**3GPP TSG-RAN WG4 Meeting #102-e R4-2206320**

**Electronic Meeting, 21 Feb – 3 Mar 2022**

**Agenda item: 9.37, 9.39, 12.7, 12.9**

**Source:** Moderator (Huawei)

**Title:** Email discussion summary for [102-e][120] LTE\_NR\_Other\_WI

**Document for:** Information

# Introduction

In this email thread, the following agenda items are discussed.

9.37 Additional NR bands for UL-MIMO  
9.39 Simultaneous Rx/Tx band combination  
12.7 Additional LTE bands for UE Cat M1/2, NB1/2  
12.9 R17 Additional enhancements for NB-IoT and LTE-MTC

# Topic #1: Additional NR bands for UL-MIMO

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203813 | Verizon Denmark | RAN4 approved the contribution R4-2117308 in meeting # 101-e for proposal to support NR band n77/n78 with UL-MIMO for PC1.5 UE in Rel-17. This draftCR is to add the same text changes into this spec based on the proposal. |
| R4-2204092 | Skyworks Solutions Inc. | **Proposal: Based on similar architecture assumptions than for PC3 NR UL MIMO, 1Tx NR-U MPR in Table 6.2F.2-1 is applicable to PC5 NR-U UL MIMO. Similarly, the NR-U PC5 1Tx A-MPR are applicable to PC5 NR-U UL MIMO.**  **Proposal:**   * **In Release 17 clause 6.2F.2D is added with relevant sub-clauses and tables and will point at the relevant NR-U specific requirements (UL MIMO power class, MPR, A-MPR) and NR UL MIMO requirements where appropriate (companion CR is provided in [3])** * **For Release 16 we seek the group view on whether to add the same changes or remove n46, n96 and n102 from the list of UL MIMO bands in Table 5.2D-1 of 38.101-1.** |
| R4-2204093 | Skyworks Solutions Inc. | Add following clauses:   * 6.2F.1D UE maximum output power for UL MIMO * 6.2F.2D UE maximum output power reduction for UL MIMO * 6.2F.3D UE additional maximum output power reduction for UL MIMO * 6.2F.4D Configured transmitted power for UL MIMO |
| R4-2204926 | Ligado Networks | Includes n24 and corresponding SUL band n99 as bands supporting UL MIMO, UL MIMO MOP for n24 and n99. |
| R4-2205592 | Huawei, HiSilicon | Introduce completed bands supporting UL MIMO. |
| R4-2205593 | Huawei, HiSilicon | WID revision. |

## Open issues summary

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

### Sub-topic 1-1 Rapporteur’s Input

*Sub-topic description: The WI rapporteur has provided the revised WID and big CR for discussion.*

*Open issues and candidate options before e-meeting:*

**Issue 1-1-1: The revised WID for additional NR bands for UL-MIMO**

### Sub-topic 1-2 MPR for NR-U PC5 UL MIMO

*Sub-topic description: The requirements for NR-U PC5 UL MIMO are incomplete in current specification, including MPR, A-MPR, configured transmitted power and etc. How to finish the related specification is discussed here.*

*Open issues and candidate options before e-meeting:*

**Issue 1-2-1: MPR and A-MPR requirements for PC5 NR-U UL MIMO in Rel-17**

**Issue 1-2-2: MPR and A-MPR requirements for PC5 NR-U UL MIMO in Rel-16**

## Companies views’ collection for 1st round

### Open issues

**Issue 1-1-1: The revised WID for additional NR bands for UL-MIMO**

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| **Company** | **Comments** |
| Moderator | There appears to be a typo. The band n77 is duplicated while n78 is missing. |
| CMCC | We would like to request the following bands supporting UL-MIMO:  n40 PC2 supporting UL-MIMO. N40 PC3 UL-MIMO has already been introduced.  n97 PC2 supporting UL-MIMO, n97 is the corresponding SUL band for n40.  N95 and n98 PC2 supporting UL-MIMO, the corresponding TDD bands n34 and n39 has already been introduced.  N28 PC3 supporting UL-MIMO. |
| AT&T | n77 PC1.5 seems to be listed twice. We ask that the rapporteur add AT&T as an “Other supporting companies” for n77 PC1.5 in Table 4.1.3-1. In addition, please add AT&T as a Supporting Company on the WID. |
| Huawei | Thanks for the inputs. The requests from operators together with the extension of PC5 as discussed in Issue 1-2-1 will be reflected in the revised WID. |

**Issue 1-2-1: MPR and A-MPR requirements for PC5 NR-U UL MIMO in Rel-17**

Discuss how to complete the PC5 NR-U UL MIMO requirements in R17 specification.

* Proposals
  + Option 1: The 1Tx NR-U MPR and A-MPR are applicable to PC5 NR-U UL MOMO.
  + Option 2: Others (please specify)
* Recommended WF
  + TBA

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| **Company** | **Comments** |
| Huawei | As the MPR/A-MPR is for NR-U, are the tdocs in wrong agenda? The current WI for UL MIMO bands only covers PC3, PC2 and PC1.5, if additional power class needs to be considered, WID revision is needed firstly.  The MOP requirement in the draft CR is put under inter-band CA, does it mean UL MIMO transmission for the NR-U band simultaneously occur with the licensed band? Note that 3T case is under discussion for the Rel-18 scope, if only 2Tx transmission is considered, then Tx switching requirements would be applied.  Though we don’t have strong view for the draft CR content, but some clarification and handling of the requirements should be further considered. |
| OPPO | Similar comment as HW, in current release only 2Tx is assumed, then no UL MIMO can be supported by inter-band UL CA. Maybe can be introduced in Rel-18. |
| Skyworks | We understand this basket WI is for all power classes but PC5 but our input is related to the fact that the NR-U bands are already in the spec in the UL MIMO bands as this was part of the R16 NR-U WI. The only missing parts was MPR and the parts I tried to address in the CR.  to Huawei: MOP for UL MIMO is in 6.2F.1D while MOP for CA if in 6.2F.1A the last letter is there to match the same suffixes for the NR requirement (A for CA, D for UL MIMO) so in this case 6.2F.1D is not under 6.2F.1A . th intention here is still to fit with the maximum 2 Tx transmittions so UL MIMO for R17 is only standalone operation in n46, n96 and n102. |
| Qualcomm | Option 1 is ok. The UL MIMO under 6.2F.1D follows the same approach as how CA was included for NR-U. The only question we is whether it is acceptable by MCC to skip B and C. |
| Huawei | Thanks Skyworks for the clarification. If the CR is to be handled under this WI, we will have some revisions for the WID in the upcoming RAN meeting to include new power classes as well. As commented by Qualcomm, there could be some procedure issue even the content is ok for the companies in RAN4. |
| Apple | Option 1. Despite the question on agenda placement we would be fine with specifying the 1Tx PC5 MPR for PC5 UL-MIMO. |

**Issue 1-2-2: MPR and A-MPR requirements for PC5 NR-U UL MIMO in Rel-16**

Discuss how to complete the PC5 NR-U UL MIMO requirements in R16 specification.

* Proposals
  + Option 1: Mirror the same changes in R17 specification.
  + Option 2: Remove band n46 and n96 from the list of UL MIMO bands in Table 5.2D-1 of TS 38.101-1.
  + Option 3: Others (please specify)
* Recommended WF
  + TBA

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| **Company** | **Comments** |
| Huawei | If following the normal release independent manner, option 2 seems the right way to go. |
| Skyworks | If we can introduce the complete requirement in R17 specification, we are Ok to remove n46 and n96 from the R16 UL MIMO band. |
| Qualcomm | Option 1 would be clearer, but option 2 could also be acceptable if release independence is understood. |
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### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| **CR/TP number** | **Comments collection** |
| R4-2203813  Draft CR to 38.101-1 for adding support NR band n77 with UL-MIMO for PC1.5 UPUE | AT&T: The draft CR is acceptable. |
| Qualcomm: Since this is a draft CR, it’s ok, but otherwise the WI code looks to be incorrect. It should probably be NR\_bands\_UL\_MIMO\_PC3\_R17-Core. |
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| R4-2204093 Draft CR TS 38.101-1: Introducing missing MPR for NR-U PC5 UL MIMO | Qualcomm: The draft CR is acceptable. One minor point (we do not insist to change it, but just pointing it out in case other changes are needed to the CR) is Table 6.2D.4-1 includes Pcmax up to 26 dBm, but since the power class is only limited to PC5 presently for NR-U, the higher values are not needed. |
| Company B |
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| R4-2204926 CR for n24 and n99 UL-MIMO PC3 | Company A |
| Company B |
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| R4-2205592 Big CR for TS38.101-1: introduction of new UL MIMO bands | Company A |
| Company B |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary** |
| **Topic# 1** | **Issue 1-2-1: MPR and A-MPR requirements for PC5 NR-U UL MIMO in Rel-17**  *Tentative agreements:* Option 1: The 1Tx NR-U MPR and A-MPR are applicable to PC5 NR-U UL MOMO is technically agreeable. And the WID needs to be updated to include PC5.  *Candidate options:*  *Recommendations for 2nd round: Confirm the tentative agreement in the dedicated WF.*  **Issue 1-2-2: MPR and A-MPR requirements for PC5 NR-U UL MIMO in Rel-16**  *Tentative agreements:* Option 2: Remove band n46 and n96 from the list of UL MIMO bands in Table 5.2D-1 of TS 38.101-1 is agreeable. The requirements shall be introduced in release-independent manner.  *Candidate options:*  *Recommendations for 2nd round: Confirm the tentative agreement in the dedicated WF.* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
| R4-2203813  Draft CR to 38.101-1 for adding support NR band n77 with UL-MIMO for PC1.5 UPUE | *To be revised. Please update the WI code as per comments.* |
| R4-2204093 Draft CR TS 38.101-1: Introducing missing MPR for NR-U PC5 UL MIMO | *To be postponed. <Concerns are raised such as under which WI to discuss, which clause to use as well as Pcmax, etc>* |
| R4-2204926 CR for n24 and n99 UL-MIMO PC3 | *To be agreed.* |
| R4-2205592 Big CR for TS38.101-1: introduction of new UL MIMO bands | *To be agreed.* |

## Discussion on 2nd round (if applicable)

### Open issues

* + WF on MPR and A-MPR requirements for PC5 NR-U UL MIMO, Skyworks

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| **Company** | **Comments** |
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### CRs/TPs

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| **CR/TP number** | **Comments collection** |
| Revision of R4-2203813  Draft CR to 38.101-1 for adding support NR band n77 with UL-MIMO for PC1.5 UPUE |  |
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## Summary for 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

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# Topic #3: Simultaneous Rx/Tx band combination

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203683 | Apple | **Observation 1**: Large MSD values have negative effects on DL coverage and throughput. This has always been a concern in the past and the issues should be considered when defining mandatory simultaneous Rx/Tx for FDD-TDD combinations.  **Observation 2:** Band combinations which are above the MSD threshold and therefore do not have mandatory simultaneous Rx/Tx can still be used with simultaneous Rx/Tx if the UE signals support for those band combinations.  **Proposal 1**: Mandatory simultaneous Rx/Tx for FDD-TDD combinations should be defined with a threshold.  **Proposal 2**: During the discussion it has already been mentioned that there exist combinations with high MSD such as CA\_n1-n77 with mandatory simultaneous Rx/Tx. As compromise the threshold for mandatory simultaneous Rx/Tx could be set to values of 29.8(2 antenna ports) / 32.5(4 antenna ports) which corresponds to the mentioned combination.  **Observation 3:** UE field logs reveal that in some cases the network configures the UE for simultaneous Rx/Tx even when the UE did not indicate that it has this capability for a certain combination. As this is not a supported mode of operation it can lead to data loss which causes unnecessary re-transmissions or even cause a complete link loss. The network should respect signaled capabilities or its absence to guarantee reliable and robust connection between UE and network.  **Observation 4:** Networks which have been observed to configure the UE not according to the UE’s indicated simultaneous Rx/Tx capability are not in compliance with the NR specification.  **Proposal 3**: RAN4 should discuss whether a requirement to ensure network compliance with the simultaneous Rx/Tx capability signaling should be introduced on the BS. |
| R4-2203684 | Apple | draft CR  The following changes are introduced:  - Add new column “Mandatory simultaneousRx/Tx” to Tables 5.2A.2.1-1, 5.2A.2.2-1, 5.2A.2.3-1m 5.2A.2.4-1, 5.2C-1, 5.2C-2, 5.2C-3, 5.2C-4 |
| R4-2204212 | SoftBank Corp. | **Observation 1: Some band combinations have already specified as the simultaneous Rx/Tx capability is mandatory support. The maximum MSD value in those band combinations is 29.8(2 antenna ports) / 32.5(4 antenna ports) dBm.**  **Observation 2: FDD-TDD band combination that cannot support the simultaneous Rx/Tx operation is not confirmed yet.**  **Proposal: The threshold should be higher than 29.8(2 antenna ports) / 32.5(4 antenna ports) dBm.** |
| R4-2204222 | MediaTek Beijing Inc. | **Proposal: Implement prior agreement to add NOTE to clarify the minimum requirements apply only when there is non-simultaneous Rx/Tx operation for CA\_n257-n259 and CA\_n258-n260, as CA\_n260-n261.** |
| R4-2204741 | ZTE Corporation | **Observation 1: For a FDD-TDD inter-band NR CA band combination, inter-band NR CA operation can not workable if simultaneous Rx/Tx operation is not supported.**  **Observation 2: Due to actual MSD can be 20 dB or more better than the MSD in the specs, actual MSD could be smaller than the threshold in case of the MSD defined in the spec larger than the MSD threshold.**  **Observation 3: The performance would be affected if changing the simultaneous Rx/Tx capability from mandatory to optional.**  **Proposal: The threshold value should be higher than 32.5dB.** |
| R4-2204742 | ZTE Corporation | Per MCC/Chairman’s guidance, the draft CR is re-submitted from the endorsed draft CR R4-2201341. |
| R4-2204743 | ZTE Corporation | Per MCC/Chairman’s guidance, the draft CR is re-submitted from the endorsed draft CR R4-2201342. |
| R4-2204744 | ZTE Corporation | To indicate same note as in R4-2201343 for simultaneous Rx/Tx capability for the existing FR2 band combinations CA\_n257-n259 and CA\_n258-n260. The changes were highlighted in yellow compared to R4-2201343. |
| R4-2204815 | Xiaomi | **Proposal 1: specify the simultaneous Tx/Rx capability case by case, no general rule for FR1+FR1 FDD-TDD band combination.** |
| R4-2205439 | NTT DOCOMO INC. | R15 Draft CR Cat F  The following description is added into section 5.2A and 5.2C:  If mandatory simultaneous Rx/Tx capability apply for a band combination, mandatory simultaneous Rx/Tx capability also apply for the band combination when the applicable band combination is a subset of a higher order band combination. |
| R4-2205446 | NTT DOCOMO INC. | R15 Draft CR Cat F  The following descriptions are added into section 5.2A.1 and 5.5B.1, respectively:  If mandatory simultaneous Rx/Tx capability apply for a band combination, mandatory simultaneous Rx/Tx capability also apply for the band combination when the applicable band combination is a subset of a higher order band combination.  If mandatory simultaneous Rx/Tx capability apply for a DC configuration, mandatory simultaneous Rx/Tx capability also apply for the DC configuration when the applicable DC configuration is a subset of a higher order DC configuration. |
| R4-2205449 | NTT DOCOMO INC. | R17 Draft CR  The following description is added into section 5.2B:  If mandatory simultaneous RxTx capability apply for a band configuration, mandatory simultaneous RxTx capability also apply for the band pair of the configuration when the applicable configuration is a subset of a higher order band configuration. |
| R4-2205579 | Huawei, HiSilicon | TR 38.839 v0.2.0 |
| R4-2205580 | Huawei, HiSilicon | ***Observation 1: MSD for FDD-TDD band combination is defined for simultaneous Rx/Tx operation.***  ***Observation 2: Though the MSD for some band combination could be very large, whether to enable a band combination is a choice of deployment decision***  ***Proposal 1: For FDD-TDD band combination for FR1 with specified MSD, simultaneous Rx/Tx operation by default is supported and no need to further discuss the MSD threshold.***  ***Proposal 2: It is proposed to consider whether the revision based on the WF in last meeting is agreeable to all, i.e.***   * No need to further discuss the MSD threshold for FR1 FDD-TDD band combinations, by default simultaneous Rx/Tx operation is supported for the FR1 FDD-TDD band combinations with MSD * If a FR1 FDD-TDD band combination is identified which cannot support simultaneous Rx/Tx operation, a note similar to FR1 TDD-TDD band combination shall be indicated in the specification, and for such operation the minimum requirements are not applicable for this band combination * Simultaneous Rx/Tx capability can still be optional for FR1 FDD-TDD band combination with specified MSD |
| R4-2205581 | Huawei, HiSilicon | TP for TR 38.839: Update for simultaneous Rx/Tx capability |
| R4-2203700 | Apple | ***Observation 1****: For 28GHz+39GHz inter-band CA, the Tx output noise floor in Rx band and Rx LO reciprocal mixing alone could already contribute 33.5dB MSD.*  ***Observation 2****: The chance for FR2 inter-band CA to stay away from MSD impact under simultaneous Rx/Tx operation in typical field operating condition is rather slim.*  ***Proposal****: To endorse draft CR R4-2201343 postponed from last RAN4 meeting for the clarification that the minimum requirements apply only when there is non-simultaneous Rx/Tx operation between inter-band NR carriers for CA\_n257-n259 and CA\_n258-n260 as shown below.*    Table 5.2A.2-1: Inter-band CA operating bands in FR2   |  |  | | --- | --- | | NR CA Band | NR Band  (Table 5.2-1) | | CA\_n257-n2591 | n257, n259 | | CA\_n258-n2601 | n258, n260 | | CA\_n260-n261 | n260, n261 | | NOTE 1: The minimum requirements apply only when there is non-simultaneous Rx/Tx operation between inter-band NR carriers in the current version of this specification. | | |

## Open issues summary

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

### Sub-topic 3-1 Simultaneous Rx/Tx capability for FR1+FR1 FDD-TDD band combination

*Sub-topic description: The discussion on MSD threshold is continued.*

*Open issues and candidate options before e-meeting:*

**Issue 3-1-1: MSD threshold**

### Sub-topic 3-2 Simultaneous Rx/Tx capability for FR2+FR2 TDD-TDD band combination

*Sub-topic description: Applicability for FR2+FR2 TDD-TDD band combinations.*

*Open issues and candidate options before e-meeting:*

**Please comment in the CR/TP section directly.**

## Companies views’ collection for 1st round

### Open issues

**Issue 3-1-1: MSD threshold**

**For FR1+FR1 FDD-TDD band combinations whose MSD is larger than a threshold (value FFS), further discuss whether simultaneous Rx/Tx can be changed to optional, otherwise, the simultaneous Rx/Tx capability is mandatory support.**

* Proposals
  + Option 1: The threshold value is set to 29.8(2 antenna ports) / 32.5(4 antenna ports) dBm.
  + Option 2: The threshold should be higher than 29.8(2 antenna ports) / 32.5(4 antenna ports) dBm.
  + Option 3: Specify the simultaneous Tx/Rx capability case by case, no general rule for FR1+FR1 FDD-TDD band combination.
  + Option 4: By default simultaneous Rx/Tx operation is supported for the FR1 FDD-TDD band combinations with MSD. If a FR1 FDD-TDD band combination is identified which cannot support simultaneous Rx/Tx operation, a note similar to FR1 TDD-TDD band combination shall be indicated in the specification, and for such operation the minimum requirements are not applicable for this band combination. Simultaneous Rx/Tx capability can still be optional for FR1 FDD-TDD band combination with specified MSD.
* Recommended WF
  + TBA

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| **Company** | **Comments** |
| ZTE | Our proposal is option 2, but we are ok with Option 1.  We think optional simultaneous Rx/Tx operation for FR1 FDD-TDD is confused, in our understanding, if simultaneous Rx/Tx operation is not supported for FR1 FDD-TDD, then how to support inter-band CA should be discussed. |
| SoftBank | Support Option 2. Option 1is also fine with us. |
| Qualcomm | We haven’t see any real justification for these proposals. Just using the precedent that there is a combo with such MSD which has mandatory simultaneous Rx-Tx support is not a good argument. We asked for some field data to show whether a certain combination is useful in practice or not but so far we have not seen anything.  Considering this, we support Option 3. |
| CHTTL | Support Option 2. Option 1 is also fine with us.  We also share similar understanding/question as what ZTE mentioned. |
| Xiaomi | Option 3. MSD threshold has been discussed for several meetings, it is hard to get a consensus. And for option 4, anyway it needs case by case analysis, whether default or mandatory simultaneous Rx/Tx operation is supported or not rely on that analysis. |
| Huawei | Option 4 is trying to break the deadlock.  If a MSD threshold is indeed preferred by most companies, we are also fine with option 1 or option 4. Since no progress for this issue for several meetings, we prefer to have some discussion in GTW meeting to efficiently exchange views there. |
| MediaTek | Option 3. To mandate simultaneous RX/TX as general rule may have impact on RF front-end design and UE implementation on antenna configurations. It shall be discussed case by case manner. |
| Skyworks | Given the situation we do not think the group can agree to any fixed criteria, Option 3 seems the only one. |
| Huawei | In our understanding, case by case study would be performed for those combinations which have difficulty to support simultaneous Rx/Tx operation, at least no such combination identified yet for FR1 FDD-TDD, but as a general rule it can be considered. With this principle, we can revise option 4 as:  **Case by case analysis is considered for FR1 FDD-TDD band combination which may have difficulty to support simultaneous Rx/Tx operation, e.g. with large MSD. If a FR1 FDD-TDD band combination is identified which cannot support simultaneous Rx/Tx operation, a note similar to FR1 TDD-TDD band combination shall be indicated in the specification, and for such operation the minimum requirements are not applicable for this band combination. Otherwise, the FR1 FDD-TDD band combination with MSD can support simultaneous Rx/Tx operation.** |
| Apple | Generally, we can be fine with option 1 or option 3.  Thanks to Huawei for their compromise proposal withx their latest comment. We could accept it. |

### CRs/TPs comments collection

*Major close to finalize Wis and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going Wis, suggest to focus on open issues discussion on 1st round.*

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| **CR/TP number** | **Comments collection** |
| R4-2203684 draftCR 38101-1 simRxTx column | Qualcomm: The way this is implemented is somewhat misleading because there is nothing written for the combinations with only FDD bands. One could read this as simultaneous Rx-Tx is not mandatory for these combos. |
| Apple: Thank you to Qualcomm for this comment; the CR merely transferred the notes notation to column without making any new proposals. Indeed, we are also confused why FDD-FDD configurations did not have the simultaneous Rx/Tx notes in the past. We are open to capture this additional change based on RAN4 consensus. |
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| R4-2204742\_draft CR to TS38.101-2[R16] On Simultaneous RxTx capability for FR2 inter-band CA | MediaTek: Technical discussion was done, and implement method was agreed. The draft CR implement the prior agreement well. We support the draft CR. |
| ZTE: Per MCC/Chairman guidance, it is resubmission from the endorsed draft CR in last meeting. |
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| R4-2204743\_draft CR to TS38.101-2[R17] On Simultaneous RxTx capability for FR2 inter-band CA | MediaTek: Technical discussion was done, and implement method was agreed. The draft CR implement the prior agreement well. We support the draft CR. |
| ZTE: Per MCC/Chairman guidance, it is resubmission from the endorsed draft CR in last meeting. |
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| R4-2204744\_draft CR to TS38.101-2[R17] On Simultaneous RxTx capability for FR2 inter-band CA\_n257-n259 and CA\_n258-n260 | MediaTek: Technical discussion was done, and implement method was agreed. The draft CR implement the prior agreement well. We support the draft CR. |
| ZTE: Technical discussion was given in [R4-2203700](C:/Program%20Files%20(x86)/zMail/app/zMail/WebContent/pcWeb/Scripts/MailControls/ReadPanelIframe/javascript:void(0);" \t "C:/Program%20Files%20(x86)/zMail/app/zMail/WebContent/pcWeb/Scripts/MailControls/ReadPanelIframe/_blank). In terms of the verification, larger MSD (34.5dB) would be foreseen if imultaneous Rx/Tx is supported for different f-group FR2 band combination. Therefore, non-simultaneuos Rx/Tx is fine (also compliance to previous agreements). The draft CR should be endorsed.  BTW: [R4-2203700](C:/Program%20Files%20(x86)/zMail/app/zMail/WebContent/pcWeb/Scripts/MailControls/ReadPanelIframe/javascript:void(0);" \t "C:/Program%20Files%20(x86)/zMail/app/zMail/WebContent/pcWeb/Scripts/MailControls/ReadPanelIframe/_blank) was removed from thread #125 to #120, as commented before the meeting. However, it seems it was missed in moderator’s summary. |
| Huawei: In principle, with case by case study, we can indicate the note for specific band combination. For FR2 combinations introduced later, the note is not generally applied, which is still based on detailed analysis. |
| MediaTek (v16):  To Huawei: Yes, I think the draft CR aligned with the case by case study concept well. The NOTE1 is added for the 3 specific band combinations. |
| R4-2205439\_darft CR for Clarification on per band pair simultaneous TxRx capability for CA and SUL for TS 38.101-1 | Qualcomm: the text has some mistakes, should be: “If the mandatory simultaneous Rx/Tx capability applies for a band combination, the mandatory simultaneous Rx/Tx capability also applies for the band combination when the applicable band combination is a subset of a higher order band combination.” |
| CHTTL: we support in principle, ok for the QC’s corrections on the text. |
| Xiaomi: Support the wording from Qualcomm |
| Huawei: Generally ok with the draft CR and further wording improvement. |
| DOCOMO: Thank you for the all comments and the correction from Qualcomm. We will revise based on the suggestion. |
| R4-2205446\_darft CR for Clarification on per band pair simultaneous TxRx capability for TS 38.101-3 | Quacomm: see the comments for 5439 |
| DOCOMO: Thank you for the correction from Qualcomm. We will revise based on the suggestion. |
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| R4-2205449\_darft CR for Clarification on per band pair simultaneous TxRx capability for DC for TS 38.101-1 | Qualcomm: see the comments for 5439 |
| DOCOMO: Thank you for the correction from Qualcomm. We will revise based on the suggestion. |
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| R4-2205581 TP for TR 38.839 Update for simultaneous RxTx capability | Qualcomm: see the comments for 5439 |
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| R4-2205579 TR 38.839 v0.2.0 | <Moderator> Please update the copyright date to 2022 as per Chairman’s guidance. |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary** |
| **Sub-topic# 3-1 & 3-2** | **Issue 3-1-1: MSD threshold**  **There’s no consensus on the value for the MSD threshold. Case-by-case analysis can always be the fallback solution. The compromised proposal from Huawei seems to receive some support. The moderator suggests to discuss it further in the 2nd round.**  *Tentative agreements:*  *Specify the simultaneous Tx/Rx capability case by case for FR1+FR1 FDD-TDD band combinations if no other agreement can be reached. Discuss the following candidate option in the 2nd round.Candidate options:*  **Case by case analysis is considered for FR1 FDD-TDD band combination which may have difficulty to support simultaneous Rx/Tx operation, e.g. with large MSD. If a FR1 FDD-TDD band combination is identified which cannot support simultaneous Rx/Tx operation, a note similar to FR1 TDD-TDD band combination shall be indicated in the specification, and for such operation the minimum requirements are not applicable for this band combination. Otherwise, the FR1 FDD-TDD band combination with MSD can support simultaneous Rx/Tx operation.***Recommendations for 2nd round:*  Discuss the above candidate option and try to reach agreement. A dedicated WF is assigned to the rapporteur to drive the discussions. |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2203684 draftCR 38101-1 simRxTx column | To be revised |
| R4-2204742\_draft CR to TS38.101-2[R16] On Simultaneous RxTx capability for FR2 inter-band CA | *To be endorsed* |
| R4-2204743\_draft CR to TS38.101-2[R17] On Simultaneous RxTx capability for FR2 inter-band CA | *To be endorsed* |
| R4-2204744\_draft CR to TS38.101-2[R17] On Simultaneous RxTx capability for FR2 inter-band CA\_n257-n259 and CA\_n258-n260 | *To be endorsed* |
| R4-2205439\_darft CR for Clarification on per band pair simultaneous TxRx capability for CA and SUL for TS 38.101-1 | *To be revised* |
| R4-2205446\_darft CR for Clarification on per band pair simultaneous TxRx capability for TS 38.101-3 | *To be revised* |
| R4-2205449\_darft CR for Clarification on per band pair simultaneous TxRx capability for DC for TS 38.101-1 | *To be revised* |
| R4-2205581 TP for TR 38.839 Update for simultaneous RxTx capability | *To be revised* |
| R4-2205579 TR 38.839 v0.2.0 | *To be revised* |

## Discussion on 2nd round (if applicable)

### Open issues

* + WF on simultaneous Rx/Tx capability, Huawei, HiSilicon

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| **Company** | **Comments** |
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### CRs/TPs

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| **CR/TP number** | **Comments collection** |
| Revision of R4-2203684 draftCR 38101-1 simRxTx column |  |
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| Revision of R4-2205439\_darft CR for Clarification on per band pair simultaneous TxRx capability for CA and SUL for TS 38.101-1 |  |
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| Revision of R4-2205446\_darft CR for Clarification on per band pair simultaneous TxRx capability for TS 38.101-3 |  |
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| Revision of R4-2205449\_darft CR for Clarification on per band pair simultaneous TxRx capability for DC for TS 38.101-1 |  |
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| Revision of R4-2205581 TP for TR 38.839 Update for simultaneous RxTx capability |  |
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|  |
| Revision of R4-2205579 TR 38.839 v0.2.0 |  |
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## Summary for 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

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# Topic #4: Additional LTE bands for UE Cat M1/2, NB1/2

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
|  |  |  |

# Topic #5: NB-IoT 16QAM

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2204077 | Huawei, HiSilicon, Ericsson, Nokia, Nokia Shanghai Bell | The EVM requirement for 16QAM NB-IoT DL is added. The draft CR has been endorsed in R4-2201832. |
| R4-2204078 | Huawei, HiSilicon, Nokia, Nokia Shanghai Bell, Ericsson | Add 16QAM to NB-IoT test model; add 16QAM to the EVM test procedure and test requirement. The draft CR has been endorsed in R4-2202296. |

## Open issues summary

### Sub-topic 5-1 BS RF Requirements

*Sub-topic description:* The impact to BS RF requirements in support of 16QAM are discussed here.

*Open issues and candidate options before e-meeting:*

No open issues. Please comment in the CR section directly.

## Companies views’ collection for 1st round

### Open issues

N/A

### CRs/TPs comments collection

*For close-to-finalize Wis and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing Wis, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2204077 | Nokia: Support the CR. |
| Huawei: Support the CR. |
|  |
| R4-2204078 | Nokia: Support the CR. |
| Huawei: Support the CR. |
|  |

## Summary for 1st round

### Open issues

N/A

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2204077 | To be agreed. |
| R4-2204078 | To be agreed. |

# Topic #6: LTE-MTC Additional Enhancements

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2204042 | Sony | **Proposal 1: Under option 1, in order to determine MPR for power boosting of sub-PRB transmissions, RAN4 agrees on specific references for the following terms:**   * **Counter-IM3** * **IQ Image** * **LO leakage** * **PA model** * **MPR evaluation methodology**   **Proposal 2: Under option 2, the MPR framework allows a sub-PRB capable UE to apply a power reduction of full-PRB, PRACH, PUCCH and SRS relative to the power of a 2-tone sub-PRB PUSCH transmission.** |
| R4-2205546 | Ericsson | **Observation#1: Reducing the full-PRB transmission power generally is against the UE rated power definition.**  **Proposal-1: Follow the framework of NR pi/2 BPSK power boosting if RAN4 decides that there is an overall gain from the subPRB boosting.**  **Observation#2: If RAN4 decided for the subPRB power boosting, it will be possible to boost power for 2 out 3 tone subPRB transmission thanks to low PAPR characteristic.**  **Proposal-2: Focus on PC5 CAT-M1 device for the potential power boosting to PC3 on subPRB transmission.**  **Proposal-3: RAN4 could discuss the feasibility only in Rel-17 in remaining one RAN4 meetings.**  **Proposal-4: RAN4 could discuss the WID objective modifications with above two options.** |

## Open issues summary

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

### Sub-topic 6-1 Feasibility study on max power reduction for PRACH, PUCCH, and full-PRB PUSCH

*Sub-topic description: The feasibility study is continued.*

*Open issues and candidate options before e-meeting:*

**Issue 6-1-1: Feasibility study on max power reduction**

## Companies views’ collection for 1st round

### Open issues

**Issue 6-1-1: Feasibility study on max power reduction**

Two different interpretations of the WI objective have been proposed:

* Alt A: Follow the framework of NR pi/2 BPSK power boosting if RAN4 decides that there is an overall gain from the subPRB boosting.

- Focus on PC5 CAT-M1 device for the potential power boosting to PC3 on subPRB transmission

* Alt B: Define full power transmission for 2-of-3 sub-PRB and allow power reduction for full-PRB PUSCH, PRACH and PUCCH

- Add supplementary MPR for full PRB transmissions for UE CAT-M1 PC3 and PC5

* Proposals
  + Option 1: Alt A is feasible and to be specified
  + Option 2: Alt B is feasible and to be specified
  + Option 3: Both Alt A and Alt B are feasible and to be specified
  + Option 4: No consensus is reached on the feasibility. Seek RAN’s guidance on whether to remove/change the WI objective.
* Recommended WF
  + TBA

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| **Company** | **Comments** |
| Qualcomm | Considering the status of the discussion and that this WI should be closed soon, Option 4 is the most suitable now. There should be plenary discussion on how to handle this topic. |
| SONY | **Discussion on Alt A and Alt B**  Alt A and Alt B are not really different interpretations of the WID, they are two different approaches to achieve the goal of the WID objective, which is basically to allow a subPRB transmission to be transmitted at a higher power than a full PRB transmission. The WID objective ([RP-211340](https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_92e/Docs/RP-211340.zip)) is:  *For Ues supporting PUSCH sub-PRB resource allocation, study and if found feasible,* ***specify support power reduction for PRACH, PUCCH, and full-PRB PUSCH****, with a maximum reduction of e.g. 3 dB below sub-PRB PUSCH power*. [LTE-MTC] [RAN4]  This objective seems to be in line with Alt B (power reduction of full PRB) rather than Alt A (power boosting of subPRB).  At the end of the day, we think that the specification impact of either Alt A or Alt B is the same and the WID objective would be reached with either of the alternatives. We would also like to note that “adding a supplementary MPR for full PRB transmission” is not central to Alt B: we think that use of a supplementary MPR would just be the simplest way to implement the WID objective while minimizing specification changes.  **Summary of benefits of transmitting subPRB at a higher power**  Our view is that a **way forward** at this stage would be to agree on the benefits of *power reduction for PRACH, PUCCH, and full-PRB PUSCH relative to subPRB transmission*. We discussed these benefits in our previous contribution ([R4-2117620](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_101-e/Docs/R4-2117620.zip) from RAN4#101e). The benefits that were observed are summarized in the table below:  Table X – Benefits of higher power sub-PRB transmission   |  |  |  | | --- | --- | --- | | **Aspect** | **Network benefit** | **UE benefit** | | Coverage | Improved coverage for higher data rates in CE CE Mode B.  Improved coverage in CE Mode A. | Improved coverage for higher data rates in CE CE Mode B.  Improved coverage in CE Mode A. | | Spectral efficiency | Improved spectral efficiency. |  | | Battery lifetime |  | Improved battery lifetime / less frequency battery replacement cycles / smaller batteries | | Latency | Reduced application latency. | Reduced application latency. |   This way forward would at least close out the “study” part of the WID objective, even if the “specify” part of the WID objective has not yet been addressed. We could capture the results of the study (e.g. the above table) in the chairman’s notes or a WF. We are happy to draft this WF.  **SONY view on moderator’s options**  Our views on the options are:  Option 1: OK  Option 2: OK and preferred  Option 3: not preferred. RAN4 should only specify one approach  Option 4: any RAN plenary discussion would be facilitated by RAN4 providing a summary of the study on the benefits of higher power sub-PRB transmission (as per the table above) as a conclusion to this email discussion. |
| Ericsson | we are fine with modified option 1 and option 4. As there is no time to specify, suggesting only capture the feasible part of wording in option 1.  Considering this is the last meeting of the WI, we are fine to document any potential agreement on “study” part on the WID objective and agree with Sony using the WF is a good approach. In WF, also possibly some guidance on potential WID update is good to have. |
| Huawei | Alt A proposes power boost, which is not in line with the power reduction objective in the WID. Alt B matches the WID better, however, it has been pointed out that the cell coverage may be impacted if the power of PRACH/PUCCH is reduced. Therefore, we tend to support option 4, i.e. neither option is feasible or infeasible, due to lack of interest/contribution from companies. |
| SONY2 | We would be OK with the approach suggested by Ericsson, which we are basically in line with:   * Document any potential agreement on the “study” part of the objective * Provide some guidance on potential WID update   Huawei> thanks for the comments. In terms of the coverage implications of PRACH / PUCCH from power reduction of those physical channels, our understanding (as detailed in [R4-2117620](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_101-e/Docs/R4-2117620.zip) from RAN4#101e) is that:   * For CE Mode B, the baseline coverage of a 1400 bits per second PUSCH, PRACH and PUCCH are balanced. If the power of PRACH and PUCCH were reduced then the coverage would be reduced. * For CE Mode B, if the baseline coverage for acceptable performance is defined as, e.g., 3000kbps then PRACH and PUCCH would not be the covering limiting channels and reducing their transmit power would not impact cell coverage. For this reason, the table above discusses “Improved coverage for higher data rates in CE Mode B”. * For CE Mode A, the coverage is limited by the coverage of PUSCH and a coverage reduction of PUCCH / PRACH would hence not impact cell coverage   Please note that the table above discusses the impacts of transmitting sub-PRB PUSCH at a higher power rather than transmitting other channels (full-PRB PUSCH, PUCCH, PRACH) at a lower power. We could also provide a table discussing the impacts of power reduction of these other channels. |

### CRs/TPs comments collection

*Major close to finalize Wis and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going Wis, suggest to focus on open issues discussion on 1st round.*

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| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
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## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary** |
| **Sub-topic# 6-1** | **Issue 6-1-1: Feasibility study on max power reduction**  *Qualcomm and Huawei expressed the support of Option 4 (i.e. no consensus on the feasibility). Ericsson supports Option 1 with modification (i.e. Alt A is feasible), but can also accept Option 4. Sony is OK with either Option 1 or 2, with preference on Option 2.*  *Tentative agreements:*  *Summarize the status of RAN4 study in a WF document to facilitate the potential discussions in the plenary meeting. Individual company’s view/analysis may be shared in the background information part of the WF, but might not become the group’s consensus without confirmation.*  *Candidate options:*  *Recommendations for 2nd round:*  *Assign the WF to Sony and discuss it in the 2nd round.* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

### Open issues

* + WF on feasibility study on max power reduction for PRACH, PUCCH, and full-PRB PUSCH, Sony

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| **Company** | **Comments** |
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## Summary for 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

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# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on simultaneous Rx/Tx capability | Huawei, HiSilicon |  |
| WF on feasibility study on max power reduction for PRACH, PUCCH, and full-PRB PUSCH | Sony |  |
| WF on MPR and A-MPR requirements for PC5 NR-U UL MIMO | Skyworks |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2203813 | Draft CR to 38.101-1 for adding support NR band n77 with UL-MIMO for PC1.5 UPUE | Verizon Denmark | To be revised |  |
| R4-2204092 | Introducing missing MPR for NR-U PC5 UL MIMO | Skyworks Solutions Inc. | To be noted |  |
| R4-2204093 | Draft CR TS 38.101-1: Introducing missing MPR for NR-U PC5 UL MIMO | Skyworks Solutions Inc. | To be postponed |  |
| R4-2204926 | CR for n24 and n99 UL-MIMO PC3 | Ligado Networks | To be agreed |  |
| R4-2205592 | Big CR for TS38.101-1: introduction of new UL MIMO bands | Huawei, HiSilicon | To be agreed |  |
| R4-2205593 | revised WID Basket UL MIMO bands | Huawei, HiSilicon | To be revised |  |
| R4-2203683 | MSD threshold for simultaneous Rx/Tx | Apple | To be noted |  |
| R4-2203684 | draft CR to 38.101-1 on new column for mandatory simultaneous RxTx | Apple | To be revised |  |
| R4-2204212 | Discussion on the simultaneous Rx/Tx capability for FR1+FR1 FDD-TDD band combination | SoftBank Corp. | To be noted |  |
| R4-2204222 | Recap on no support of FR2 simultaneous TxRx discussion | MediaTek Beijing Inc. | To be noted |  |
| R4-2204741 | Simultaneous RxTx capability for FR1+FR1 FDD-TDD band combination | ZTE Corporation | To be noted |  |
| R4-2204742 | Draft CR to TS 38.101-2: On Simultaneous RxTx capability for FR2 inter-band CA | ZTE Corporation | To be endorsed |  |
| R4-2204743 | Draft CR to TS 38.101-2: On Simultaneous RxTx capability for FR2 inter-band CA | ZTE Corporation | To be endorsed |  |
| R4-2204744 | Draft CR to TS 38.101-2: On Simultaneous RxTx capability for FR2 inter-band CA CA\_n257-n259 and CA\_n258-n260 | ZTE Corporation | To be endorsed |  |
| R4-2204815 | Discussion on principle for simultaneous Rx Tx band combinations for CA, SUL, MR-DC and NR-DC | Xiaomi | To be noted |  |
| R4-2205439 | Draft CR for clarification on per band pair simultaneous RxTx capability for CA and SUL for TS 38.101-1 | NTT DOCOMO INC. | To be revised |  |
| R4-2205440 | Draft CR for clarification on per band pair simultaneous RxTx capability for CA and SUL for TS 38.101-1 | NTT DOCOMO INC. | Return to | Mirror CR |
| R4-2205444 | Draft CR for clarification on per band pair simultaneous RxTx capability for CA and SUL for TS 38.101-1 | NTT DOCOMO INC. | Return to | Mirror CR |
| R4-2205446 | Draft CR for clarification on per band pair simultaneous RxTx capability for TS 38.101-3 | NTT DOCOMO INC. | To be revised |  |
| R4-2205447 | Draft CR for clarification on per band pair simultaneous RxTx capability for TS 38.101-3 | NTT DOCOMO INC. | Return to | Mirror CR |
| R4-2205448 | Draft CR for clarification on per band pair simultaneous RxTx capability for TS 38.101-3 | NTT DOCOMO INC. | Return to | Mirror CR |
| R4-2205449 | Draft CR for clarification on per band pair simultaneous RxTx capability for DC TS 38.101-1 | NTT DOCOMO INC. | To be revised |  |
| R4-2205579 | TR 38.839 v0.2.0 | Huawei, HiSilicon | To be revised |  |
| R4-2205580 | Further consideration on the simultaneous Rx/Tx capability for FR1 TDD-FDD | Huawei, HiSilicon | To be noted |  |
| R4-2205581 | TP for TR 38.839: update for simultaneous RxTx capability | Huawei, HiSilicon | To be revised |  |
| R4-2203700 | MSD analysis for FR2 inter-band CA with simultaneous Rx/Tx | Apple | To be noted |  |
| R4-2204042 | On max power reduction for PRACH, PUCCH, and full-PRB PUSCH | Sony | To be noted |  |
| R4-2204077 | CR to TS16104 Addition of NB-IoT 16QAM | Huawei, HiSilicon, Ericsson, Nokia, Nokia Shanghai Bell | To be agreed |  |
| R4-2204078 | CR to TS16141 Addition of NB-IoT 16QAM | Huawei, HiSilicon, Nokia, Nokia Shanghai Bell, Ericsson | To be agreed |  |
| R4-2205546 | RF impact analysis on R17 eMTC WID | Ericsson | To be noted |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

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| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
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Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex: Contact Information

|  |  |  |
| --- | --- | --- |
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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)