**3GPP TSG-RAN WG4 Meeting # 100-e R4-210XXXX**

**Electronic Meeting, Aug, 2021**

**Agenda item:** 9.7

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for [100-e][131] NR\_TxD

**Document for:** Information

# Introduction

Tx diversity work was agreed to be organized under a new WI (RP-211597) in RAN#92e. The objective of the work is

This document is a summary of email discussion in RAN4#100e for the TxD WI.

Five distinct topics have been identified for the email discussion:

* Topic #1: General topics and documents
  + TR, WID revisions, rolling Cr that includes aspect from all agreed issues and other general issues are handled here
* Topic #2: Phase I open RF requriements
  + Requirements and open issues according to phase I in the WID are handled here
* Topic #3: Phase II SRS and ULFPTx
  + Issue according the phase II
* Topic #4: Power class ambiguity
  + Issues related to UE power class behaviour being unclear because of txd implementation
* Topic #5: Capability and LS
  + Issues related to capability and what ran4 should let other WGs know are discussed here

# Topic #1: General topics and documents

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2113009**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113009.zip) | TP for TR 38.837 on Annex part for Transparent Tx Diversity | vivo, Qualcomm, Huawei | This paper provides the text proposals for Annex part of the TR based on the TR skeleton, which including all the key related agreements up till now. |
| [**R4-2113010**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113010.zip) | TP for TR 38.837 on Requirements part for Transparent Tx Diversity | vivo, Qualcomm, Huawei | This paper provides the text proposals for performance part of the TR based on the TR skeleton. The contents are aligned with Annex part, but not all the sections have been completed. |
| [**R4-2114358**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114358.zip) | TR 38.837 skeleton for Transparent Tx Diversity | vivo, Qualcomm, Huawei | Skeleton |
| [**R4-2114552**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114552.zip) | TxD work plan | Qualcomm Incorporated | Work plan according to TUs |
| [**R4-2114554**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114554.zip) | TxD WID revision | Qualcomm Incorporated | WID adds information and corrects mostly details. No change in objectives or justification |
| [**R4-2114511**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114511.zip) | CR for TS 38.101-1 Tx diversity requirements | Huawei, HiSilicon, vivo, OPPO, CMCC, Qualcomm | CR 38.101-1 Rel-17: includes basics + SRS antenna switch |
| [**R4-2114510**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114510.zip) | On remaining TxD requirements | Huawei, HiSilicon | ***Proposal 1: Except for high modulation schemes, it is proposed to adopt the delta MPR value close to the lower bound for the ranges. No delta value is needed for inner RB allocation for QPSK/16QAM.***  ***Proposal 2: It is proposed that same set of A-MPR requirements for the same power class are applied for both UL MIMO and TxD***  ***Proposal 3: It is proposed that A-MPR requirements for bands supporting PC3 UL MIMO are also applicable for PC3 TxD***  ***Proposal 4: It is proposed that if new A-MPR requirements are identified for bands supporting UL MIMO/TxD, the corresponding study should be carried in the existing Rel-17 WI NR bands for UL-MIMO***  ***Proposal 5: PC1.5 should be considered together with TxD implementation for SRS antenna switching.***  ***Proposal 6: For UE indicates TxD capability, delta SRS is applicable for all antenna connectors at least for 1T2R, 1T4R and 1T4R/2T4R.***  ***Observation 1: The description of single port transmission in the spec include cases for both Rel-15 and Rel-16, i.e. the case UE supporting UL MIMO but not ULFPTs is also included.***  ***Observation 2: ULFPTx Mode 1 and Mode 2 could utilize TxD to reach the full power transmission.***  ***Proposal 7: It is proposed to redirect the applicable requirements for single antenna-port PUSCH transmission for some cases in UL MIMO clause to TxD specific clause, which include UE supporting UL MIMO but not ULFPTx and ULFPTx Mode 1 and Mode 2.***  ***Proposal 8: It is proposed to continue the Rel-16 TxD capability signalling design in RAN2, and reply to RAN2 with the clarification agreement in RAN4#99e that the capability signalling applies for all Power Classes for both Rel-15 and Rel-16.*** |
| [**R4-2114003**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114003.zip) | Discussion on requirements for Tx Diversity | Orange Spain | **Proposal 1: Agree on representative channel model(s) capturing the most problematic cases for TxDIV, e.g., high antenna correlation, low RMS delay spread.**  **Proposal 2: In order to ensure the correct implementation of Tx Diversity, its BLER performance needs to be at least as good as the performance of a single Tx with a full-power rated PA for a given channel model and allocation bandwidth of PRB.**  **Proposal 3: In order to ensure that gNodeB can synthetize the virtual SRS antenna port of TxD, the effective SINR of this virtual port should be the same as the one experienced by the following PUSCH transmission whatever its allocated bandwidth (greater than a minimum bandwidth to be defined).** |

## Open issues summary

Comment to the TPs below please. Huawei [**R4-2114510**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114510.zip)proposals are discussed in the corresponding sections

### Sub-topic 1-1 Orange [**R4-2114003**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114003.zip) propsals

**Issue 1-1:** Are there any actionable requirement changes for UE or BS requirements based on proposals?

* Proposals
  + Option 1: Yes for UE, please comment what
  + Option 2: Yes for BS, please comment what
  + Option 3: Neither, proposals are for studies only
* Recommended WF
  + TBA

**Issue 1-2: Should RAN4 investigate advanced (dual) receivers for UE conformance testing?**

* Proposals
  + Option 1: Yes
  + Option 2: No
  + Option 3: Other comments
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Orange | We have submitted contribution R4-2114003 to highlight the TxD performance issue to the RAN4 group. We know there is a tendency to reduce the number of RAN4 performance requirement tests since RAN4 is overloaded. However, in the case of TxD, we think operators should pursue the support of proper UE TxD conformance test implementation in RAN4. Indeed, bad TxD implementation can impact severely the coverage of the network (see R4-2109974). It is complicated since TxD performance depends on many parameters: the antenna correlation, bandwidth, channel model, Modulation and Coding Scheme considered. We need to sample some representative and problematic cases. The idea is to ensure that TxD performance behaves similarly to single Tx with full power rated Power Amplifier (PA). For example, the required TxD SNR to reach 10% BLER should be within a margin to the one required for single Tx with full power rated PA. Note that it is not a gNB receiver problem. A simple one tap receiver would be enough as a reference receiver (LMMSE, ZF). Note that the envisioned TxD conformance tests are similar to BS demodulation tests. As a result, an appropriate simple test-system reference receiver should be adopted.  So, we think there is a misunderstanding in the moderator summary and we propose to rephrase issue 1-2 as follows:  *Should RAN4 investigate TxD BLER performance requirements conditional on well chosen RAN4 channel model(s), PUSCH bandwidth(s), PUSCH Modulation and Coding Scheme(s) and based on a simple test-system reference receiver ?*  *Note: the benchmark is single Tx full power rated BLER performance, i.e., TxD should perform similarly.* |
| OPPO | **Issue 1-1:** Are there any actionable requirement changes for UE or BS requirements based on proposals?  Option 3: Neither, proposals are for studies only  **Issue 1-2: Should RAN4 investigate advanced (dual) receivers for UE conformance testing?**  Option 2: No |
| Skyworks | **Issue 1-1: One aspect that we may need to tackle on the UE side is whether there is a need to verify that some mechanism (like SD-CDD) is actually applied by the UE since the currently agreed test by connector does not check this. This should not be a fixed requirement: may be a simple delay range checked for a particular waveform.**  **Issue 2-2: This could be a way to address issue 1-1 input above but unclear how a dual receiver is enough to qualify if TxD results in power received at BS (>2 Rx) is effectively PC2.** |
| Rohde & Schwarz | In current test equipment for UE conformance, it is not foreseen to do some elaborate UL throughput testing.  E.g. for DL doing throughput tests with fading and a fixed SNR is possible since the TE controls all the parameters and the UE is tested. When trying to do the same thing on the uplink the UE will send the signal, but the TE is having a clean channel to optimally receive the signal from the UE and perform measurements on this signal. Tests like the ones proposed by Orange would rather test the TE receiver implementation than the UE performance.  In our understanding the BLER performance of the UE could be tested via the EVM test, since a bad EVM of the device would correspond to the gNodeB not properly receiving the UL. Currently we the EVM for TxD is weighted over both connectors, so it gives some idea on how the diversity of the device works. We had in previous meetings already proposed to use some form of dual receiver (R4-2107112), which could help. |
| Huawei, HiSilicon | We understand the concern from operator, but it’s difficult to have verification for conductive based test. Also SD-CDD is transparent implementation, the main purpose is to fulfil the full power transmission, in some cases, TxD is the only choice, e.g. PC1.5. So we share similar view as OPPO. |
| Samsung | Issue 1-1: Are there any actionable requirement changes for UE or BS requirements based on proposals?  For UE side requirement: During the TxD discussion before R17 TxD WI was set up, there is already agreement for not introducing requirement to guarantee “correct” CDD behaviour, which is because the “correct” CDD parameters (at least including the time delay length) should be dependent on channel based on UE-implementation manner and the criteria for a “correct” CDD behaviour is hard to be tested.  For gNB side requirement: I assume proposal’s intention is not to introduce additional BS requirement to guarantee RX baseband competence.  Issue 1-2: Should RAN4 investigate advanced (dual) receivers for UE conformance testing?  No. |
| vivo | **Issue 1-1:** Option 3 Neither.  **Issue 1-2:** Option 2  It is understandable that there is a concern on more reliable performance, but this is really not that suitable for conformance tests. |
| ZTE | **Issue 1-1:**  Option 3. A this stage, we are not sure if RAN4 can afford time or efforts to investigate and specify part or whole sets of performance requirements for NR TxD.  **Issue 1-2:**  Option 2. This is not RAN4’s job. |
| Ericsson | **Issue 1-1: Are there any actionable requirement changes for UE or BS requirements based on proposals?**  Not for Option 2, this work item does not concern BS requirements or performance.  From a network perspective there is no virtue of the TxD indication other than that the gNB is made aware that the actual power capability as seen at the gNB receiver may not be as advertised by the UE. In view of this, additional requirement using the EVM test as discussed by R&S could be considered.  We note that the PC1.5 would also have to indicate TxD or a full-power mode without full-power PA capability with possible degradations for single-port transmissions.  Having said this, Ericsson accepts introducing the TxD indication in Rel-17 despite the potential performance degradations.  **Issue 1-2: Should RAN4 investigate advanced (dual) receivers for UE conformance testing?**  Option 3: consider the proposal by R&S of BLER verification using the EVM test. |

### 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** |
| [**R4-2113009**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113009.zip)  TR Annex | Company A |
| Company B |
|  |
| [[**R4-2113010**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113010.zip)](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113009.zip)  TR requirements | skyworks: in RF assumptions the PA calibration point is an important aspect and for PC2 using two PC3(23dBm) Pas, the Pas should be calibrated for 30dB ACLR. For PC3 with two 20dBm Pas since there is no available reference for 20dBm Pas other than for NRU but at 25dB ACLR, the suggestion to re-use PC3 1Tx can be the calibration point for a 20dBm PA which would meet 30dB ACLR + SEM(+3dB) + some margin for RIMD. May be something to capture.  In ACLR section it may be worth mentioning that Power class related ACLR should be met: 31dB for PC2/PC1.5, 30dB for PC3. |
| vivo:  To skyworks: The RF assumptions for PA calibration point mentioned can be added as a Text proposal in the respective section, and it is welcome to do for companies. The basic contents were already included in the Annex part as part of the agreements in A.1.8. |
|  |
| [**R4-2114358**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114358.zip)  TR skeleton |  |
| [**R4-2114511**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114511.zip)  Rolling CR | Skyworks: moving 2Tx to TxD section is OK but needs to make sure that UL MIMO section properly points at this section. As of now there is no agreement on the MPR values other than PC1.5 but that is rediscussed. The values are subject to further agreement and CR cannot be agreed as is. |
| Samsung: (1) we assume MPR value needs to be aligned with discussion results from other sub-topic, rather than directly reuse 1TX MPR table. (2) The correction for SRS related part is not correct. In original spec, “1T2R”, “1T4R”, “1T4R/2T4R”, “2T4R” are corresponding to R15 capability, and removing R15 capability but replacing by R16 capability is not correct. In our draft CR in R15 TEI agenda (R4-2113180), we give the solution to R15 related issues, but need FFS for R16 SRS-antenna switching capability. (3) IE [txDiversity-r16] should be r17. (4) typo: missing space after “Table 6.2.1-1” in clause 6.2G.1 |
| Ericsson: return to. We assume that this version of the rolling CR will be revised in accordance with agreements made at this meeting (e.g. the SRS antenna switching). |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #1-1** | *Tentative agreements: No actionable requirement changes seems to be majority view but based on issue 1-2 respoinces, maybe RAN4 can investigate UE Tx EVM requirement to cover the concerns.*  *Candidate options:*   1. *Study further TxD UE in networks* 2. *Study EVM requirements*   *Recommendations for 2nd round: Continue discussion and gather comments on how the concerns can be accommodated in UE requrements* |

### 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.*

|  |  |
| --- | --- |
| **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)

# Topic #2: Phase I open RF requriements

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2114545**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114545.zip) | PC2 TxD MPR evaluation and SD-CDD waveform choice | Skyworks Solutions Inc. | **Observation: a SD-CDD delay of 600ns is used for 15 kHz SCS measurements**  **Observations:**   * **There are two inner case (orange highlight) where the limit changes from relative (ACLR) for PC3 to absolute (SEM) for 1TX PC2 and 2Tx PC2** * **There are inner cases (yellow highlight) where 1Tx PC3 and PC2 had margins for emissions but 2Tx PC2 needs MPR due to 3dB higher PSD, 1dB higher ACLR and addition of RIMD** * **Our measurements of edge cases (bold) do not show the need for large MPR as the edge allocation higher MPR was needed to account for a specific WOLA implementation with less aggressive filtering. Nevertheless for the small 5MHz guard band, the effect is 1:1 as it is not related to PA non-linearity and thus do not see RIMD impact.** * **For ACLR cases, 2Tx PC2 has to compensate for 1dB higher ACLR and the additional RIMD contribution** * **For SEM cases, the needed 2Tx PC2 backoff has to account for 3dB higher PSD vs 1Tx PC3 but also has to compensate for the 1dB lower linearity versus 1Tx PC2** * **RIMD impact is seen and varies with the slope of the SEM/ACLR and waveform PAPR. It is expected that this difference is higher for ET due to higher RIMD impact.** * **When comparing required back off with 1Tx PC2, 2Tx PC2 based on two PC3 Pas we observe that:**   + **The cases where the limit changes from relative (ACLR) to absolute (SEM) see the higher back-off increase (>1dB)**   + **Otherwise the additional back off is less than 1dB and in most inner cases emissions are not limiting and the cases that become emission limited need very little back off.** * **Note that inner allocation have not been retested for EVM but RIMD is not expected to have a large impact for QPSK**   **Proposal 1 on outer allocations for 2xPC3Tx PC2 MPR: 1Tx PC2 edge MPR can be reused for 2Tx PC2.**  **Proposal 2 on QPSK outer allocations: 1dB additional MPR is added for outer compared to 1Tx PC2.**  **Proposal 3 on QPSK inner allocations: 2Tx PC2 based on two PC3 Pas should have the following MPR**   * **0.5dB for DFT-s-OFDM QPSK inner (vs 0 for 1Tx PC2) due to SEM issue.** * **For CP-OFDM, the 1.5dB MPR seem sufficient to absorb the SEM issue**   **Proposal 4 on higher order modulation: The need for a small additional 2Tx PC2 back-off for inner and outer 256 QAM and 64QAM should be reassessed accounting for only RIMD contribution.**  **Proposal 5 on UL MIMO MPR: TxD MPR can be reused for UL MIMO using the same PA configuration and single port transmissions are supported via TxD.** |
| [**R4-2113891**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113891.zip) | R17 Discussion on UL MIMO fallback to TxD | OPPO | ***Proposal 1: It is proposed to clarify in the spec that for UE supporting TxD and UL MIMO, when it is scheduled for single antenna port transmission the UE only needs to meet the TxD requirements and exempt from the 1Tx basic requirements.***  38.101-1  If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.1 apply to UE without indicating IE [*Txdiversity-r16*] as defined in TS 38.331 [7], and requirements in clause [6.2G.1] apply to UE indicating IE [*Txdiversity-r16*]. |

## Open issues summary

### Sub-topic 2-1 MPR

Sub-topic description: MPR for Tx diversity PC2

Relevant proposals:

[**R4-2114510**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114510.zip)

**Proposal 1: Except for high modulation schemes, it is proposed to adopt the delta MPR value close to the lower bound for the ranges. No delta value is needed for inner RB allocation for QPSK/16QAM*.***

[**R4-2114545**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114545.zip)

**Proposal 1 on outer allocations for 2xPC3Tx PC2 MPR: 1Tx PC2 edge MPR can be reused for 2Tx PC2.**

**Proposal 2 on QPSK outer allocations: 1dB additional MPR is added for outer compared to 1Tx PC2.**

**Proposal 3 on QPSK inner allocations: 2Tx PC2 based on two PC3 Pas should have the following MPR**

* **0.5dB for DFT-s-OFDM QPSK inner (vs 0 for 1Tx PC2) due to SEM issue.**
* **For CP-OFDM, the 1.5dB MPR seem sufficient to absorb the SEM issue**

**Proposal 4 on higher order modulation: The need for a small additional 2Tx PC2 back-off for inner and outer 256 QAM and 64QAM should be reassessed accounting for only RIMD contribution.**

Companies to indicate where changes are necessary. Intent is to down scope which MPR will be changed. 2nd round we intent o agree values

**Issue 2-1: Which MPRs to be changed**

* Proposals for changes for MPR
  + Option 1: Edge MPR
  + Option 2: Inner
  + Option 3: Outer
  + Option 4: Higher MCS (EVM driven)
* Recommended WF
  + TBA

### Companies comments for Sub topic 2-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Skyworks | As shown in our measurements:  It is not true that inner are not affected by RIMD as some inner allocation become SEM limited when PC2 power is involved. Unless one looks at these corner cases there is no way to reveal the RIMD and added 3dB power impact. 0.5dB MPR is needed for DFT QPSK. In some cases ACLR (relative) is the limitation but 0.5dB MPR is needed to compensate from 30dB PC3 to 31dB PC2.  For EDGE allocations, The MPR is related to the waveform filtering and is thus not impacted by RIMD and can be reused from 1Tx PC2. Our proposal 1 is for edge allocation not outer (typo) but is within the edge allocation chapter so hopefully this was understood by companies.  For outer: because both the 1dB higher ACLR and RIMD needs to be covered, 1dB additional MPR vs 1Tx PC2 is needed for both CP and DFT QPSK.  For Higher MCS at least 256QAM which is already with a tight budget for the PA, additional MPR vs 1Tx need to be enabled to compensate for RIMD. |
| Huawei, HiSilicon | Thanks Skyworks for the comprehensive measurement results. The measurement is based on the agreed assumptions, and the explanation for the results are reasonable in our view. The proposed values by Skyworks are acceptable to us. |
| LGE | Issue 2-1(Which MPRs to be changed): we think that RAN4 needs additional data from other interested companies to complete MPR requirements for all edge/outer/inner regions. LGE can provide the updating MPR values of all edge/outer/inner regions for PC2 TxD in the next meeting. |
| vivo | We support Skyworks’ proposal for MPR. It is quite close to the tentative proposals in last meeting. |
| Ericsson | Given that the tolerance for PC2 is +2/-3 (one dB larger lower tolerance than PC3), is it needed to accommodate differences of about 1 dB between 1TX and 2TX for PC2?  We remark that the MPR for 2TX is on top of degradation as seen in the gNB receiver due to correlated transmissions with TxD. Differences between 1TX and 2TX should be as small as possible. |

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

Sub-topic description: A-MPR for TxD

Companies are encouraged to comment if and how UL MIMO A-MPR should be handled. One possibility is to do bands one by one but how to manage which bands have been studies and which not. Where a list is maintained?

Relevant proposals

[**R4-2114510**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114510.zip)

**Proposal 4: It is proposed that if new A-MPR requirements are identified for bands supporting UL MIMO/TxD, the corresponding study should be carried in the existing Rel-17 WI NR bands for UL-MIMO**

**Issue 2-2: UL MIMO A-MPR for UE’s with Tx diversity**

* Proposals
  + Option 1: Study band specific A-MPR requirements in the TxD WI
  + Option 2: Study band specific A-MPR requirements in the UL MIMO bands WI
* Recommended WF
  + TBA

### Companies comments for Sub topic 2-2

Sub topic 2-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Option 1: At this stage, TxD WI since UL MIMO bands WI is specific to PC3. |
| OPPO | Option 2. The related bands might be large, if not be able to complete in TxD Rel-17 time frame, then UL MIMO bands WI might be good to give more time. |
| Skyworks | Once MPR is agreed, we can tackle A-MPR in this WI, depending if PC3 2Tx MPR is same than 1TX, no work is needed. Then for PC2 only small A-MPR case should be a concern for RIMD as for large MPR RIMD contribution is small and can probably be absorbed. Some delta MPR for MPR<XXdB approach could be used. |
| Huawei, HiSilicon | Option 2. Just to clarify that the scope UL MIMO bands WI has been extended to PC2 and PC1.5 in previous RAN meeting. |
| LGE | Prefer option2. A-MPR for PC2 UL-MIMO is a different value according to the operating NR band. So, it can be treated in UL-MIMO band WI. |
| vivo | Prefer option2. This WI is better to focus on more general requirements rather than too much band specific values. |

### Sub-topic 2-3 UL MIMO MPR and A-MPR

Sub-topic description: Relation of UL MIMO to Tx Diversity MPR

Relevant proposals

**[R4-2113177](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113177.zip)**

**Proposal 2: After MPR table for 2TX is introduced in Rel-17 transparent TxD requirement for per-UE emission requirement, the same MPR requirement should be applied to ULFPTx UE which relies on transparent TxD to achieve full power, i.e., ULFPTx Mode 1 UE and Mode-2 UE with Mechanism-1 (SRS port virtualization).**

[**R4-2114545**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114545.zip)

**Proposal 5 on UL MIMO MPR: TxD MPR can be reused for UL MIMO using the same PA configuration and single port transmissions are supported via TxD.**

**[R4-2114553](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114553.zip)**

**Proposal 1: MPR for Tx diversity UE should be applied for UL MIMO when UE declares it needs Tx diversity to fulfil maximum power requirements.**

**[R4-2114510](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114510.zip)**

**Proposal 2: It is proposed that same set of A-MPR requirements for the same power class are applied for both UL MIMO and TxD**

**Proposal 3: It is proposed that A-MPR requirements for bands supporting PC3 UL MIMO are also applicable for PC3 TxD**

**Issue 2-3-1: TxD MPR is applicable for UL MIMO**

* Proposals
  + Option 1: When UE declares txd (R4-2114545, R4-2114553, R4-2113177)
  + Option 2: For all UL MIMO implementations (R4-2114510)
  + Option 3: Other?
* Recommended WF
  + TBA

**Issue 2-3-2: MPR applicability for 2-layer UL MIMO and ULFPTx**

* Proposals
  + Option 1: Same MPR applies for 2-layer and ULFPTx
  + Option 2: Different MPR can apply between 2-layer and ULFPTx
* Recommended WF
  + TBA

### Companies comments for Sub topic 2-3

Issue 2-3-1 **TxD MPR is applicable for UL MIMO**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Option 1. Need to understand what all UL MIMO implementation means in terms of specifications. |
| OPPO | Option 3. The specification of UL MIMO and TxD both need to be defined, and it should be that TxD MPR requirement is applicable to UL MIMO specification. This is not relevant to UE implementation or capability. Therefore, the meaning of Option 1 and 2 are not clear. |
| Skyworks | In our evaluation we always used SD-CDD with 1-layer and 2-layer UL MIMO waveforms and we believe that a single MPR table targeting all 3 modes should be the target as we have not seen major differences. It may still be useful to discriminate the case where TxD is signaled vs not as at least the 1 layer cases where only one antenna is used could refer to the 1Tx MPR if TxD is not signaled. |
| Huawei, HiSilicon | The options for issue 2-3-1 are not very clear. We tend to agree with OPPO, MPR requirements for TxD and UL MIMO both should be defined in the spec. If the requirements are the same for TxD and UL MIMO, no matter whether UE declares TxD or not, the requirements what we are discussing are also applicable for UL MIMO. |
| LGE | Option 1. Generally, TxD PC2 MPR will be reused PC2 UL-MIMO when the UE declares TxD. |
| Samsung | I think we already have agreement for the same MPR reqruiement should be followed for both UL MIMO and TxD. |
| vivo | The question is not that clear, since we already had previous agreement in R4-2016830:   * *MPR for Transparent and UL MIMO*    + *Whether 2 Tx MPR should be the same MPR requirement for TX Diversity and UL MIMO for the same power class.*   + *Agreement*     - *Option 1: Yes* |
| Ericsson | Option 3: would there not be a 2TX MPR that applies for all relevant transmissions with two TX connectors? |
| T-Mobile USA | Option 1. The TxD MPR should only apply for UEs that declare TxD for a given power class. If the UE does not need TxD for the power class, then the MPR for the power class should apply for UL MIMO as it has been. As Skyworks said in R4-2114545, “Proposal 5 on UL MIMO MPR: TxD MPR can be reused for UL MIMO using the same PA configuration and single port transmissions are supported via TxD.” What this means is that MPR for 2x23 dBm = PC2 should be re-used for 2x23 dBm = PC2 UL MIMO, but not 2x26 = PC2 UL MIMO. Applying the 2x23 dBm = PC2 TxD MSD to 2x26 dBm = PC2 UL MIMO would be a relaxation of the requirements. |

Issue 2-3-2 **MPR applicability for 2-layer UL MIMO and ULFPTx**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Option 1 if PA configurations are same. |
| Skyworks | Option 1 if PA configurations are the same and as discussed above if ULFPTx is signaled without TxD then a PC2 PA is available which is a different configuration. |
| Huawei, HiSilicon | Option 1. Whether to support TxD or ULFPTx are UE implementation capability. It is not necessary to combine the applicable requirements together with supporting both two capabilities. |
| LGE | Option 1 is reasonable if PA configurations are the same |
| Samsung | Option 1. |
| vivo | Option 1. |
| Ericsson | Option 1 |
| T-Mobile USA | Option 1 if the PA configurations are the same We agree with Skyworks that if ULFPTx is signaled without TxD then a PC2 PA is available which is a different configuration. |

### Sub-topic 2-4 UL MIMO with Tx diversity

Sub-topic description: What requirements apply for fall back DCI UE that implements UL MIMO. Change is proposed to refer to “G” suffix.

Relevant proposals [**R4-2113891**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113891.zip)

***Proposal 1: It is proposed to clarify in the spec that for UE supporting TxD and UL MIMO, when it is scheduled for single antenna port transmission the UE only needs to meet the TxD requirements and exempt from the 1Tx basic requirements.***

38.101-1 change

If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.1 apply to UE without indicating IE [*Txdiversity-r16*] as defined in TS 38.331 [7], and requirements in clause [6.2G.1] apply to UE indicating IE [*Txdiversity-r16*].

**Issue 2-4: Fall back reference to D suffix**

* Proposals
  + Option 1: Change as in [**R4-2113891**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113891.zip) Included in to big CR
  + Option 2: Other handling
* Recommended WF
  + TBA

### Companies comments for Sub topic 2-4

Sub topic 2-4

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Agree with Option 1. |
| Huawei, HiSilicon | Agree with Option 1. |
| LGE | Support Option 1 |
| Samsung | The proposed Option 1 is not based on latest R16 or R17 spec:  In our paper, we have the following proposal, which is contained in Phase II ULFPTx paper (R4-2113177), and we suggest to use the following wording:   |  | | --- | | If UE not supporting Tx diversity [xx, TS38.306] is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.1 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. If UE supporting Tx diversity [xx, TS 38.306] is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause [6.2G.1] apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. |   Why we discuss similar issue here and also in Sub topic 3-2? |
| vivo | It is proposed to use the discussion outcome for Sub-topic 3-2 ULFPTx, and apply the same description here for Rel-15.  We had agreement in RAN4#99e, “*Confirm ue-PowerClass should always be supported for 1-port transmission fall back mode for SA in Rel-15*”. We had a CR in R4-2113012 which should also be included as baseline. |
| ZTE | Ok with Option 1. |
| Ericsson | Option 2: we prefer a formulation with the TxD requirement listed as an allowed exception:  If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.1 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling with the following exception: for UEs indicating *txDiversity-*r16, the requirements in clause [6.2.1G] for the power class indicated by the *ue-PowerClass.* |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#2-1** | *Tentative agreements: Some non-zero MPR seems acceptable*  *Candidate options:*  *Recommendations for 2nd round:*   1. *Detailed proposal to be put together.*   What to do with higher modulation order MPR? One possibility is to take proposals from last meeting |
| **2-2** | *Tentative agreements: UL MIMO AMPR needs to be studied for TxD UE. Ran4 can study first in this Wi and then what is not finished, in UL MIMO bands WI.*  *Candidate options:*   1. *List of high priority bands to be put to in to TxD WID* 2. *All bands are gathered in the UL MIMO WID*   *Recommendations for 2nd round: Option 2 seems more favorable.* |
| **2-3** | *Issue 2-3-1: It seems there are few comments saying issue is not understood. Intention is to agree if TxD MPR applies for all UL MIMO implementations, including the rel-15 one which has 26 dBm PA, or only for UL MIMO for UE that implements/declares TxD.*  *Recommendations for 2nd round: Re word the issue if no consensus.*  *Issue 2-3-2: Tentative agreements: 1 and 2-layer UL MIMO share the MPR.*  *Recommendations for 2nd round: Agree wording for CR.* |
| **2-4** | *Seems the same issues is discussed in 3-2 so merging views here.*  *The change to D suffix seems agreeable but two open items:*   1. *Release,* **[R4-2113891](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113891.zip)** *seems to propose Rel-15 change and* R4-2113177 *proposes* Rel-17 2. *The detailed wording needs to be resolved between*   If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.1 apply to UE without indicating IE [*Txdiversity-r16*] as defined in TS 38.331 [7], and requirements in clause [6.2G.1] apply to UE indicating IE [*Txdiversity-r16*].  *And*  If UE not supporting Tx diversity [xx, TS38.306] is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.1 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. If UE supporting Tx diversity [xx, TS 38.306] is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause [6.2G.1] apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. |
|  |  |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

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

# Topic #3: Phase II SRS and ULFPTx

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2111904**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2111904.zip) | On enabling ULFPTx Ues to employ transparent TxD | Qualcomm Incorporated | **Observation 1: Sub-clauses 6.xD must ensure that any new tTxD requirement framework should also apply to mode 1 ULFPTx.**  **Proposal: For Ues that support both ULFPTx and tTxD, subclauses 6.xD shall include a redirection to the set of requirements designed specifically for Ues that support transparent TxD**  If UE does not support Tx diversity [xx, TS 38.306] and is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.1 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. If a UE supports Tx diversity and  is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2[G].x apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. |
| [**R4-2113894**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113894.zip) | R17 TxD and ULFPTx | OPPO | ***Observation 1: TxD and ULFPTx are two separate features in applicablility.***  ***Observation 2: UE is allowed to support TxD and ULFPTx simultaneously when configured with single SRS antenna port or multi SRS antenna ports.***  ***Observation 3: TxD and ULFPTx can be tested with corresponding requirements therefore function can be guaranteed.***  ***Observation 4: Mapping of TxD and ULFPTx is up to UE implementation as long as requirements are met.***  ***Observation 5: It is not necessary for NW to exactly know how the ULFPTx is achieved, e.g. with or without TxD.***  ***Proposal 1: It is proposed to confirm that there is no dependency between TxD and ULFPTx and no ULFPTx spec need to be changed due to the introduction of TxD.*** |
| [**R4-2112828**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112828.zip) | ULFPTx and the TxD capability | Ericsson | **Proposal 1: RAN4 is to confirm which multi-antenna features have UE behavior and performance that is unaffected by TxD capability.**  **Proposal 2: Clarify in the RAN2 specification that the *ul-FullPowerTransmission* capability is not conditioned on indication of *txDiversity-16* for any full-power mode.**  **Proposal 3: for single-antenna fallback for full-power modes the following exception for full-power modes: “For Ues supporting ULFPTx Mode-1 or ULFPTx Mode-2 without full-power TPMI, the requirement in clause [6.2.1 for TxD] for the power class as indicated by the ue-PowerClass when the UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 and ul-FullPowerTransmission is provided.”** |
| [**R4-2113177**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113177.zip) | Discussion on Transparent TxD – Uplink Full Power Tx (ULFPTx) related | Samsung | ***Observation-1: Rel-16 ULFPTx feature can be categorized into Mode-0 (“fullpower” mode), Mode-1 and Mode-2, and in Mode-2 there are two mechanisms, i.e., Mechanism-1 for SRS port virtualization and Mechanism-2 for TPMI indication.***  ***Observation-2: After TxD UE is introduced in Rel-17, MOP requirement of Rel-16 ULFPTx Mode-1 UE needs no revisit.***  ***Observation-3: After TxD UE is introduced in Rel-17, MOP requirement of Rel-16 ULFPTx Mode-2 UE needs no revisit.***  ***Observation-3: After TxD UE is introduced in Rel-17, MOP requirement of Rel-16 ULFPTx Mode-0 UE needs no revisit.***  ***Observation 4: For ULFPTx Mode 1 UE and Mode-2 UE with Mechanism-1 (SRS port virtualization), if fallback DCI is scheduled, the MOP requirement needs to be redirected to suffix [G] to enable transparent TxD usage. But the same redirect is not only for ULPFTx but also for Rel-15 UL-MIMO UE which rely on transparent TxD.***  ***Proposal 1: The text proposal below is adopted for MOP requirement if fallback DCI is scheduled, after Rel-17 transparent TxD requirement is introduced:***   |  | | --- | | If UE not supporting Tx diversity [xx, TS38.306] is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.1 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. If UE supporting Tx diversity [xx, TS 38.306] is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause [6.2G.1] apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. |   ***Observation 5: For ULFPTx MPR requirement, it follows the same MPR requirement for 1TX and Rel-15 UL-MIMO because “per antenna connector”-based method is used when ULFPTx is introduced.***  **Proposal 2: After MPR table for 2TX is introduced in Rel-17 transparent TxD requirement for per-UE emission requirement, the same MPR requirement should be applied to ULFPTx UE which relies on transparent TxD to achieve full power, i.e., ULFPTx Mode 1 UE and Mode-2 UE with Mechanism-1 (SRS port virtualization).** |
| [**R4-2112827**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112827.zip) | SRS antenna switching with antenna virtualization | Ericsson | **Proposal 1: the ∆TRxSRS is a maximum allowance due to additional routing loss for RX antennas, the same value for all power classes (but can be band dependent)**  **Proposal 2: for Ues indicating *txDiversity-r16* (TxD) and ULFPTx except for Mode 0 and Mode 2 supporting full-power TPMI, ΔPPowerClass = 3 dB for single-port SRS transmissions with usage set to ‘antennaSwitching’**  **Observation 1: Non-codebook based Ues require full power Pas per Tx chain for power efficient operation, which is incompatible with the half power assumption driving the transparent TxD design.**  **Proposal 3: new values of ∆TRxSRS are not defined for non-codebook Ues, the same value for all power classes** |
| [**R4-2113178**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113178.zip) | Discussion on Transparent TxD – SRS antenna switching related | Samsung | * **Proposal 1: For 1T2R SRS antenna switching, UE capable of PC2 (with ΔPPowerClass = 0 dB) and tranparent TxD:**    + **needs to be allowed for 3dB on both 1st and 2nd ports due to non-full-rated Pas;**   + **whether or not still to take insertion loss (4.5dB for n79 and 3 dB for bands whose FUL\_high is lower than the FUL\_low of n79) on the 2nd port into account needs FFS.** * **Proposal 2: For 1T4R SRS antenna switching, UE capable of PC2 (with ΔPPowerClass = 0 dB) and tranparent TxD:**    + **needs to be allowed for 3dB on both 1st and 2nd port due to non-full-rated Pas;**   + **whether or not still to take insertion loss (4.5dB for n79 and 3 dB for bands whose FUL\_high is lower than the FUL\_low of n79) on the 2nd port into account needs FFS.**   + **no change on 3rd and 4th antenna port, i.e., The value of ∆TRxSRS is 7.5dB for n79 and 6 dB for bands whose FUL\_high is lower than the FUL\_low of n79).** * **Proposal 3: For 2T4R SRS antenna switching, UE capable of PC2 (with ΔPPowerClass = 0 dB) and tranparent TxD:**    + **needs to be allowed for 3dB on both 1st and 2nd port due to non-full-rated Pas;**   + **No insertion loss is needed for 1st and 2nd ports;**   + **No change on 3rd and 4th antenna port, i.e., The value of ∆TRxSRS is 7.5dB for n79 and 6 dB for bands whose FUL\_high is lower than the FUL\_low of n79).** |
| [**R4-2113306**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113306.zip) | Discussion on Tx diversity SRS antenna switching | Xiaomi | **Observation 1: ∆TRxSRS for the UE architecture 26dBm+23 dBm is already covered in the existing spec.**  **Proposal 1: it is proposed above change is adopted for ∆TRxSRS when UE supporting TxD is also considered.**  ∆TRxSRS is applied when  a) UE transmits SRS to other than first SRS port when the *SRS-TxSwitch* capability is indicated as ‘1T2R’, ‘1T4R’ or, ‘1T4R/2T4R’  b) UE transmits SRS to other than first or second SRS port when the *SRS-TxSwitch* capabilityis indicated as ‘2T4R’ or ‘1T4R/2T4R’, or  c) UE transmits SRS to a DL-only carrier  The value of ∆TRxSRS is 4.5dB for n79 and 3 dB for bands whose FUL\_high is lower than the FUL\_low of n79 when the device is capable of power class 3 in the band. The value of ∆TRxSRS is 7.5dB for n79 and 6 dB for bands whose FUL\_high is lower than the FUL\_low of n79 when the device is capable of power class 2 and power class 1.5 in the band.  For other SRS transmissions ∆TRxSRS is 3dB for UE supporting TxD, otherwise ∆TRxSRS is zero; |
| [**R4-2113892**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113892.zip) | R17 SRS IL for TxD | OPPO | ***Observation 1: It was agreed only one PA can be applied in the SRS switch transmission, and no antenna virtualization in the SRS antenna switch transmission.***  ***Observation 2: For PC3+PC3 UE when it is configured with 1T4R SRS switch, all antennas include the first antenna have 3dB lower power than the power class.***  ***Observation 3: For PC3+PC3 UE when it is configured with 2T4R SRS switch, only additional PCB IL needs to be defined when it is switched to SRS other than the 1st and 2nd SRS port.***  ***Observation 4: 1T2R SRS switch IL is same as 1T4R.***  ***Observation 5: Current spec already cover PC2+PC3 and PC2+PC2 cases for UE without TxD.***  ***Observation 6: New srs-TxSwitch capability including fallback modes has been introduced since Rel-16, and RAN4 spec needs to be updated according to 38.331.***  ***Proposal 1: It is proposed to define SRS IL as below:***   * **When the *SRS-TxSwitch* capability is indicated as 1T4R or 1T2R, the additional power back off for Ant 0 is 3dB, and for Ant ½/3 is 6 dB (bands below n79) and 7.5dB (n79);** * **When the *SRS-TxSwitch* capability is indicated as 2T4R, the additional power back off for antennas other than 1st and 2nd antenna is 3 dB (bands below n79) and 4.5dB (n79).** |
| [**R4-2113893**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113893.zip) | Draft Rel-15 CR for introduction of TxD SRS IL | OPPO | CR: 38.101-1 Rel-15  ∆TRxSRS is applied when  a) UE transmits SRS to other than first SRS port when the *SRS-TxSwitch* capability is indicated as ‘t1r2’ or ‘t1r4’ or ‘t1r4-t2r4’’‘’‘’  b) UE transmits SRS to other than first or second SRS port when the *SRS-TxSwitch* capabilityis indicated as‘t2r4’ or ‘t1r4-t2r4’’‘’  c) UE transmits SRS to a DL-only carrier.  d) UE supporting TxD (*capability IE*)  The value of ∆TRxSRS is 4.5dB for n79 and 3 dB for bands whose FUL\_high is lower than the FUL\_low of n79 when the device is capable of power class 3 in the band. The value of ∆TRxSRS is 7.5dB for n79 and 6 dB for bands whose FUL\_high is lower than the FUL\_low of n79 when the device is capable of power class 2 in the band without TxD (*capability IE*).  When the device is capable of TxD (*capability IE*), and   * when the *SRS-TxSwitch* capability is indicated as ‘t1r2’ or ‘t1r4’ or ‘t1r4-t2r4’, the value of ∆TRxSRS for first SRS port is 3dB, for SRS ports other than first SRS port is 7.5dB for n79 and 6 dB for bands whose FUL\_high is lower than the FUL\_low of n79; * when the *SRS-TxSwitch* capability is indicated as ‘t2r4’ or ‘t1r4-t2r4’, the value of ∆TRxSRS for SRS ports other than first and second SRS ports is 4.5dB for n79 and 3 dB for bands whose FUL\_high is lower than the FUL\_low of n79. |
| [**R4-2114590**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114590.zip) | On Transmit Power Relaxations for SRS Switching | Lenovo, Motorola Mobility | **Observation:** If it is found that SRS transmit power relaxations have a significant negative impact on the extracted downlink CSI, then methods should be considered which would allow the gNB to differentiate between the transmit power relaxations and the differences in antenna gains between the SRS ports so that the transmit power relaxations can be used to correct the channel measurement. |

## Open issues summary

### Sub-topic 3-1 Dependencies between capabilities for ULFPTx

Relevant proposals

[**R4-2113014**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113014.zip)

**Proposal 1: Even certain substitutes exist, it is unreasonable to exclude TxD as an implementation.**

**Proposal 2: There is no need to set dependencies between Full Tx Power / SRS antenna switching and TxD capability.**

**Proposal 3: Other multi-antenna features should be discussed explicitly and case by case, if consider capability dependencies.**

[**R4-2112828**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112828.zip)

**Proposal 1: RAN4 is to confirm which multi-antenna features have UE behavior and performance that is unaffected by TxD capability.**

**Proposal 2: Clarify in the RAN2 specification that the *ul-FullPowerTransmission* capability is not conditioned on indication of *txDiversity-16* for any full-power mode.**

[**R4-2112827**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112827.zip)

**Proposal 2: for Ues indicating *txDiversity-r16* (****TxD) and ULFPTx except for Mode 0 and Mode 2 supporting full-power TPMI, ΔPPowerClass = 3 dB for single-port SRS transmissions with usage set to ‘antennaSwitching’**

**Issue 3-1: Dependencies between capabilities**

* Proposals
  + Option 1: There is a dependency other than in option 2 and up to discussion which features ([**R4-2112828**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112828.zip)**,** [**R4-2113014**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113014.zip))
  + Option 2: No dependency between txDiversity-16 and ***ul-FullPowerTransmission*** ([**R4-2112828**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112828.zip))
  + Option 3: No dependency (R4-2113014)
  + Option 4: Dependency between TxD and ULFPTx for **ΔPPowerClass = 3 dB for single-port SRS transmissions with usage set to ‘antennaSwitching’, for ULFPTx Mode 1**
* Recommended WF
  + TBA

### Companies comments on issue 3-1

Sub topic 3-1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| OPPO | Option 2.  In ULFPTx WI, it was agreed that “The applicability of Transparent TxD is NOT related to UE supporting or not supporting Rel-16 ULFPTx”. This means TxD and ULFPTx can be supported by UE and no restriction on each other in implementation.  RAN4 also sent LS to RAN1 to clarify the transparent TxD and ULPFTx in single SRS port and two SRS ports implementations. And RAN1 confirms these implementations are feasible.  In general, the implementation of transparent TxD is up to UE and there is no fixed mapping between ULFPTx to TxD as long as requirements are met. It is not necessary for NW to exactly know how the ULFPTx is achieved, e.g. with or without TxD. |
| Huawei, HiSilicon | Option 2. Agree with the clarification by OPPO |
| Samsung | From signaling perspective, ULFPTx and TxD are two independent optional features. Although some of Mode of ULPFTx needs TxD to achieve the full power, it is not needed to introduce complex dependency rule of two features’ support. |
| vivo | Option 2 and 3, the intention is the same.  Agree with OPPO/Samsung’s views. |
| ZTE | It seems that our contribution R4-2112320 is missing.  Option 2 as proposed in our contribution. |
| Ericsson | The UEs shall be able to virtualize antennas with a full-power mode without support of the TxD capability. The following could suffice: clarify in the RAN2 specification that the *ul-FullPowerTransmission* capability is not conditioned on indication of *txDiversity-16* for any full-power mode. |

### Sub-topic 3-2 Changes to enable ULFPTx with TxD

Relevant proposals

[**R4-2113177**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113177.zip)

***Proposal 1: The text proposal below is adopted for MOP requirement if fallback DCI is scheduled, after Rel-17 transparent TxD requirement is introduced:***

|  |
| --- |
| If UE not supporting Tx diversity [xx, TS38.306] is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.1 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. If UE supporting Tx diversity [xx, TS 38.306] is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause [6.2G.1] apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. |

[**R4-2111904**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2111904.zip)

**Proposal: For Ues that support both ULFPTx and tTxD, subclauses 6.xD shall include a redirection to the set of requirements designed specifically for Ues that support transparent TxD**

If UE does not support Tx diversity [xx, TS 38.306] and is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.1 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. If a UE supports Tx diversity and  is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2[G].x apply for the power class as indicated by the *ue-PowerClass* field in capability signalling.

**Issue 3-2: Spec changes for ULFPTx**

* Proposals for spec to be changed according to
  + Option 1 (Qualcomm) [**R4-2111904**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2111904.zip)
  + Option 2 (Samsung) [**R4-2113177**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113177.zip)
* Recommended WF
  + TBA

### Companies comments on issue 3-2

Sub topic 3-2

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei, HiSilicon | The two options are almost the same. Either is ok. |
| LGE | There was no difference to us. So either is fine. |
| Samsung | Text proposals are similar.  Apart from the above text proposal for fallback DCI, we have analyze why ULFPTx’s MOP requirement don’t need change after introducing TxD, as analyzed in our paper R4-2113177:  Observation-2: After TxD UE is introduced in Rel-17, MOP requirement of Rel-16 ULFPTx Mode-1 UE needs no revisit.  Observation-3: After TxD UE is introduced in Rel-17, MOP requirement of Rel-16 ULFPTx Mode-2 UE needs no revisit.  Observation-3: After TxD UE is introduced in Rel-17, MOP requirement of Rel-16 ULFPTx Mode-0 UE needs no revisit. |
| vivo | The two options are basically the same and either one is fine.  In addition, this description is also quite suitable for Rel-15 refinement, though no ULFPTx is available for Rel-15. It is proposed to apply the same description for Rel-15. |
| ZTE | The two options are quite similar. However it might be possible to polish the wording for more conciseness. |
| Ericsson | We propose to consider an alternative to the above that allows a full-power capable UE equipped with a full-rated PA but also indicating TxD as allowed use the TxD exception in 6.2.1G accommodating half-rated PAs. This UE would not be verified according to 6.2.1 for the full-rated TX connector.  The following would work assuming that full-power capable UEs are always indicating TxD capability (e.g. for PUCCH transmissions for which the core requirements also apply):  One way to solve this is to add a requirement that the full-power mode and Mode 2 shall meet the requirements in 6.2.1:  If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.1 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling with the following exception: for UEs indicating *txDiversity-*r16 and neither supporting ULFPTx Mode-0 nor ULFPTx Mode-2 with full-power TPMI, the requirements in clause [6.2.1G] for the power class indicated by the *ue-PowerClass.* |

### Sub-topic 3-3 SRS

Changes to accommodate TxD Ues according to agreement in RAN4#99e GTW:

* *SRS antenna switching which was targeted for DL CSI would not use UL antenna virtualization, i.e. UL TxD*

**Issue 3-3:**

* Proposals for spec to be changed according to
  + Option 1 (Huawei, Qualcomm, vivo) [**R4-2114511**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114511.zip)
  + Option 2 (Samsung) [**R4-2113178**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113178.zip)
  + Option 3 (Xiaomi) [**R4-2113306**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113306.zip)
  + Option 4 (Oppo) [**R4-2113893**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113893.zip)
  + Option5 (Ericsson) [**R4-2112827**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112827.zip) No additional allowance for UE with TxD
* Recommended WF
  + TBA

### Companies comments on issue 3-3

Sub topic 3-3

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Difficult to select one…It is better to have common case study conditions for the respective PA configurations in the next meetings and fix ambiguity of the existing SRS antenna switching requirements first. |
| OPPO | Option 1 and 4 are aligned and ok. The proposal in Option 2 about additional 3dB is not allowed when ΔPPowerClass = 3 dB is enabled (UE fallback to PC3) can be further added to the big CR. |
| Xiaomi | Comparted this options, it seems both the intention is that the SRS power for any RX port which is referred to UE power class should be 3dB lower than power class except additional insert loss. The only difference is how to implement to the spec. |
| Huawei, HiSilicon | Option 1 and 4 are the same. The main point is that SRS is not virtualized, thus 3dB delta value should be considered for the first SRS port. Case of ΔPPowerClass = 0 dB can be further considered. |
| Samsung | Discussion is needed for R15 spec firstly, which at least contains the confusion mentioned as Issue 1, 2 and 3 in our paper. The case of ΔPPowerClass = 0 dB and to discriminate two cases of “1T4R/2T4R” is provided in our CR (R4-2113180) to Rel-15 TEI firstly. |
| Ericsson | Further consideration needed. The Pcmax requirements should make sure that the UE does not use virtualization and the allowance for R-connectors should not be excessive.  In R4-2112827 we make the following to proposals:  **Proposal 1: the ∆TRxSRS is a maximum allowance due to additional routing loss for RX antennas, the same value for all power classes (but can be band dependent)**  Why is **∆**TRxSRS =6 dB allowed for PC2?  This is an allowance for insertion loss and should not be dependent on the power class (the MPR that also applies for SRS may cover differences). The parameter ΔPPowerClass should be used for UEs indicating TxD or supporting Mode-1 and equipped with half-power PAs. This also makes sure that the power on the T-connectors are attenuated by ΔPPowerClass with respect to the power class thus making sure that these UEs do not virtualize (switching with a half-power rated PA across all connectors). Other implementations uses the full-power rated PA for switching. ∆TRxSRS = 3 dB for all cases except for n79.  **Proposal 2: for Ues indicating *txDiversity-r16* (TxD) and ULFPTx except for Mode 0 and Mode 2 supporting full-power TPMI, ΔPPowerClass = 3 dB for single-port SRS transmissions with usage set to ‘antennaSwitching’**  This also removes the problem addressed in Option 2. No particular handling needed for PC1.5. |

### 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.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2113893**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113893.zip) | OPPO: This is for Rel-15 CR and align with updated *SRS-TxSwitch* capabilities in 38.331. |
| Samsung: If the intention is a Rel-15 spec change, need to propose in R15 TEI. For R17 TxD feature related, only change to Rel-17 spec. |
| Vivo: Since the contents are closely related to TxD, CR may be also appropriate to be treated here in this agenda. |
| Ericsson:not agreed, the TxD capability should not be included in the RAN4 Rel-15 specification, it will be included in Rel-16 or Rel-17 and then use release independence (the 38.331 allows early indication). |
| YYY | Company A |
| Company B |
|  |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#2-1** | *Tentative agreements: Some non-zero MPR seems acceptable*  *Candidate options:*  *Recommendations for 2nd round:*   1. *Detailed proposal to be put together.*   What to do with higher modulation order MPR? One possibility is to take proposals from last meeting |
| **2-2** | *Tentative agreements: UL MIMO AMPR needs to be studied for TxD UE. Ran4 can study first in this Wi and then what is not finished, in UL MIMO bands WI.*  *Candidate options:*   1. *List of high priority bands to be put to in to TxD WID* 2. *All bands are gathered in the UL MIMO WID*   *Recommendations for 2nd round: Option 2 seems more favorable.* |
| **2-3** | *Issue 2-3-1: It seems there are few comments saying issue is not understood. Intention is to agree if TxD MPR applies for all UL MIMO implementations, including the rel-15 one which has 26 dBm PA, or only for UL MIMO for UE that implements/declares TxD.*  *Recommendations for 2nd round: Re word the issue if no consensus.*  *Issue 2-3-2: Tentative agreements: 1 and 2-layer UL MIMO share the MPR.*  *Recommendations for 2nd round: Agree wording for CR.* |
| **2-4** | *Seems the same issues is discussed in 3-2 so merging views here.*  *The change to D suffix seems agreeable but two open items:*   1. *Release,* **[R4-2113891](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113891.zip)** *seems to propose Rel-15 change and* R4-2113177 *proposes* Rel-17 2. *The detailed wording needs to be resolved between*   If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.1 apply to UE without indicating IE [*Txdiversity-r16*] as defined in TS 38.331 [7], and requirements in clause [6.2G.1] apply to UE indicating IE [*Txdiversity-r16*].  *And*  If UE not supporting Tx diversity [xx, TS38.306] is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.1 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. If UE supporting Tx diversity [xx, TS 38.306] is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause [6.2G.1] apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

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

# Topic #4: Power class ambiguity

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2112318**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112318.zip) | On the remaining power ambiguity issue | ZTE Wistron Telecom AB | * Alt. #1: use the lower possible power class in Pcmax calculation for NR to decide the lower bound of the configured power. * Alt. #2: Revise Pcmax for NR according to the declared NR power capability for NSA to guarantee a correct PHR.   **Observation 1: Alt. #2 provides a flexibility for a UE to choose either PC2 or PC3 operation for the NR leg in the EN-DC combination, while Alt. #1 does not have such a flexibility.**  **Proposal 1: RAN4 to conclude the power ambiguity issue by Alt. #2, i.e., Revise Pcmax for NR according to the declared NR power capability for NSA to guarantee a correct PHR.**  **Propose 2: If RAN4 eventually goes for Alt. #1, a simpler correction is to remove power class 2 ambituity in the rooting sentence in order to keep specs consistency.** |
| [**R4-2112829**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112829.zip) | Correction of Pcmax for an NR PC2 UE supporting NR PC3 for EN-DC | Ericsson | CR 38.101-3 Rel-15  6.2B.4.1.1 Intra-band contiguous EN-DC  - ∆PPowerClass,NR = 3 dB if the UE indicates power class 2 in the *UE-NR-Capability* but only complies with power class 3 as specified in clause 6.2.1 of [2] for the NR part of the configured EN-DC band combination; ∆PPowerClass,NR = 0 dB otherwise;  6.2B.4.1.3 Inter-band EN-DC within FR1  - ∆PPowerClass,NR = 3 dB if the UE indicates power class 2 in the *UE-NR-Capability* but only complies with power class 3 as specified in clause 6.2.1 of [2] for the NR part of the configured EN-DC band combination; ∆PPowerClass,NR = 0 dB otherwise; |
| [**R4-2113011**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113011.zip) | Remaining issues in Power class related requirements and Reply LS to GCF | vivo | **Proposal 1: Agree the changes for general description of EN-DC power class as previously endorsed CR. (Resubmission CR in [**R4-2113013**])**  **Proposal 2: The Pcmax need to be adjusted to reflect the changes, and the TxD signalling need to be used.**  **Proposal 3: The Pcmax for NR is modified to use the lower possible power class to decide the lower bound of the configured power which is more conservative but simpler and possibly more reliable. The possible negative effect is also quite limited.**  **Proposal 4: Add the description of 1-port transmission fall back for SA in Rel-15 which is the same to Rel-16.**  **Proposal 5: Reply the Rel-15 conclusions to GCF based on approved CRs, and close the power class related issues.** |
| [**R4-2113012**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113012.zip) | Clarification of 1-port fall back SA power class for Rel-15 | vivo | CR 38.101-1 Rel-15  6.2D.1  If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.1 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling.  6.2D.2  If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.2 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling.  6.2D.3  If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.3 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling.  6.2D.4  If UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2.4 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. |
| [**R4-2113013**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113013.zip) | Correction of general description of EN-DC related power class based on the TxD capability | vivo | CR 38.101-3 Rel-15  Unless otherwise stated, requirements for NR transmitter written in TS 38.101-1 [2] and TS 38.101-2 [3] apply and are assumed anchor agnostic. If UE indicates IE [*Txdiversity*] as defined in TS 38.331 [9], and UE indicates IE maxNumberSRS-Ports-PerResource = n2 in NR standalone operation mode, the said UE shall meet the NR requirements for either power class 2 or power class 3 in EN-DC within FR1 if UE indicates IE maxNumberSRS-Ports-PerResource = n1 for EN-DC on this NR band. If UE do not indicate IE [*Txdiversity*] as defined in TS 38.331 [9], the UE shall meet NR requirements according to its power class in NR standalone operation mode. Requirements are verified under conditions where anchor resources do not interfere NR operation. |
| [**R4-2114512**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114512.zip) | Discussion and draft reply LS on EN-DC power class | Huawei, HiSilicon | ***Observation 1: Without a power class to indicate the difference between SA and NSA for the NR band, it’s ambiguous which power class would be used for*** *PCMAX\_L,f,c,,NR****, consequently, UE may fail the Pcmax test for the NR part in an EN-DC band combination.***  ***Observation 2: The main issue of Pcmax identified by RAN5 is to address the measurement problem.***  ***Proposal: It is proposed to adopt the method to set a lower bound for PCMAX\_L,f,c,,NR if PPowerClass,NR is indicated as a higher power class rather than the default power class.*** |
| [**R4-2114513**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114513.zip) | draft CR for TS 38.101-3 correction of power class for EN-DC | Huawei, HiSilicon | CR: 38.101-3 Rel-15 6.2B.4.1.1 Intra-band contiguous EN-DC - ∆PPowerClass,NR = 3 dB for a power class 2 capable EN-DC UE in PCMAX\_L,f,*c,,NR* if PPowerClass,NR is indicated a higher power class other than the default power class and IE [*txDiversity-r16*] is indicated by the UE; otherwise ΔPPowerClass,NR = 0 dB;  6.2B.4.1.3 Inter-band EN-DC within FR1  - ∆PPowerClass,NR = 3 dB for a power class 2 capable EN-DC UE in PCMAX\_L,f,*c,,NR* if PPowerClass,NR is indicated a higher power class other than the default power class and IE [*txDiversity-r16*] is indicated by the UE; otherwise ΔPPowerClass,NR = 0 dB; |

## Open issues summary

There are proposals for SA with UL MIMO and EN-DC referring and without referring to tx diversity capability. For how to do the changes, we discuss based on CRs but few items are to be clarified with the issues and hopefully conclude after 1st round.

### Sub-topic 4-1 Applicable release

**Issue 4-1: Release where power class ambiguity needs to be corrected**

* Proposals
  + Option 1: Rel-15
  + Option 2: Same release as other tx diversity changes
* Recommended WF
  + TBA

### Sub-topic 4-2 Need to refer to tx diversity capability for power class

Does the power class ambiguity need to be fixed explicitly in pcmax calculation or if a general ambiguity is allowed (refer to discussion in [**R4-2112318**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112318.zip)) and see the change in [**R4-2113013**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113013.zip)vs the change in **R4-2114513 or R4-2112829**

**Issue 4-2: Power class ambiguity alt#1 (general) vs alt#2 (pcmax for tx div) as in** [**R4-2112318**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112318.zip)

* Proposals
  + Option 1: Alt#1 allow general ambiguity and use lowest possible power class
  + Option 2: Alt#2 define explicit pcmax reference for tx div UE’s
  + Option 3: Other
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 4-1 **Release where power class ambiguity needs to be corrected**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Option 2: If release independent from Rel-15 applies, the change from Rel-16 must be enough. |
| OPPO | Option 1 if TxD can release independent from Rel-15. |
| Huawei, HiSilicon | Option 1. The applicable requirements for this case are not newly defined in this Rel-17 WI, which is different from release independent manner. |
| LGE | It is depend to support TxD feature as release independent manner. |
| vivo | Option 1 is preferred. Up till now, we still have GCF questions about ambiguities which is not solved yet and clarification is really helpful for Rel-15. |
| ZTE | Option 1. The issue exists in Rel-15. |
| Ericsson | Option 1 |

Sub topic 4-2 **Power class ambiguity alt#1 (general) vs alt#2 (pcmax for tx div) as in** [**R4-2112318**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112318.zip)

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Option 2: Alt#2 |
| OPPO | Option 2. |
| Huawei, HiSilicon | Prefer option 1. The ambiguity is due to lack of capability indication as that introduced in Rel-16. Alt#2 is based on UE declaration, which is not the usual way adopted in the UE spec. In addition, the changes should also be applicable for PC1.5, as PC1.5 could also be supported by a Rel-15 UE. |
| LGE | Option 2 |
| vivo | Option 1 is preferred. This somewhat more conservative option can avoid using more UE declarations and should have less impact for Rel-15. The performance degradation is not significant. |
| ZTE | Option 2 preferred as stated in our contribution. |
| Ericsson | Option 2. |

### CRs/TPs comments collection

If pcmax change is preferred especially focus on comments [**R4-2114513**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114513.zip) vs [**R4-2112829**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112829.zip) since they are close to each but the other is referring to tx div capability.

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2114513**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114513.zip) | Ericsson: not agreed. |
| Company B |
|  |
| [**R4-2113013**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113013.zip) | vivo: This is already endorsed in last meeting, and are seeking official endorsement in this meeting to be included in the spec. |
| Company B |
|  |
| [**R4-2113012**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113012.zip) | Vivo: As discussed in Sub topic 2-4, this CR need to be revised to align Rel-16 discussion to keep consistent behaviour. |
| [**R4-2112829**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112829.zip) |  |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

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

# Topic #5: Capability and LS

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2112319**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112319.zip) | Draft reply LS to RAN2 on the capability of transparent TxD | ZTE Wistron Telecom AB | RAN4 appreciates RAN2’s works on the signaling design to support NR TxD, and the reply LS on the corresponding capabilities.  Regarding the applicable power class for capability signaling in different releases, RAN4 has reached an agreement that the TxD capability signaling applies for all Power Classes for both Rel-15 and Rel-16.  RAN4 also discussed on the relationship between NR TxD and other relevant features, e.g., ULFPTx, SRS antenna switching, non-codebook based transmission and other multiple-antenna features, etc., and has identified no dependency required for the support of NR TxD. |
| [**R4-2113014**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113014.zip) | Discussion and Reply LS on the capability related to transparent TxD | vivo | **Proposal 1: Even certain substitutes exist, it is unreasonable to exclude TxD as an implementation.**  **Proposal 2: There is no need to set dependencies between Full Tx Power / SRS antenna switching and TxD capability.**  **Proposal 3: Other multi-antenna features should be discussed explicitly and case by case, if consider capability dependencies.**  **Proposal 4: RAN4 needs to confirm that the capability release is Rel-16 or Rel-17.**  **Proposal 5: Update the information to RAN2 on the capability release, and let RAN2 do further confirmation base the new situation.** |
| [**R4-2114514**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114514.zip) | draft CR for TS 38.307: release independent requirements for TxD | Huawei, HiSilicon | CR 38.307 Rel-17   |  |  |  |  | | --- | --- | --- | --- | | Transparent Tx diversity | Rel-15 | Table B.4.8-1 | Rel-17 WI NR\_RF\_TxD introduced transparent Tx diversity requirements: see Table B.4.8-1 | |
| [**R4-2114553**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114553.zip) | Legacy UE type handling with TX Diversity | Qualcomm Incorporated | **Proposal 1: MPR for Tx diversity UE should be applied for UL MIMO when UE declares it needs Tx diversity to fulfil maximum power requirements.**  **Observation 1: UE with 26 dBm PA may still implement Tx diversity.**  **Proposal 2: Capability for tx diversity will need a third type with UE that implements tx diversity but implements full power PA.**  **Observation 2: Extension of the tx diversity capability to also recognise UE with full power PA and tx diversity capability will benefit network for further information on UE behaviour.** |

## Open issues summary

### Sub-topic 5-1 Capability for TxD

Relevant proposals

[**R4-2114510**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114510.zip)

***Proposal 8: It is proposed to continue the Rel-16 TxD capability signalling design in RAN2, and reply to RAN2 with the clarification agreement in RAN4#99e that the capability signalling applies for all Power Classes for both Rel-15 and Rel-16.***

[**R4-2114553**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114553.zip)

**Proposal 2: Capability for tx diversity will need a third type with UE that implements tx diversity but implements full power PA.**

[**R4-2112319**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112319.zip)

Regarding the applicable power class for capability signaling in different releases, RAN4 has reached an agreement that the TxD capability signaling applies for all Power Classes for both Rel-15 and Rel-16.

[**R4-2113014**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113014.zip)

**Proposal 4: RAN4 needs to confirm that the capability release is Rel-16 or Rel-17.**

**Proposal 5: Update the information to RAN2 on the capability release, and let RAN2 do further confirmation base the new situation.**

**Issue 5-1-1: Capability release**

* Proposals
  + Option 1: TxD capability is introduced from Rel-16 and early implementation is adopted for Rel-15
  + Option 2: TxD capability is introduced from Rel-17 and early implementation is adopted for Rel-15
* Recommended WF
  + TBA

**Issue 5-1-2: Third state needed for capability**

* Proposals
  + Option 1: yes, three states are needed to distinguish UE with txd and full power PA
  + Option 2: no, only two are needed
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

Issue 5-1-1 **Capability release**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Option 2 |
| OPPO | Option 1 since this is the Rel-16 leftover issue and put in Rel-17 WI is only from work management perspective. |
| Huawei, HiSilicon | Option 1. The LS previously sent to RAN2 is under Rel-16 agenda. It would be better to introduce the capability as early as possible, otherwise, the capability can only be used after Rel-17 ASN.1 is frozen. Agree with OPPO that the Rel-17 WI is to facilitate the RAN4 work management rather than introducing a new Rel-17 feature. |
| LGE | Option 2 |
| vivo | Either option 1 or option 2 is fine.  If we can not reach consensus here, we may let RAN2 decide on which release the TxD capability is introduced. |
| ZTE | Both options are fine, just a matter of routinary works. |
| Ericsson | Option 1 or Option 2 (but this is a Rel-17 work item and release independence applies, so should perhaps be Rel-17). RAN2 can introduce the capability in the Rel-16 of 38.331 (then RAN4 should also introduce the capability from Rel-16). |

Issue 5-1-2 **Third state needed for capability**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Does QC have any specific benefit from this indication? Is there any specific reason to exclude a PA configuration of 26dBm+26dBm ? This makes us apply more precise SRS antenna switching relaxion. |
| OPPO | Option 2. Doesn’t see the need or benefit of distinguishing 23+26 case by additional capability. |
| Skyworks | We support adding signaling that provided indication of the PA configuration to the network regardless of whether a single MPR table is used but it also helps determining if additional delta SRS is needed. For this PC3 with: 20+20, 20+23, 23+23dBm and PC2 with 23+23, 26+23, 26+26dBm configurations should be visible as 1T2R 2T4R could be supported differently. It could simply be declaring full power capability or not per branch. |
| Huawei, HiSilicon | Option 2. Usually the requirements are implementation agnostic in RAN4 spec. Even for ULFPTx, actually it does not exclude all possible implementation for each mode, which is also confirmed by the RAN1 reply LS. |
| LGE | If RAN4 defines the same MPR requirements regardless of PA configuration, then what is a benefit to distinguish the PA configuration? It can be further discussed after RAN4 defines TxD MPR requirements. |
| vivo | Option 2. This basically means that reporting UE detailed structure, which is not common behavior for RAN4.. |
| ZTE | Option 2. It looks not convincing to us to introduce the third state. |
| Ericsson | The UE behaviour when configured with full-power operation shall be independent of the TxD indication. |

### 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.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2114514**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2114514.zip) | Company A |
| Company B |
|  |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

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

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

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

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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)