  |  | 101 | 101 | 101 | 101 | 101 |  | 101 |  |  |  |  |  |  |  |  |
| Note 1: UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.3.2-1). |

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

|  |  |
| --- | --- |
| 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 |

Recommended WF:

* FFS on PC3 REFSENS based on more companies’ input.

**Issue 2-3-3 PC2 RSD for 1Tx and 2Tx for 40MHz**

|  |  |  |
| --- | --- | --- |
| Source | RSD 1Tx (dB) | RSD 2Tx (dB) |
| Skyworks (R4-2413062) | 4 | 8.5 |
| Muruta (R4-2411476) | 2.8 | 8.8 |

Recommended WF:

* FFS on PC2 RSD for 40MHz

**Issue 2-3-4 ∆MPR for 40MHz**

Proposal 1 (ZTE): ΔMPR= 0.5dB

Proposal 2 (Apple, CATT): further discuss ∆MPR for 40MHz channel.

Recommended WF:

* Check whether ΔMPR= 0.5dB can be reused for 40MHz

**Issue 2-3-5 NS\_17 for 40MHz**

Proposal 1 (Qualcomm): NS\_17 is not required for 40 MHz CBW

Recommended WF:

* Do not specify NS\_17 for 40 MHz CBW

**Issue 2-3-6 NS\_18 for 40MHz**

Proposal 1 (Qualcomm): Based on spectrum allocations in APAC region, NS\_18 should be included for 40 MHz.

Recommended WF:

* Specify NS\_18 for 40MHz. FFS on the requirements.

**Issue 2-3-7 General coex requirements for 40MHz**

Proposal 1 (Qualcomm): Evaluate whether the general co-ex requirements specified for n28 are applicable for 40 MHz channel bandwidth.

Recommended WF:

* FFS on whether general co-existence requirements specified for n28 are applicable for 40MHz

**Issue 2-3-8 channel location**

Proposal 1 (Nokia): 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.

Proposal 2 (ZTE): For the 40MHz bandwidth, the minimum requirements are specified for NR UL transmission bandwidth configuration confined to 703-743 MHz.

Proposal 3 (CMCC):

For UEs supporting 40MHz, for the 20 MHz bandwidth, the minimum requirements are specified for NR UL carrier frequencies confined to either 713-733 MHz or 728-738 MHz. For the 25 MHz bandwidth, the minimum requirements are specified for NR UL carrier frequencies confined to either 715.5-730.5 MHz or 730.5-735.5 MHz. For the 30MHz bandwidth, the minimum requirements are specified for NR UL carrier frequencies confined to 718-728MHz or 733MHz. For the 40MHz bandwidth, the minimum requirements are specified for NR UL transmission bandwidth configuration confined to 703-743MHz.

Recommended WF:

* Check whether proposal 3 is agreeable

**Issue 2-3-9 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
 |

Proposal 1 (Nokia): UE supporting 40 MHz channel bandwidth in band n28 shall support Enhanced channel raster.

Proposal 2 (CATT): Add the exceptional channel raster point of n28 to UE RF specification TS 38.101-1 for UE CBW 40MHz.

Recommended WF:

* Add the exceptional channel raster point of n28 to UE RF specification TS 38.101-1 for UE CBW 40MHz.

**Issue 2-3-10 Release independence**

Proposal 1 (vivo): To align with gNB, 40MHz UE CBW is proposed be the optional feature and release independent from rel16.

Proposal 2 (CMCC): UE 40MHz channel bandwidth is release independent from Rel-15.

Recommended WF:

* Discuss the release independence of 40MHz for n28
	+ Option 1: Rel-15
	+ Option 2: Rel-16