**3GPP TSG-RAN WG4 Meeting # 101-e R4-21xxxx**

**Electronic Meeting, 01 – 12 November, 2021**

**Agenda item:** 8.7.1

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for [101-e][123] NR\_TxD

**Document for:** Information

# Introduction

The scope of this document is to capture discussions in RAN4#101e on contributions to agenda 8.7 for WID [RP-211940] TX Diversity.

The following topics are identified:

* Topic#1: General. TR maintenance, workplan, WID updates and release independence aspect
* Topic #2: Phase 1, MPR and capability. MPR discussions and proposals, capabilities on which types of implementations are covered by specifications
* Topic #3: SRS antenna switching. How to capture SRS antenna switching requirements for UEs with TX diversity
* Topic #4: ULFPTx. How to specify requirements for UE that support ULFPTx.

Please make sure you follow chairs guidance on documentation management in slide 11 of R4-2117001, “RAN4#101e E-Meeting Arrangements and Guidelines”, RAN4 Chair (Huawei).

# Topic #1: General

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

## Companies’ contributions summary

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| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2117790**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2117790.zip) | 3GPP TR 38.837 v0.1.0 | vivo | TR based on agreed TPs from previous meeting |
| [**R4-2118282**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118282.zip) | TP for TR 38.837 on capability signaling and applicable release | vivo | TP for capability signalling and applicable release for it |
| [**R4-2119496**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2119496.zip) | TxD work plan update | Qualcomm Incorporated | Work plan update based on WID update. |
| [**R4-2119525**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2119525.zip) | On release independent requirements for TxD | Huawei, HiSilicon | Add TxD and suffix G in to rel-17 38.307 |
| [**R4-2119526**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2119526.zip) | draft CR for TS 38.307: release independent requirements for TxD | Huawei, HiSilicon | CR to add the suffix G table to 38.307 |
| [**R4-2118535**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118535.zip) | On update of TR 38.822 Rel-16 NR UE feature list | CMCC | Proposal to add 2-21 Transparent Tx Diversityin to Rel-16 feature list |
| [**R4-2118536**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118536.zip) | LS on Rel-16 updated RAN4 UE features lists for LTE and NR | CMCC | Following RAN plenary guidance, RAN4 would like to kindly ask RAN2 to capture the agreed updated UE feature list (R4-2118537) into TR 38.822. |
| [**R4-2118537**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118537.zip) | Updated RAN4 UE features list for Rel-16 | CMCC | Updated feature list with changes from 8535 |

## Open issues summary

*This topic handles general papers suchb as WID management related. No dedicated subtopics are identified but comments for papers for approval are invited.*

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| R4-2117790  3GPP TR 38.837 v0.1.0 | Vivo: This v0.1.0 version TR actually contains the agreed TPs in last meeting and need to be approved in the 1st round, since the proposed TPs in this meeting is actually based on it.  **To moderator:** A new Tdoc number is needed after 1st round for an updated TR entitled: “3GPP TR 38.837 v0.2.0”, it would be used to capture the agreed TPs in this meeting and would seeking Email approval right after this meeting. |
| R4-2118282  TP for TR 38.837 on capability signaling and applicable release | Company A:  Company B: |
| R4-2119496  TxD work plan update |  |
| R4-2119525  On release independent requirements for TxD | Samsung: We agree with the introduced new B.4.8 section in TS38.307 for the requirements for transparent Tx diversity UE. However, it should be noted that the title of Table 5.4-1 is “additional requirement of other release independent features”, which indicate that not only the requirement listed in B.4.8-1, other RF TX requirement should also be applied. The group should be careful about this,   * e.g. for HST RRM related feature in this Table 5.4-1, the table C.1-1 just list all the “additional” RRM requirement to be fulfilled if this HST RRM feature is supported, while all other RRM requirement for legacy Rel-15 should also be applied. * For TxD, the situation is different from our understanding. E.g., for MOP requirement, if UE claim its support of TxD in this band, the requirement of clause 6.2G instead of clause 6.2 applies. So the wording “additional” in Table 5.4-1 can give confusion different from the group’s intention. |
| R4-2119526  draft CR for TS 38.307: release independent requirements for TxD |  |
| [R4-2118535](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118535.zip)  On update of TR 38.822 Rel-16 NR UE feature list |  |
| R4-2118536  LS on Rel-16 updated RAN4 UE features lists for LTE and NR | Ericsson: see comments on R4-2118537 |
| R4-2118537  Updated RAN4 UE features list for Rel-16 | Ericsson: no issues with the contents but which is the applicable release? Are we asking RAN2 to introduce txDiversity-r16 in the Rel-16 or Rel-17 version of the 38.331 (early indication from Rel-15 in any case)?  CMCC: RAN2 was already agreed to introduce the capability in 38.331 in last meeting and the formal CRs are under discussion in RAN2 this meeting. So we propose to capture txDiversity-r16 as a Rel-16 feature. |

## Summary for 1st round

### Open issues

See summary per each document in 5.1

### 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.*

See summary per each document in 5.1

## Discussion on 2nd round (if applicable)

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| **TDoc** | **Company Comments** |
| [R4-2119526](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2119526.zip) revised to ?  draft CR for TS 38.307: release independent requirements for TxD |  |

# Topic #2: Phase 1, MPR and capability

*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** |
| [**R4-2117200**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2117200.zip) | 1CC 2Tx MPR for different PAs implementations and signaling for 1CC and 2CC cases | Skyworks Solutions Inc. | **2.2. Management of 2Tx MPR requirements in 38.101-1**  Observation: 2Tx MPR tables apply to both TxD and UL MIMO  Proposal on 2Tx MPR: 2Tx MPR tables should be placed in the general section 6.2.2 in 38.101-1 and the TxD and UL MIMO section point to these tables. Table 6.2G.2-1 should be moved to general section under Table 6.2.2-3  **2.3 PC2 2Tx 26dBm+26dBm MPR based on PC1.5 MPR**  Observation: 2Tx PC2 operation using two 26dBm PA is an important use case for UEs already implementing two 26dBm PAs for intra-band ENDC or UL CA but that are not able to support PC1.5 due to thermal or power management aspects.  Proposal on MPR for 2Tx PC2 with two 26dBm PAs: Following MPR equation is proposed for 26+26dBm architecture and restricted to the smartphone use case (10dB antenna isolation): MPR[dB]= Max (0, Table 6.2.2-4 MPR -3dB). For single Tx operation Table 6.2.2-2 MPR applies.  **2.4. Additional measurements for PC2 2Tx 26dBm+23dBm case**  Observations:   * As discussed in RAN4#100, edge allocations have similar performance for 1Tx or 2Tx as the limitation is linked to the waveform filtering rather than the PA linearity. Except for the 26+26dBm case where the two PAs already benefit from an intrinsic 3dB back-off. * Confirming the analysis in 2.3, the PC2 2Tx 26+26dBm case always achieves higher power capability than 26dBm, including for our edge allocation measurement which benefit from good waveform filtering. However, to account for designs with less filtering, the 1Tx PC2 edge MPR can be applied. * The PC2 2Tx 26+23dBm always achieve the same or higher power capability or margin than 1Tx PC2. This means that the 26dBm PA intrinsic 3dB back-off allows compensating for the lower linearity of the 23dBm PA and the RIMD contribution. * As discussed in [1] the 2Tx PC2 23+23dBm case requires additional MPR compared to 1Tx PC2 case to compensate for the lower 23dBm PA linearity and the additional contribution of RIMD.   Proposal on MPR for 2Tx PC2 with one 26dBm PA: 26+23dBm architecture shall fulfil the 1Tx PC2 MPR Table 6.2.2-2 in 38.101 for both single and dual Tx operation.  **2.5. Signaling aspect for the different cases**  Observation:  Additional signaling is needed to distinguish:   * The three PC2 2Tx 1CC cases (23+23, 26+23 and 26+26dBm) if all architectures are allowed to signal TxD support * The two PC2 2Tx 2CC cases (23+23 and 26+26dBm) if both are allowed to signal TxD support   Proposal on 2Tx signaling based on PC1.5 use of modified MPR bits   * Alternative 1 (preferred): TxD is only allowed for the 1CC and 2CC cases where there is no full power PA available and it is the only way to achieve full UL power. Full UL power capability is only declared for the architectures with at least one full power PA available. The one versus two full power PA cases are sorted by using modified MPR bit for the 26+26dBm case like for PC1.5 FWA case. * Alternative 2 (more complex but future proof): TxD signaling is allowed for all 1Cc and two CC architectures and modified MPR bits are used for the cases with at least one full power PA:   + Two modified MPR values are needed for 1CC 26+23dBm and 26+26dBm cases   + One modified MPR value is needed for 2CC 26+26dBm case * An LS is sent to Ran2 to inform them on RAN4 agreements on 2Tx architecture signaling * 38.101-1 1Cc and 2CC 2Tx MPR requirements are clarified with how the exact TxD, full UL power and modified MPR signaling maps to the 1Tx and 2Tx MPR tables/equations/values. |
| [**R4-2118474**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118474.zip) | MPR of Tx Diversity (TxD) PC2 for two PC3 PA architecture | LG Electronics Inc. | Observation 1: In the case of CP-OFDM(QPSK &16QAM) Edge RB allocations, 0.5 dB additional MPR value is required compared to the MPR value in WF[1].  Observation 2: In the case of CP-OFDM 256QAM, the 8.0dB MPR value can meet the required emission and EVM requirements.  Observation 3: For other test cases, those MPR values in WF[1] can be used.  Proposal 1: In the case of CP-OFDM(QPSK & 16QAM) Edge RB allocations, the 4.0 dB MPR value can be considered.  Proposal 2: In the case of CP-OFDM 256QAM, the 8.0 dB MPR value can be considered. |
| [**R4-2118550**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118550.zip) | Draft CR TS 38.101-1: Move PC1.5 MPR to Clause 6.2G | Huawei, HiSilicon, Qualcomm | CR for moving PC1.5 MPR tables under suffix G |
| [**R4-2118874**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118874.zip) | R17 FR1 UL MIMO fallback to TxD and draft LS | OPPO | Proposal 1: It is proposed to only test UE with TxD requirements for UE with 23+23 PAs in single antenna port mode  Observation 2: For UE with 23+26 PAs it can achieve 26dBm in TxD mode, and also in 1T 26dBm mode, and it is out of NW control which mode UE is using.  Observation 3: The most straight forward way to verify UE with 23+26 PAs performance in single antenna port mode is to test both 1Tx requirements and TxD requirements.  Proposal 2: It is proposed to define both 1Tx requirements and TxD requirements for UE with 23+26 PAs in single antenna port mode. [Draft CR is R4-2118875]  Observation 4: UE capability needs to be defined to distinguish TxD UE PA configurations whether it is 23+23 or 23+26.  Proposal 3: It is proposed to define a new UE capability for TxD UE to distinguish whether PA configuration is 1Tx or 2Tx in single antenna port mode. [Draft LS is in the annex]  Observation 5: It is transparent to NW whether the 23+26 UE is transmitting max power via the 1Tx 26dBm PA or via the 23+23 PAs and therefore may cause testing problems.  Proposed changes to TS38.101-1 and LS are in the paper |
| [**R4-2118875**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118875.zip) | Draft R17 CR on UL MIMO falllback to TxD | OPPO | CR to add the 23+26 requirement according to the paper 8874 |
| [**R4-2119593**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2119593.zip) | On Using the Pseudo-Inverse to Define EVM for Transmit Diversity | Lenovo, Motorola Mobility | **Proposal:** Keep the existing agreement in which the EVM for transparent transmit diversity is defined as  where EVM1 and EVM2 denote the EVM measured at the first and second antenna connectors and P1 and P2 denote the power measured at the first and second antenna connectors.  Moderator note: There is no counter proposal and this paper proposes to keep the existing agreement so no discussion is needed and paper will be noted after 1st round. |

## 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 2-1 MPR Table placement

*Sub-topic description:* Where to place TxD MPR table in the specification including PC1.5 tables.

[**R4-2117200**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2117200.zip)**:** Proposal on 2Tx MPR: 2Tx MPR tables should be placed in the general section 6.2.2 in 38.101-1 and the TxD and UL MIMO section point to these tables. Table 6.2G.2-1 should be moved to general section under Table 6.2.2-3

[**R4-2118550**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118550.zip)**:** CR to move PC1.5 tables to suffix G

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

**Issue 2-1: MPR table placement**

* Proposals
  + Option 1: Place all tables in the general subclause 6.2.2
  + Option 2: Place tables for dual TX in suffix G, 6.2G.2
  + Option 3: Other possible solutions, please only opt for this if you provide a conclusive solution
* Recommended WF
  + TBA

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| **Sub-topic 2-1 MPR Table placement** | Option 1: Place all tables in the general subclause 6.2.2 (Skyworks, Samsung)  Option 2: Place tables for dual TX in suffix G, 6.2G.2 (Ericsson, LGE, ZTE, Qualcomm, Huawei)  Option 3: Other possible solutions, please only opt for this if you provide a conclusive solution (ZTE: add no suffix as “single carrier single Tx, 2Tx&1CC in “D” or “G”)  *Tentative agreements after 1st round* Go with majority view, MPR table placement should not be too controversial since it is merely a documentation issue so hope Skyworks and Samsung can compromise here. We can also accommodate ZTE comments on clarifying the suffixless definition but this is better left for discussion on the 2nd round.  *Recommendations for 2nd round:* draft CR according to majority view, Huawei [R4-2118550](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118550.zip) to be revised or the original approved.  Friday GTW 15 mins.  Discussion:  Skyworks: we are OK with option 2. The table is also applicable to UL-MIMO. We need a UL-MIMO section to be pointed from this table. PC1.5 is for UL-MIMO. The MPR tables are for both TxD and UL-MIMO.  Ericsson: we are OK to put table under the section corresponding to scenario which the requirement is intended to be used. Prefer to 6D.X.  ZTE: we should consider the current spec structure. There is overlapping between sections. We can add section for single carrier and single Tx. We would like to avoid overlapping.  Qualcomm: we can reuse the requirement. We can put pointer between section G and D. To Ericsson, majority of companies want to put the requirement under G section. We can even to put requirement in the annex and point to it.  Samsung: same as Skyworks. Key point is to align the requirement between UL\_MIMO and TxD. We prefer to put it under section G. In Rel-16 there is no TxD.  Huawei: Agree with Qualcomm. The same requirement will be used for UL-MIMO and TxD. We would like to follow majority views.  Ericsson: in order to keep consistence to Rel-16, and considering RAN5, we prefer to section D. Consider the test application.  Huawei: this is WID for TxD. I am not sure if putting it in UL-MIMO is proper.  LGE: Fine to define in D. We can combine suffix G and D.  Agreement:   * Restruct the specification to capture the requirements of MPR in the way to align the requirement between TxD and UL-MIMO   + Option 1:Place tables for dual TX in suffix D, 6.2D.2     - Point the MPR requirement for TxD to this table.   + Option 2: Merge section D and G |

#### Companies views’ collection for 1st round

**Issue 2-1: MPR table placement**

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| **Company** | **Comments** |
| Skyworks | Option 1: Place all tables in the general subclause 6.2.2 . This enables TxD and UL MIMO clauses to point to the same tables (CP-OFDM only for UL MIMO) in the general part. Note that this is anyhow the case for PC3 where both TxD and UL MIMO point to 1Tx tables. With different PA architectures for 2Tx PC2 different tables can be pointed to in the general section depending on UL full power support and 1Tx or 2Tx operation. Finally PC1.5 can only be supported with 2Tx and thus should be in the general requirement part. |
| Ericsson | The MPR tables should be places in relevant clauses according to their applicability (and associated feature). The requirements in 6.2 apply per connector and if a 2TX MPR table also applies for a 2TX mode that complies with the declared power class per connector then the table could be placed in 6.2. Mode 0 or UL-MIMO with full-power rated PAs are perhaps an example? Now, more common is that the 2TX MPR would be used for UL-MIMO etc and clause 6.2G is more appropriate (6.2D could refer to 6.2G). PC1.5 must be measured according to 6.2G. Option 2, but not completely obvious. |
| Samsung | Option 1 (i.e., place all MPR tables in the general subclause 6.2.2 and make the TxD and UL-MIMO section point to these tables) are reasonable and better solution to us. The names of these MPR tables can be FFS. |
| LGE | Option 2. We have the same view as Ericsson. The TxD shall be moved to Suffix G. |
| ZTE | Option 2 or Option 3 (subclause 6.2D.2 UL-MIMO).  In order to avoid confusion, 38.101-1 may clearly describe the suffices (no suffix, A-G), however, there is overlapping among suffices . For example, “no suffix” means single carrier, but “D”(UL-MIMO) also refers to single carrier but in UL-MIMO, and “G” refers to single carrier as well but with TxD. To be more clear and avoid overlapping, we can update the description on the “no suffix” case as single carrier single Tx, and it captures requirements only for 1Tx. Of course, other parts can refer to it for the applicable cases. And for 2Tx/single carrier requirements, they can be captured either in UL-MIMO or TxD. |
| Qualcomm | We are fine with both options even prefer the option 2. But we will need clarification to “all tables” if option 1 is chosen. Is it all for single CC or including also CA. And what about UL MIMO? It seems we will come up with a new table for CA + UL MIMO. Can one of the proponents of option 1 propose a detailed list for 2nd round? |
| Huawei | Prefer option 2. As we have agreement that one set of MPR requirements apply for UL MIMO and TxD, the spec should avoid to duplicate the same Tx requirements in different places. Open to have further discussion for other option if a detailed solution can be proposed in 2nd round discussion. |
| vivo | No strong view on the options as long as defined clearly. Both methods have respective interpretations and their merits. |

### Sub-topic 2-2: MPR values for TxD PC2

*Sub-topic description:* Proposal for the MPR modifications are as follows:

[**R4-2118474**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118474.zip)

* Proposal 1: In the case of CP-OFDM(QPSK & 16QAM) Edge RB allocations, the 4.0 dB MPR value can be considered.
* Proposal 2: In the case of CP-OFDM 256QAM, the 8.0 dB MPR value can be considered.

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

**Issue 2-2: TxD PC2 MPR changes**

* Proposals
  + Option 1: Change CP-OFDM(QPSK & 16QAM) Edge RB from 3.5 to 4.0 dB
  + Option 2: Change CP-OFDM 256QAM, from 8.5 to 8.0 dB
  + Option 3: No changes
* Recommended WF
  + TBA

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| **Sub-topic 2-2: MPR values for TxD PC2** | Option 1: Change CP-OFDM(QPSK & 16QAM) Edge RB from 3.5 to 4.0 dB (LGE)  Option 2: Change CP-OFDM 256QAM, from 8.5 to 8.0 dB (Skyworks, LGE, Ericsson)  Option 3: No changes (ZTE?)  *Tentative agreements after 1st round:* Seems no-one was against the proposed changes. Option 2 received most support. There was also one question asked.  *Recommendations for 2nd round:* Draft CR according to original proposals from LGE? Check if this approach is acceptable.  Friday GTW, 10 mins.  Discussion:  LGE: support both option. Based on the simulation results.  ZTE: this is an important requirement. It seems only one company provided input.  Skyworks: we also provided the input.  LGE: we re-simulate some cases.  Ericsson: For both, tolerance is 5dB. 0.5dB seems not make too much difference during the test, since the tolerance is large. We propose using the smaller number. We should take into account the tolerance for MPR.  Skyworks: we support the both changes.  Agreement:   * Change CP-OFDM 256QAM, from 8.5 to 8.0 dB * Change CP-OFDM(QPSK & 16QAM) Edge RB from 3.5 to 4.0 dB |

#### Companies views’ collection for 1st round

**Issue 2-2: TxD PC2 MPR changes**

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| **Company** | **Comments** |
| Skyworks | We are fine to reduce CP-OFDM 256 QAM to 8dB |
| Ericsson | Option 2 while noting that the tolerance at this back-off is 5.0 dB that is likely to absorb any difference. Hence the PASS/FAIL is 26 – 8 – 5 – TT = 13 – TT dBm |
| LGE | LGE is a proponent with option1 and option2. Based on our simulation results (R4-2118474), we prefer to apply both option 1 and option 2. For other test cases, those MPR values in WF[R4-2114753] can be used. |
| ZTE | Are the proposed MPR changes are based on single company’s simulation results, or are there other companies having the same observation/requirement? |

### Sub-topic 2-3: MPR applicability when there is full power PA

*Sub-topic description:* Proposal for the MPR applicability as below. It should be also considered if 26+26 PC2 and 26+23 PC2 should both use 1Tx PC2 MPR. This has impact on the issue 2-4 and issue 2-4 has impact on MPR in this issue.

[**R4-2117200**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2117200.zip)

* Proposal on MPR for 2Tx PC2 with one 26dBm PA: 26+23dBm architecture shall fulfil the 1Tx PC2 MPR Table 6.2.2-2 in 38.101 for both single and dual Tx operation
* Proposal on MPR for 2Tx PC2 with two 26dBm PAs: Following MPR equation is proposed for 26+26dBm architecture and restricted to the smartphone use case (10dB antenna isolation): MPR[dB]= Max (0, Table 6.2.2-4 MPR -3dB). For single Tx operation Table 6.2.2-2 MPR applies.

Note that Table 6.2.2-4 is PC1.5 MPR table

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

**Issue 2-3-1: PC2 26+23 dBm MPR**

* Proposals
  + Option 1: 1Tx PC2 MPR Table 6.2.2-2 in 38.101-1 applies for 26+23 dBm
  + Option 2: Other, please provide how to change and justification for it
* Recommended WF
  + TBA

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| **Sub-topic 2-3: MPR applicability when there is full power PA**  **Issue 2-3-1: PC2 26+23 dBm MPR** | Option 1: 1Tx PC2 MPR Table 6.2.2-2 in 38.101-1 applies for 26+23 dBm (Skyworks, Ericsson, Oppo, Samsung, Huawei)  Option 2: Other, please provide how to change and justification for it (LGE, vivo: 26+23 follows 23+23)  *Tentative agreements after 1st round:* Majority prefers to apply 1Tx MPRs for 26+23 dBm implementation.  *Recommendations for 2nd round:* Continue discussion and intent to agree majority view in WF to approve the MPR applicability. This issue needs to be connected with subtopic 2-4.  Friday GTW 5 min, this issue is dependent on issue 2-4-1.  Discussion:  Skyworks: we compared all the different cases. In our view, it is fair to enable 23+26 to use 1Tx requirement.  LGE: We can further discuss it based on simulation results.  Agreement: encourage companies to provide more evaluation and measurement data in future. |

**Issue 2-3-2: PC2 26+26 dBm MPR**

* Proposals
  + Option 1: PC2 MPR[dB]= Max (0, Table 6.2.2-4 MPR - 3dB) for smartphones
  + Option 2: Other, please provide how to change and justification for it
* Recommended WF
  + TBA

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| **Sub-topic 2-3: MPR applicability when there is full power PA**  **Issue 2-3-2: PC2 26+26 dBm MPR** | Option 1: PC2 MPR[dB]= Max 0, Table 6.2.2-4 MPR - 3dB) for smartphones (Skyworks, Ericsson, Oppo, Samsung)  Option 2: Other, please provide how to change and justification for it (Qualcomm: Opt1 creates a new version of PC1.5 and is redundant; Huawei: prefer to apply 26+23 MPR here, vivo: no needed)  *Tentative agreements after 1st round:* small majority prefers option 1 but it seems that the benefit of introducing 26+26 is questioned by the opposing companies.  *Recommendations for 2nd round:* Continue discussion and intent to agree majority view in WF to approve the MPR applicability. This issue needs to be connected with subtopic 2-4.  Friday GTW 5 min, this issue is dependent on issue 2-4-1.  Discussion:  Agreement: |

#### Companies views’ collection for 1st round

**Issue 2-3-1: PC2 26+23 dBm MPR**

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| **Company** | **Comments** |
| Skyworks | We obviously support option 1 but want to point at the need to solve the associated signaling aspects to differentiate from 23+23 and/or 26+26 cases |
| Ericsson | Option 1: we support the proposal that a 23 + 26 dBm such as FP Mode 2 shall meet the requirements in 6.2 (DCI 0\_0) and 6.2D according to the 1TX MPR table w r t its supported power class. |
| OPPO | Ok with option 1. |
| Samsung | Option 1 is good to us, but we don’t think ULFPTx Mode-2 is necessarily linked to 23+26, because 23+23 by SRS virtually mapping to one port is also a possible mechanism, which is discussion in ULFPTx section, may not be needed to discussed here. |
| LGE | Option 2. For PC2 TxD UE, the 23+26 PA UE shall follow the MPR of 23+23 PA. Because the 23+26 UE will be operated with the same PSD and modulation and RB size for TxD operation. Then, the same MPR will be derived as 23+23 PA UE. |
| Huawei | Ok with option 1. |
| vivo | Option 2. We prefer to have unified requirements between 26+23 dBm and 23+23 dBm implementation. The signaling differentiation between them is also questionable. |

**Issue 2-3-2: PC2 26+26 dBm MPR**

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| **Company** | **Comments** |
| Skyworks | We obviously support option 1 but want to point at the need to solve the associated signaling aspects to differentiate from 23+23 and/or 26+23 cases |
| Ericsson | Option 1. Regarding signaling, only the declared power class and the supported mode of operation e.g. full-power UL-MIMO are relevant from a network perspective. 26 + 26 dBm could be an UL-MIMO capable declaring PC2. Notwithstanding we support the idea to reduce MPR for UEs equipped with full power rated PAs. We also note that the lower tolerances as larger for TxD, 3 dB compared to 2 dB at the maximum power for UEs compliant with 6.2 per connector. |
| OPPO | Ok with option 1. |
| Samsung | Option 1 is reasonable proposal to us. |
| LGE | LGE support option 1. |
| Qualcomm | 26+26 dBm TXD implementation for PC2 with different MPR’s than 23+23 dBm would create a new feature, working name “enhanced PC2 TxD” and it would need a capability, like Ericsson is saying. If we decide to create this capability, what would the motivation over PC1.5? Right now, we would not support creation of this new MPR and feature.  Having said the above, there are bands where PC1.5 is defined in 6.2.1 but not in 6.2D.1 (UL MIMO) There is no separate power class capability for UL MIMO if UE wants to support UL MIMO it is forced to support PC2 also for fall back behavior. But still, this seems a problem in the specification rather than motive to create the enhanced PC2 TxD feature. |
| Huawei | Disagree with option 1. For example, inner RB allocation for CP 16QAM is 2.5dB for PC1.5, with this formula, the MPR for 26+26 PC2 would be 0dB, however, the value for the case of existing PC2 is 2.5dB, the difference would be too large. It is also noticed that for PC3 UE to support 2Tx, the typical implementation is 23+23, following the similar logic as proposed in the formula, most cases for 2Tx PC3 would use the 0dB MPR, however, the same MPR adopted for both 1Tx and 2Tx PC3 UE. We don’t think that the formula without differentiating the RB allocation cases is reasonable.  Our preference is to use the same MPR for 23+26, i.e. 1Tx PC2 MPR Table 6.2.2-2 in 38.101-1 applies for 26+26 dBm if we do need to consider the “enhanced PC2”. |
| vivo | Similar to discussion in CA part, we do not think 26+26, which is architecture assumption of PC1.5, is a typical implementation for PC2. So a dedicated requirements and signaling is questionable. |

### Sub-topic 2-4: UE with full power PA and TxD

*Sub-topic description:* The following proposals were made. It should be noted that the proposal in[**R4-2117200**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2117200.zip) already assumes UE with at least one 26 dBm PA can declare TxD. Proposal discusses MPRs for that case.

Also it is moderators understanding that proposal in [**R4-2118874**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118874.zip)does not mean to define a parallel capability to the one already agreed but to define a capability to indicate that the UE which has full power PA can indicate if it meets requirements with 2Tx or 1Tx.

[**R4-2118874**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118874.zip)proposal 2and[**R4-2117200**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2117200.zip) (see issue 2-3-1 and 2-3-2) discuss how to set requirements for UE’s with TxD and full power PA. If agreement is to recognize this type of implementation, we can discuss in more detail on 2nd round. Issue 2-4-2 provides place for comments in 1st round.

[**R4-2117632**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2117632.zip)**:** Proposal 1: The tTxD capability shall be extended to include a third type of UE (‘TxD\_singleTxMPR’) that implements Tx diversity but complies with single Tx PC2 MPR of 6.2.2 of TS38.101-2.

[**R4-2118874**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118874.zip)**:**  Proposal 3: It is proposed to define a new UE capability for TxD UE to distinguish whether PA configuration is 1Tx or 2Tx in single antenna port mode. [Draft LS is in the annex]

[**R4-2117200**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2117200.zip)**:** Proposal on 2Tx signaling based on PC1.5 use of modified MPR bits. *Moderator note: this proposal is conditional if 26+23 and 26+26 architecture are distinguished in the requirements*

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

**Issue 2-4-1:** **Declaration of TxD for UE’s with at least one full power PA**

* Proposals
  + Option 1: Define a capability to declare UE support for TxD when it has at least one full power PA
  + Option 2: Leave TxD as implementation aspect and assume that UE that does not declare TxD meets 1Tx requirements and has at least one full power PA
* Recommended WF
  + TBA

**Issue 2-4-2:** **Requirements for UE with full power PA and TxD support**

* Proposals
  + Option 1: Define requirements and capability separately for 26+23 and 26+26 implementations for TxD
  + Option 2: Test both 1Tx and TxD requirements for the UE that declares TxD and has full power PA
* Recommended WF
  + TBA

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| **2.2.4 Sub-topic 2-4: UE with full power PA and TxD**  **Issue 2-4-1: Declaration of TxD for UE’s with at least one full power PA** | Option 1: Define a capability to declare UE support for TxD when it has at least one full power PA (Qualcomm)  Option 2: Leave TxD as implementation aspect and assume that UE that does not declare TxD meets 1Tx requirements and has at least one full power PA (Skyworks, Ericsson, Oppo, Samsung: if requirements are different; Xiaomi, Huawei, vivo, Apple)  Vast majority prefers not to create capability  *Tentative agreements after 1st round:* UE that does not declare TxD has atleast one full power PA and 1Tx requirements apply.  *Recommendations for 2nd round:* Confirm agreement in WF.  Friday GTW, 30 min. Conclusion about this issue has an impact to 2-2, 2-3 and topic #3  Discussion:  Qualcomm: there would be different requirements for 23+26 and 26+26. Do we need differentiate them from 1Tx implementation?  Ericsson: from network side, singaling is useful if there is big difference for MPR. If it is just performance test, it is RAN5. We should focus on whether the UE behavior is changed or new function. We do not need to discuss testing. Any UE can be declared in RAN5.  Skyworks: TxD is worse case to implement PC2. I do not want to let UE with 26dBm PA to declare TxD. The network should be sure what happens.  Qualcomm: We have discussion on MPR. I do not know the rule. To Ericsson, there is papers to discuss how TxD UE behaves in the network. Even though there would be MPR difference, it is good for network to know whether UE has a full power PA.  Ericsson: We fully agree with Skyworks. Qualcomm had a good point with singling cancellation. TxD is transparent. It is difficult for gNB to do something. We would like to power requirement to ensure that UE meets the requirement at connector with PA. We would like to see the requirements encourage the implementation with full power PA. If UE is equipped with full PA, it should not declare TxD. There is uncertainty of MPR. It should not be default case.  Huawei: two things whether to introduce the different requirements for different configurations. Whether we should differentiate 23+26 and 26+26? For 23+23 the TxD is only possible implementation to meet PC2. For the other two, they do not need to report TxD capability.  Skyworks: we need understand whether there is different requirement. 23+26 and 26+26 can meet 1Tx PC2 MPR requirement. We are OK if we agree PC2 TxD requirement only cover 23+23. 26+26 does not require TxD.  Samsung: like What Huawei commented, we can separately discuss the requirement and capability. For capability, it should be static capability based on UE implementation. If CDD is not well configured, then there is performance degradation. How can UE do something even if we agree on the capability.  ZTE: Does UE have freedom to choose TxD PC2 or 1Tx PC2? Network does not know which mode UE uses. We can preclude such freedom.  Qualcomm: I do not know how to preclude the freedom. The baseband can implement the TxD. Then UE has full power PA but it can get the easier requirement if it declares the support of TxD.  Apple: TxD is introduced for some transparent for gNB. The baseline assumption is 23+23. The TxD signaling should be used only for 23+23.  LGE: for capability issue, some architecture other than 23+23 cannot meet the 1Tx PC2 requirement. We should differentiate it.  Skyworks: we disagree with LGE. It is wrong way to make TxD as baseline. The baseline is at least one full power PA.  LGE: Skyworks simulation can meet the requirement. But simulation results would be different for other company.  Ericsson: RAN4 minimum requirement makes sure the minimum performance for network operation. If we discuss the high power mode with high MPR and larger tolerance and signal cancellation between Tx, then there would be meaningless to allow high power UE.  Agreement:   * Leave TxD as implementation aspect and assume that UE that does not declare TxD meets 1Tx requirements and has at least one full power PA   + Only UE supporting 23+23 for PC2 and UE supporting 26+26 for PC1.5 are allowed to report TxD     - FFS whether 1Tx PC2 MPR requirement or 23+23 TxD MPR requirement needs be applied to 23+26 UE   + If PC2 UE does not report TxD, then 1Tx PC2 MPR requirement will be applied at least in one Tx operation mode |
| **2.2.4 Sub-topic 2-4: UE with full power PA and TxD**  **Issue 2-4-2: Requirements for UE with full power PA and TxD support** | Option 1: Define requirements and capability separately for 26+23 and 26+26 implementations for TxD (Qualcomm)  Option 2: Test both 1Tx and TxD requirements for the UE that declares TxD and has full power PA (Skyworks, Ericsson, Oppo, Samsung, Huawei, vivo)  Vast majority prefers not to create a capability but TxD indication means requirements in suffix G apply and otherwise 1Tx requirements apply.  *Tentative agreements after 1st round:*. If such new class of implementation is recognized with different MPRs, then distinguishing 26+23 and 26+26 is supported by (Skyworks, Ericsson, Oppo, Samsung) and same requirements apply is supported by (Huawei, Qualcomm, vivo)  *Recommendations for 2nd round:* Confirm simply the agreement from issue 2-4-1 with WF. Maybe add a note the situation with 26+23 vs 26+26 requirements in the background information.  Friday GTW, this issue is dependent on issue 2-4-1.  Discussion  Agreement: |

#### Companies views’ collection for 1st round

**Issue 2-4-1: Declaration of TxD for UE’s with at least one full power PA**

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| --- | --- |
| **Company** | **Comments** |
| Skyworks | In our proposals we assumed that TxD would be signaled only if there is no full power PA available. If TxD can still be signaled for the case where there is at least one full power PA. we need additional signaling to separate the different PA architectures and clarify when 1Tx requirement may apply. |
| Ericsson | Option 2 would be useful, then TxD is only indicated by UEs that must virtualize to meet the declared power class. We recognize that there may be modes of operation in which the UE may virtualize even if implemented with a full power PA. Now, for 2TX virtualizing the SRS for two-port transmissions does appear questionable (RAN1 in fact advised against in their reply on antenna virtualization for 2TX) so UE implemented with full power PA should meet single-port antenna requirements for at least one connector.  From a network perspective a capability is less useful given the MPR differences, but we encourage implementations with full power PAs. Moreover, any 2TX antenna virtualization (SRS transmissions) should be consistent such that a UE transmits 2 layers as it would for 1 layer. Example: a Mode 2 with full-power TPMI (23 + 26 dBm at least) should meet the requirements for single-port transmission at least for one connector.  The R4-2117200 is very comprehensive. Hats off for a good contribution! |
| OPPO | Option 2 (Leave TxD as implementation aspect and assume that UE that does not declare TxD meets 1Tx requirements and has at least one full power PA) |
| Samsung | Option 2. Firstly, we agree with it should be allowed to have a UE with full power PA to claim its support of TxD. But before discussion on capaiblity, the group can conclude the set of requirement for 23+26 and 26+26 firstly. For defining the new capability, we still see the ambiguity to discuss:   * In QC’s paper (R4-2117632), it is argued that PC2 UE may claim its support of TxD for more power backoff (based on the tentative agreement of MPR for 2TX case) which is higher than its need, but we don’t see the big problem because for UE with 26+23, it can claim its support ULFPTx Mode-1 without claiming TxD support, and it can also claim its support of ULFPTx Mode 2 with full TPMI reporting mechanism without claiming TxD support. In short, these UE implementation (even claiming its support of ULFPTx) still be allowed to not support TxD. If TxD is claimed, more margin is given and those TxD UE are not superior than non-TxD UE. We don’t see the big problem.   Even for the capability, more clarification is needed because we see different proposal of OPPO, which is based on UE’s claim of architecture, rather than fulfilling certain requirement set. |
| Xiaomi | Option 2. If the declared power class is met without TxD reporting, it can be assumed the UE has at least one full power PA. |
| Qualcomm | To enable different MPRs, a capability is needed to distinguish between implementation 23+23 and X+Y where X and/or Y is > 23 dBm.  It should also be noted that there is a difference between   1. UE that is 1Tx full power capable i.e. the base line UE that also uses TxD. 2. Requirements for UE that is full power capable when it turns on TxD   Our preference is to define that capability since it provided important information to the network but it seems we are alone (not sure about Skyworks) so we can end all this MPR discussion then.  To Oppo, your paper has this proposal:  Proposal 3: It is proposed to define a new UE capability for TxD UE to distinguish whether PA configuration is 1Tx or 2Tx in single antenna port mode. [Draft LS is in the annex]  How is that different from Option 1: Define a capability to declare UE support for TxD when it has at least one full power PA.  Or do you mean that *every UE is TxD UE, some just have full power PA* as opposed to *some UEs are 1Tx full power capable but maye also have the second PA and turn on TxD* |
| Huawei | Option 2 is preferred, for a PC2 UE which is not indicated with TxD, the 1Tx requirements would apply. |
| Vivo | Option 2. Though we can understand what Qualcomm say that more information to network can be provided, it may not be that necessary in most of cases. |
| Apple | If a simple one bit TxD indication is used then we would prefer to generally assume that a UE signaling TxD has no full power PA available. And if TxD is not signaled then the UE should meet single Tx requirements (e.i. Option 2). Otherwise, we would not be against more complex signaling allowing to distinguish the different PA setups. Such a signaling could be beneficial for other topics as well. |

**Issue 2-4-2: Requirements for UE with full power PA and TxD support**

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| **Company** | **Comments** |
| Skyworks | In our proposals we assumed that TxD would be signaled only if there is no full power PA available thus only distinction left was between 26+23 vs 26+26. If TxD can be asserted whatever the case, we need to distinguish the 3 possible implementations for both 1Tx and 2Tx operation |
| Ericsson | Option 2 perhaps, see comment to Issue 2-4-1. |
| OPPO | Option 2 (Test both 1Tx and TxD requirements for the UE that declares TxD and has full power PA). Regarding Option 1, it relates to Issue 2-3-1 and Issue 2-3-2. If separate MPR defined then signaling might be needed. |
| Samsung | Different from Op1 and Op2. Prefer simpler solution. If UE’s claim of its support of TxD, the requirement defined in suffix G applies. Argument is provided in previous issue 2-4-1. |
| Qualcomm | So if we agree option 2 in in 2-4-1, issue 2-4-2 and whole sub topic 2-3 are not neither needed.  Or how would anyone know if UE has full power PA if it declares TxD and needs to be tested for TxD and 1Tx requirements? Or the other way around, how would anyone know that UE that does not declare TxD can turn TxD on?  Our view is that if option 1 in 2-4-1 is chosen then option 2 is sufficient. 23+26 and 26+26 does not need to be distinguished. |
| Huawei | Firstly, we think that it may not be necessary to differentiate the requirements for 23+26 and 26+26 as commented for issue 2-3.  Secondly, we agree with Samsung that a simpler solution would be better. Whether 1Tx requirements or TxD requirements apply for 2Tx capable UE depends on the indication of TxD. |
| vivo | Share Samsung’s view on the simpler solution: For UE claim supporting TxD only requirments in suffix G applies. No need to separate requirements for 26+23 and 26+26; |

### 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** |
| [**R4-2118875**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118875.zip) | Skyworks: in our view the CR and signaling needs to bring a solution for all cases:  23+23 with mandatory TxD to meet full power  26+23 optional TxD for full power but 1Tx MPR applies in both 1Tx and 2Tx with without TxD  26+26 (optional TxD?) PC2 1Tx MPR applies for 1Tx operation wo TxD, max(0,PC1.5MPR-3dB) applies if TxD for 1Tx or 2Tx operation. |
| Company B: we do not quite agree with the CR but an interesting idea if used for a related purpose. A capability for distinguishing a 23 + 26 dBm and avoid the blanket additional 3 dB relaxation for PC2 with SRS switching (6 dB total)? If indicated the gNB is aware that the UE is using a lower power for the R-ports with single-port SRS? |
| ZTE: Agree with Skyworks’ views. In addition, for 23+26, if PC2 is achieved via 1Tx at 26dBm-PA, it has nothing to do with TxD. The proposed term for the signaling “TxD PA configuration as 1Tx” may cause confusion. |
| Qualcomm: Why Oppo supports option 2 in 2-4-1 but CR has new capability proposed? *TxD\_PAconfigurations.* The CR is good skeleton but we should first agree clearly there is a new capability and discuss definition of it. I hope it is clear **that this PA configurations are for UE that has fullk power PA and supports TxD.** |
| Huawei: We think that a new UE capability to differentiate 2Tx implementation is not necessary, TxD capability can fulfill the purpose for the applicable requirements, if no TxD is indicated, then the 1Tx requirements apply. |

## 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 2-1 MPR Table placement** | Option 1: Place all tables in the general subclause 6.2.2 (Skyworks, Samsung)  Option 2: Place tables for dual TX in suffix G, 6.2G.2 (Ericsson, LGE, ZTE, Qualcomm, Huawei)  Option 3: Other possible solutions, please only opt for this if you provide a conclusive solution (ZTE: add no suffix as “single carrier single Tx, 2Tx&1CC in “D” or “G”)  *Tentative agreements after 1st round* Go with majority view, MPR table placement should not be too controversial since it is merely a documentation issue so hope Skyworks and Samsung can compromise here. We can also accommodate ZTE comments on clarifying the suffixless definition but this is better left for discussion on the 2nd round.  *Recommendations for 2nd round:* draft CR according to majority view, Huawei [R4-2118550](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118550.zip) to be revised or the original approved.  Friday GTW 15 mins.  Discussion:  Skyworks: we are OK with option 2. The table is also applicable to UL-MIMO. We need a UL-MIMO section to be pointed from this table. PC1.5 is for UL-MIMO. The MPR tables are for both TxD and UL-MIMO.  Ericsson: we are OK to put table under the section corresponding to scenario which the requirement is intended to be used. Prefer to 6D.X.  ZTE: we should consider the current spec structure. There is overlapping between sections. We can add section for single carrier and single Tx. We would like to avoid overlapping.  Qualcomm: we can reuse the requirement. We can put pointer between section G and D. To Ericsson, majority of companies want to put the requirement under G section. We can even to put requirement in the annex and point to it.  Samsung: same as Skyworks. Key point is to align the requirement between UL\_MIMO and TxD. We prefer to put it under section G. In Rel-16 there is no TxD.  Huawei: Agree with Qualcomm. The same requirement will be used for UL-MIMO and TxD. We would like to follow majority views.  Ericsson: in order to keep consistence to Rel-16, and considering RAN5, we prefer to section D. Consider the test application.  Huawei: this is WID for TxD. I am not sure if putting it in UL-MIMO is proper.  LGE: Fine to define in D. We can combine suffix G and D.  Agreement:   * Restruct the specification to capture the requirements of MPR in the way to align the requirement between TxD and UL-MIMO   + Option 1:Place tables for dual TX in suffix D, 6.2D.2     - Point the MPR requirement for TxD to this table.   Option 2: Merge section D and G |
| **Sub-topic 2-2: MPR values for TxD PC2** | Option 1: Change CP-OFDM(QPSK & 16QAM) Edge RB from 3.5 to 4.0 dB (LGE)  Option 2: Change CP-OFDM 256QAM, from 8.5 to 8.0 dB (Skyworks, LGE, Ericsson)  Option 3: No changes (ZTE?)  *Tentative agreements after 1st round:* Seems no-one was against the proposed changes. Option 2 received most support. There was also one question asked.  *Recommendations for 2nd round:* Draft CR according to original proposals from LGE? Check if this approach is acceptable.  Friday GTW, 10 mins.  Discussion:  LGE: support both option. Based on the simulation results.  ZTE: this is an important requirement. It seems only one company provided input.  Skyworks: we also provided the input.  LGE: we re-simulate some cases.  Ericsson: For both, tolerance is 5dB. 0.5dB seems not make too much difference during the test, since the tolerance is large. We propose using the smaller number. We should take into account the tolerance for MPR.  Skyworks: we support the both changes.  Agreement:   * Change CP-OFDM 256QAM, from 8.5 to 8.0 dB   Change CP-OFDM(QPSK & 16QAM) Edge RB from 3.5 to 4.0 dB |
| **Sub-topic 2-4: UE with full power PA and TxD**  **Issue 2-4-1: Declaration of TxD for UE’s with at least one full power PA** | Option 1: Define a capability to declare UE support for TxD when it has at least one full power PA (Qualcomm)  Option 2: Leave TxD as implementation aspect and assume that UE that does not declare TxD meets 1Tx requirements and has at least one full power PA (Skyworks, Ericsson, Oppo, Samsung: if requirements are different; Xiaomi, Huawei, vivo, Apple)  Vast majority prefers not to create capability  *Tentative agreements after 1st round:* UE that does not declare TxD has atleast one full power PA and 1Tx requirements apply.  *Recommendations for 2nd round:* Confirm agreement in WF.  Friday GTW, 30 min. Conclusion about this issue has an impact to 2-2, 2-3 and topic #3  Discussion:  Qualcomm: there would be different requirements for 23+26 and 26+26. Do we need differentiate them from 1Tx implementation?  Ericsson: from network side, singaling is useful if there is big difference for MPR. If it is just performance test, it is RAN5. We should focus on whether the UE behavior is changed or new function. We do not need to discuss testing. Any UE can be declared in RAN5.  Skyworks: TxD is worse case to implement PC2. I do not want to let UE with 26dBm PA to declare TxD. The network should be sure what happens.  Qualcomm: We have discussion on MPR. I do not know the rule. To Ericsson, there is papers to discuss how TxD UE behaves in the network. Even though there would be MPR difference, it is good for network to know whether UE has a full power PA.  Ericsson: We fully agree with Skyworks. Qualcomm had a good point with singling cancellation. TxD is transparent. It is difficult for gNB to do something. We would like to power requirement to ensure that UE meets the requirement at connector with PA. We would like to see the requirements encourage the implementation with full power PA. If UE is equipped with full PA, it should not declare TxD. There is uncertainty of MPR. It should not be default case.  Huawei: two things whether to introduce the different requirements for different configurations. Whether we should differentiate 23+26 and 26+26? For 23+23 the TxD is only possible implementation to meet PC2. For the other two, they do not need to report TxD capability.  Skyworks: we need understand whether there is different requirement. 23+26 and 26+26 can meet 1Tx PC2 MPR requirement. We are OK if we agree PC2 TxD requirement only cover 23+23. 26+26 does not require TxD.  Samsung: like What Huawei commented, we can separately discuss the requirement and capability. For capability, it should be static capability based on UE implementation. If CDD is not well configured, then there is performance degradation. How can UE do something even if we agree on the capability.  ZTE: Does UE have freedom to choose TxD PC2 or 1Tx PC2? Network does not know which mode UE uses. We can preclude such freedom.  Qualcomm: I do not know how to preclude the freedom. The baseband can implement the TxD. Then UE has full power PA but it can get the easier requirement if it declares the support of TxD.  Apple: TxD is introduced for some transparent for gNB. The baseline assumption is 23+23. The TxD signaling should be used only for 23+23.  LGE: for capability issue, some architecture other than 23+23 cannot meet the 1Tx PC2 requirement. We should differentiate it.  Skyworks: we disagree with LGE. It is wrong way to make TxD as baseline. The baseline is at least one full power PA.  LGE: Skyworks simulation can meet the requirement. But simulation results would be different for other company.  Ericsson: RAN4 minimum requirement makes sure the minimum performance for network operation. If we discuss the high power mode with high MPR and larger tolerance and signal cancellation between Tx, then there would be meaningless to allow high power UE.  Agreement:   * Leave TxD as implementation aspect and assume that UE that does not declare TxD meets 1Tx requirements and has at least one full power PA   + Only UE supporting 23+23 for PC2 and UE supporting 26+26 for PC1.5 are allowed to report TxD     - FFS whether 1Tx PC2 MPR requirement or 23+23 TxD MPR requirement needs be applied to 23+26 UE   + If PC2 UE does not report TxD, then 1Tx PC2 MPR requirement will be applied at least in one Tx operation mode |
| **2.2.4 Sub-topic 2-4: UE with full power PA and TxD**  **Issue 2-4-2: Requirements for UE with full power PA and TxD support** | Option 1: Define requirements and capability separately for 26+23 and 26+26 implementations for TxD (Qualcomm)  Option 2: Test both 1Tx and TxD requirements for the UE that declares TxD and has full power PA (Skyworks, Ericsson, Oppo, Samsung, Huawei, vivo)  Vast majority prefers not to create a capability but TxD indication means requirements in suffix G apply and otherwise 1Tx requirements apply.  *Tentative agreements after 1st round:*. If such new class of implementation is recognized with different MPRs, then distinguishing 26+23 and 26+26 is supported by (Skyworks, Ericsson, Oppo, Samsung) and same requirements apply is supported by (Huawei, Qualcomm, vivo)  *Recommendations for 2nd round:* Confirm simply the agreement from issue 2-4-1 with WF. Maybe add a note the situation with 26+23 vs 26+26 requirements in the background information.  Friday GTW, this issue is dependent on issue 2-4-1.  Discussion  Agreement: |
| **Sub-topic 2-3: MPR applicability when there is full power PA**  **Issue 2-3-1: PC2 26+23 dBm MPR** | Option 1: 1Tx PC2 MPR Table 6.2.2-2 in 38.101-1 applies for 26+23 dBm (Skyworks, Ericsson, Oppo, Samsung, Huawei)  Option 2: Other, please provide how to change and justification for it (LGE, vivo: 26+23 follows 23+23)  *Tentative agreements after 1st round:* Majority prefers to apply 1Tx MPRs for 26+23 dBm implementation.  *Recommendations for 2nd round:* Continue discussion and intent to agree majority view in WF to approve the MPR applicability. This issue needs to be connected with subtopic 2-4.  Friday GTW 5 min, this issue is dependent on issue 2-4-1.  Discussion:  Skyworks: we compared all the different cases. In our view, it is fair to enable 23+26 to use 1Tx requirement.  LGE: We can further discuss it based on simulation results.  Agreement: encourage companies to provide more evaluation and measurement data in future. |
| **Sub-topic 2-3: MPR applicability when there is full power PA**  **Issue 2-3-2: PC2 26+26 dBm MPR** | Option 1: PC2 MPR[dB]= Max 0, Table 6.2.2-4 MPR - 3dB) for smartphones (Skyworks, Ericsson, Oppo, Samsung)  Option 2: Other, please provide how to change and justification for it (Qualcomm: Opt1 creates a new version of PC1.5 and is redundant; Huawei: prefer to apply 26+23 MPR here, vivo: no needed)  *Tentative agreements after 1st round:* small majority prefers option 1 but it seems that the benefit of introducing 26+26 is questioned by the opposing companies.  *Recommendations for 2nd round:* Continue discussion and intent to agree majority view in WF to approve the MPR applicability. This issue needs to be connected with subtopic 2-4.  Friday GTW 5 min, this issue is dependent on issue 2-4-1.  Discussion: |

### 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** |
| R4-2118550  Draft CR TS 38.101-1: Move PC1.5 MPR to Clause 6.2G | 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”.*

|  |  |
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| **CR/TP number** | **Company comments** |
| R4-2118550 revised to  Draft CR TS 38.101-1: Move PC1.5 MPR to Clause 6.2G |  |
| R4-21XXXX  WF on PC2 TxD implementations with 26+23 and 26+26 PA’s |  |
| R4-21XXXX  Draft CR on MPR of Tx Diversity (TxD) PC2 for two PC3 PA architecture |  |
| R4-21XXXX  WF on MPR table placement for dual TX |  |

# Topic #3: SRS antenna switching

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

SRS antenna switching topic seems complicated with many different proposals and CR’s. Intention is in the 1st round to agree on some bigger principles and comments on proposes CRs and then aim in the 2nd round to focus on one CR to capture what was agreeable.

## Companies’ contributions summary

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| **T-doc number** |  | **Company** | **Proposals / Observations** |
| [**R4-2118133**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118133.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’  Proposal 3: for UEs indicating ULFPTx Mode 2 supporting full-power TPMI, a exceptional ∆TRxSRS = 6/7.5 dB allowed for single-port transmissions; for two-port SRS transmissions ∆TRxSRS = 3/4.5 dB.  Proposal 4: a capability indicating ∆TRxSRS = 0 dB or an indication of different SRS transmission power across T- and R-connectors for ULFPTx Mode 2 could be considered with a view to avoid exceptions and faciliate measurements of SRS antenna strength. |
| [**R4-2118134**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118134.zip) | CR: Correction to Pcmax for SRS usage set as antenna switching | Ericsson, Apple | CR with the changes proposed in 8133 |
| [**R4-2118218**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118218.zip) | Discussion on Transparent TxD – SRS antenna switching related | Samsung | * Proposal 1: For 1T2R SRS antenna switching, UE capable of both 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;   + 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 is no longer allowed. * Proposal 2: For 1T4R SRS antenna switching, UE capable of both 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;   + 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 is no longer allowed.   + 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 both PC2 (with ΔPPowerClass = 0 dB) and tranparent TxD:   + No change is needed for TxD UE, so still on 3rd and 4th antenna port, 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. * Observation 1: For UE capable of both PC3 and tranparent TxD, RAN4 clarify whether or not 20dBm + 20dBm implementation is allowed**.** |
| [**R4-2118219**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118219.zip) | Draft CR on configured power requirement for TxD UE with SRS antenna switching | Samsung | CR based on 8218 |
| [**R4-2118283**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118283.zip) | Discussion on SRS antenna switching for TxD | vivo | **Proposal 1:** With TxD capable UE that with only half-power PA compared to declared power class possible, new relaxation of 3dB should be introduced for the cases of optimum Tx chain, while 2T4R which adapt to TxD can still have no relaxation.  **Observation 1:** *SRS-TxSwtich* can be continued to use in Rel-17, while introducing *SRS-TxSwtich-v1610* parameters would make the requirements more complicated.  **Observation 2:** Requirements depend on other Rel-16 signalling such as *SRS-TxSwtich-v1610* may bring more difficulty for release independency of TxD to be achieved.  **Proposal 2:** Continue to use Rel-15 capability *SRS-TxSwtich* for Rel-17 TxD requirements and do not introduce *SRS-TxSwtich-v1610,* for simpler spec and easier release independency.  **Proposal 3:** Continue to consider lower possible PA configuration as current requirements did.  **Observation 3:** In current 38.101-1 V17.3.0, PC1.5 was simply added with PC2 in SRS swithicng part and no differentiation made.  **Proposal 4:** Define SRS switching requirements for PC1.5 in Rel-17 only (A CR to remove Rel-16 part of this is also provided in maintenance agenda), and the relaxation principle is similar to 23+23 for PC2.  **Proposal 5:** TxD would not impact the relaxation for DL-only carrier.  **Proposal 6**. A draft text proposal for SRS requirements, the developing procedure is as following, were provided in Annex and also include the CR.   * + Separate and list all the detailed conditions and corresponding insertion loss requirements;   + Group and combine the conditions by different set of requirements, combine TxD capable and non-TxD capable UE;   + Doing editorial refinements to make structure clearer;   **Proposal 7:** Send a LS to RAN1 to explain RAN4 agreements, and ask to clarify the case about SRS resource sharing between resource sets with different usage to avoid contradiction and make revisions if necessary. |
| [**R4-2118284**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118284.zip) | Draft CR on SRS antenna switching for TxD | vivo | CR based on 8283 |
| [**R4-2118878**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118878.zip) | R17 SRS IL for TxD | OPPO | 2.1 UE architecture  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.  2.2 SRS IL  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 1/2/3 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).   Observation 7: PC1.5 SRS IL can be covered by SRS IL for TxD.  Proposal 2: It is proposed to move PC1.5 SRS IL to SRS IL for TxD part since it inherently support TxD. |
| [**R4-2118879**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118879.zip) | Draft R17 CR on SRS IL for TxD | OPPO | CR based on 8878 |
| [**R4-2119287**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2119287.zip) | Discussion on TxD and SRS antenna switching | Apple | **Observation:** For SRS transmission with antenna switching there exist two competing approaches. One utilizes ∆TRxSRS with additional3dB while the other is based on deploying ∆PPowerClass with 3dB. The first approach would allow to use antenna virtualization which could potentially degrade DL-CSI estimation, while the second approach would prevent virtualization during SRS transmission.  **Proposal 1**: Use ∆PPowerClass with 3dB for TxD capable devices.  **Proposal 2**: Any solution on SRS antenna switching with TxD should account for PC1.5. |
| R4-2119524 | draft CR for TS 38.101-1 Tx diversity requirements (phase 2) | Huawei, HiSilicon | *Moderator note: will be used to capture agreements if merging is needed* |

## 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

*Sub-topic description:* Use of IL or use of delta P\_Powerclass for TxD implementation 3 dB lower SRS power compared to power class. Delta P\_Powerclass will keep the power window narrow. Some of the relevant proposals below. Most companies seem to assume Il is used so direct counter proposal to [**R4-2119287**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2119287.zip) does not exist.

[**R4-2119287**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2119287.zip)**:** Proposal 1: Use ∆PPowerClass with 3dB for TxD capable devices.

[**R4-2118133**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118133.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’

[**R4-2118283**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118283.zip)**: Proposal 1:** With TxD capable UE that with only half-power PA compared to declared power class possible, new relaxation of 3dB should be introduced for the cases of optimum Tx chain, while 2T4R which adapt to TxD can still have no relaxation.

[**R4-2118878**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118878.zip)**:** 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 1/2/3 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).

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| **Sub-topic 3-1**  Issue 3-1: use of ∆PPowerClass or 3 dB bigger IL | Option 1: use ∆PPowerClass (Ericsson, Apple, Xiaomi, ZTE)  Option 2: use larger IL (Huawei, vivo)  Option 3: Other options? (Samsung: for txd allow 3dB more IL)  Itseems difficult to converge,maybe because SRS antenna switching is complicated.  *Tentative agreements after 1st round:* Take different approach and define lower maximum power for TxD separately from current parameters. This is Samsung’s approach.  *Recommendations for 2nd round:* Continue discussions with Samsung’s approach and separately specify the impact of not virtualizing the SRS for antenna switching. WF.  Discussion:  Qualcomm (moderator): the previous agreement is that no virtulization will be used for SRS switching. 3dBm lower power. We can accept Samsung approach.  Ericsson: the main problem is the insertion loss is give blank 6dBm which results in very difference between anntenas. We would like to minimize the too large relaxation. SRS requirements will be impacted regardless of power class. Delta\_power class is the perfect. PCmax only applies for SRS transmission occasion. We do not see the conflict due to duty cycle.  Skyworks: even if UE cannot meet the maximum output, Delta-power class reflects the fact. There are a lot of discussion about the PA numbers and power, i.e., 23+23… Depending on the architecture, the requirement would be different.  Samsung: to Ericsson comment, we are not far from each other. Even for second port the insertion loss is not allowed. 3dB for both 1st and 2nd ports. How to define the 3dB needs more discussion.  Ericsson: it would be useful to have some signaling to tell network that for some port there is difference. For 2Tx cases, we see no additional issue. For 23+26, need more discussion.  Vivo: using insertion loss is more reasonable. Insertion loss is used for SRS antenna relaxation before. If we use delta-Powerclass, it means upper limit of Pcmax will be lower. Maybe some UE does not need 3dB relaxation for first port. It is reasonable to apply 3dB for lower bound. To Samsung, regarding the second port, whether it needs extra insertion loss or not, if UE would like to use TxD, then it would be more reasonable to improve the performance for second Tx. If we use 0dB for second Tx, there will be constraint and it will lead to worse performance.  OPPO: similar as VIVO especially to allow 23+26 to support TxD. If so Vivo comment is valid. Regarding 1T2R SRS, even UE with 23+23 configuration, in the implemtation UE only active one PA to transmit on all the antenna, and then 3dB and insertion loss is needed.  Huawei: Besides the issue identified by Vivo and OPPO. For some UL-MIMO configuration, the power should…  Ericsson: even if UE does not report TxD, it is still allowed 6dB relaxation blankly. If device indicates TxD, you should apply Delta\_powerclass. We should make the feature works when defining the minimum requirements which implies some implementation.  Apple: there are different UE architecture but the baseband is just 23+23. Delta-power class is useful. Both upper and lower bound should be 3dB lower. |

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

**Issue 3-1: use of ∆PPowerClass or 3 dB bigger IL**

* Proposals
  + Option 1: use **∆PPowerClass** (Ericsson, Apple)
  + Option 2: use larger IL ()
  + Option 3: Other options?
* Recommended WF
  + TBA

#### Companies views’ collection for 1st round

**Issue 3-1: use of ∆PPowerClass or 3 dB bigger IL**

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| **Company** | **Comments** |
| Ericsson | Option 1 as proponent. The IL should only be used for the purpose of allowing insertion loss and be independent of power class (and input power to the R-connectors)  But an interesting proposal in Samsung’s R4-2118218: is the IL = 0 dB for the second resource for 1T2R in general when the UE indicates TxD (R-connector used for second TX)? |
| Nokia | We understand the motivation to use ΔPPowerClass instead of IL. But ΔPPowerClass has been used for multiple purposes. We think that ΔPPowerClass is not always used exclusively. Then, we may have an issue since it is not sure what the requirement is when P-max of 23 dBm is signalled by network and relaxation due to IL is required simultaneously. |
| OPPO | Ok with either option 1 or option 2. If go with option 1 the meaning of delta Ppowerclass is enlarged from power class indication.  Regarding the IL for TxD UE configured with 1T2R, there might be different implementations, UE1 use one PA for both antennas, UE2 use separate PA for each antenna. This gives different IL, and spec should cover both implementation, i.e. UE1 should be accommodated and IL is not 0dB. |
| Samsung | Option 2 is not our proposal in R4-2118218 and we would like to clarify more:   * Take 1T2R as example, for UE capable of both PC2 (with ΔPPowerClass = 0 dB) and tranparent TxD, 3dB (due to non-full-rated PA) can be allowed for 1st and 2nd ports, we propose to not allow insertion loss. * In other words, for 1T2R UE capable of PC2 and TxD, just allow 3dB for 1st and 2nd ports. * Our understanding is Option 1 is also not the relevant company’s proposal. More clarification could be given. |
| Xiaomi | We slightly prefer option 1, as it was agreed that SRS antenna switching which was targeted for DL CSI would not use UL antenna virtualization, i.e. UL TxD , the approach using ΔPPowerClass which can be applied to both Pcmax\_L and Pcma\_H seems more reasonable. |
| ZTE | Option 1, which fits for the primary purpose of introducing TxD. and it is “fixed”, while IL describes more or less “the dynamic” connection between PAs to antennas, so for a TxD capable PC2 UE with 23+23, an IL will be added in addition to 3dB for ‘2T4R’ SRS antenna switching for non-main antennas. |
| Huawei | Prefer option 2. Delta SRS in current spec is specific to SRS antenna switching occasion. For other usages, it is still under discussion in sub-topic 3-5. |
| vivo | Option 2.  We think using delta\_powerclass (option 1) is problematic since it may preclude TxD capable UE to equip a full-power PA. For example: if a TxD UE can equip a full-power PA, then it is possible for the UE to use this full-power PA to do SRS transmission for SRS antenna switching without virtualization, and this would need 0dB relaxation. In this sense, the upper limit of Pcmax do not need to be limited, and insertion loss only applied to Pcmax\_L would be perfectly match.  Furthermore, as some other companies also pointed out, there is already functions for delta\_power class and it is the insertion loss part serve for SRS antenna switching relaxation, it is also more natural extension to continue using insertion loss. |
| Apple | We support option 1. SRS antenna switching should not use antenna virtualization. If there are collisions due to multiple use of ΔPPowerClass it might be needed to investigate whether different wording could solve the issue. |

### Sub-topic 3-2

*Sub-topic description:* Relation of delta SRS IL with UL MIMO. It was stated earlier that the UE may use lower power PA that is available for UL MIMO reasons and due to routing is easier if the main PA does not need to be routed to all antenna ports. If allowed lower power for SRSs and the assumption should be coupled with the UL MIMO capability should be discussed and principle agreed. For 1st round intention is to discuss if groups wanta to couple the Ul MIMO capabilities with SRS antenna sw IL and then 2nd round see what modes and how to capture.

[**R4-2118133**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118133.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’
* Proposal 3: for UEs indicating ULFPTx Mode 2 supporting full-power TPMI, a exceptional ∆TRxSRS = 6/7.5 dB allowed for single-port transmissions; for two-port SRS transmissions ∆TRxSRS = 3/4.5 dB.

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

**Issue 3-2: Are SRS power relaxations condition to some UL MIMO modes**

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

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| **Sub-topic 3-2:**  Issue 3-2: Are SRS power relaxations condition to some UL MIMO modes | Option 1: Yes (Ericsson, Nokia, Xiaomi)  Option 2: No (Oppo, Samsung, ZTE, Qualcomm, Huawei, vivo, Apple)  Not sure about Skyworks, comment here seems to be about issue 2-4-1 but there the position is opposite, no capability?  Majority prefers not to couple SRS relaxations with any UL MIMO modes  *Tentative agreements after 1st round:* CR that allow power relaxation due to UE not virtualizing SRS for antenna switching for UE indicating TxD should not refer to any of the UL MIMO capabilities.  *Recommendations for 2nd round:* Confirm the tentative agreement. WF.  Discussion:  Skyworks: need clarification on the proposal.  Ericsson: are we going to distinguish different cases? It is related to single port relaxation discussion.  Xiaomi: the intention is to indicate the UL power mode is to single the PA architeuture. We are open to discussion on the other signaling.  Qualcomm: no way to test what UE implementation is. We should not do apply the relaxation depending on reported UL-mimo capability. SRS switching is downlink MIMO feature.  OPPO: the issue is misleading. What is the meaning of “condition to”. SRS power relaxation should not depend on UL MIMO capability.  Huawei: RAN1 sent LS to RAN4 to check if it is possible to indicate the implementation. There is no one to one mapping from UE implementation to UL-MIMO capability. There is no way to differentiate the implementation.  Ericsson: agree with Xiaomi. We have proposed to distinguish the relaxation between different implementations. RAN1 has nothing to preclude any implementation. For mode 1 the understanding is to use two half power PA. We can only do the worst case relaxation. There will be 6dB blank relaxation for all the PC2.  ZTE: there could be some UE to be equipped with two PA to only support TxD but not UL-MIMO. For such UE, if the SRS relaxation replies on UL-MIMO, then what relaxation will be applied. |

#### Companies views’ collection for 1st round

**Issue 3-2: Allow lower power SRS power for UL MIMO modes**

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| **Company** | **Comments** |
| Skyworks | Question for clarification: If PA architectures that implement at least one full power PA are allowed to signal TxD how can we distinguish? For 26+23dBm case and signaling 2T2R how do we apply the relaxation?  We believe that we need a proper signaling design in R17 to distinguish the 3 implementation cases 23+23, 26+23 and 26+26 or in other words 3 generic cases:  0 full power PA  1 full power PA on main antenna  2 full power PAs  Such signaling would also be a good approach for UL CA. |
| Ericsson | Option 1 as proponent. Our aim is to minimize the cases for which the UE is allowed a 6 dB relaxation, now allowed for any PC2 implementation and SRS transmission. An exception should only be granted for a 26 + 23 dBm implementation sounding on one of the PAs. In our view this is a Mode 2 implementation indicating full-power TPMI.  One alternative is to introduce an indication that the R-ports are sounded with a different input power like the capability proposed in the OPPO CR R4-2118875. Then the gNB would be aware and could account for this in the estimation of the antenna strength  Power reductions due to the insertion loss the ∆TRxSRS can significantly degrade quality of CSI at the gNB, any differences in UE antenna element performance not accounted for. The ∆TRxSRS should be as small as possible (routing loss allowance).  The t2r2 case would be a two-port SRS and the power should be split equally between the ports no matter the PA power rating. |
| Nokia | Option 1: it seems possible. |
| OPPO | For clarification of the question itself, does it mean the SRS IL is depending on the UL MIMO mode 0/1/2 capability? If it is, then Option 2, since ULFPTx is an optional capability, not all 2Tx UEs support this capability.  In our paper R4-2118874 and CR R4-2118875 it is proposed to define a new UE capability for TxD UE to distinguish whether PA configuration is 1Tx or 2Tx in single antenna port mode as below:   * When the UE capability (*TxD\_PAconfigurations*) indicate 1Tx it means UE use one 26dBm PA to achieve the max power defined by power class capability.   When the UE capability (*TxD\_PAconfigurations*) indicate 2Tx it means UE use two PAs to achieve the max power defined by power class capability. |
| Samsung | Prefer to have different SRS power relaxation based on TxD capability. |
| Xiaomi | Option 1 Yes, If 26 + 23 dBm implementation is also possible for TxD |
| ZTE | Option 2 No. SRS power relaxation does not depend on the support of UL-MIMO if the number of receive antennas in SRS switching is larger than the number of transmit antennas in UL-MIMO. |
| Qualcomm | UE should be allowed to support TxD and SRS power should be properly aligned regardless of UE supporting UL MIMO (any of the modes or 2-layers). |
| Huawei | Option 2. Not suitable to couple TxD and ULFTPx together to determine the SRS power relaxation. |
| vivo | Option 2. SRS power relaxations for TxD should not depend on ULFPTx mode since they are different features. |
| Apple | It seems that the proposals for more granular architecture signaling could be a good and future proof solution and could also help with Issue 2-4-1. It would allow to grant the additional IL only where it is needed without linking it to ULFPTx mode. |

### Sub-topic 3-3

*Sub-topic description:* If PC1.5 should be handled part of TxD for SRS IL or not.

[**R4-2118878**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118878.zip)Proposal 2: It is proposed to move PC1.5 SRS IL to SRS IL for TxD part since it inherently support TxD.

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

**Issue 3-3: PC1.5 handling**

* Proposals
  + Option 1: Yes, PC1.5 IL is conditional to TxD
  + Option 2: No, PC1.5 should be allowed extra 3dB only because of power class declaration
* Recommended WF
  + TBA

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| **Sub-topic 3-3:**  If PC1.5 should be handled part of TxD for SRS IL or not.  Issue 3-3: PC1.5 handling | Option 1: Yes, PC1.5 IL is conditional to TxD (Oppo, Apple)  Option 2: No, PC1.,5 should be allowed extra 3dB only because of power class declaration (Skyworks, Ericsson, Nokia, ZTE, Qualcomm, Huawei)  To clarify the options:  if Opt1 is chosen, mentioning TxD indication in SRS IL in specification would suffice  If Opt2 is chosen means for PC1.5 need to be mentioned in the SRS IL specification.  Majority prefers to make the additional SRS power relaxation condition to PC1.5 declaration only.  *Tentative agreements after 1st round:* The additional power relaxation shall mention PC1.5 explicitly (in addition to TxD indication).  *Recommendations for 2nd round:* Confirm the tentative agreement that PC1.5 is explicitly allowed lower SRS power. WF.  Discussion:  OPPO: Option 1 and 2 are OK for us.  Huawei: no big difference between option 1 and 2.  Agreement: PC1.5 should be allowed extra 3dB only because of power class declaration |

#### Companies views’ collection for 1st round

**Issue 3-3: PC1.5 handling**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Skyworks | PC1.5 is mandatory TxD for 1Tx operation but for SRS switching it cannot use TxD thus it should be back to a PC2 case for IL and then the 3dB relaxation only needed due to power class declaration (option 2) in essence it is a similar case than PC2 with two 23dBm PAs |
| Ericsson | Option 2. The same if it also indicates TxD. |
| Nokia | Option 2. |
| OPPO | We propose Option 1. Actually no matter the IL is due to power class declaration or TxD, 3dB IL is allowed. And PC1.5 intrinsically support TxD, it can be included in TxD. |
| Xiaomi | No clear what’s difference and purpose for these two options. |
| ZTE | Option 2. PC1.5 must rely on TxD, i.e, 3dB less. On top of this, SRS IL should be considered for non-main antennas. |
| Qualcomm | Option 2. PC1.5 = TxD for Rel-16 and Rel-17 atleast |
| Huawei | PC1.5 is anyway based on assumption of TxD implementation. SRS relaxation for TxD can already cover the power class. |
| vivo | Not quite clear the differences. Agree that PC 1.5 must rely on TxD at least for Rel-16/17. No strong view on how the spec drafted, as long as clear enough. |
| Apple | Not quite sure about the exact meaning of the two options. However, to our understanding if UE signals PC1.5 capability it should also indicate TxD as there is no single port PUSCH for this power class. Similar relaxations are required as any UE using TxD for achieving full power with two half power PAs. From our perspective it would make sense to use TxD with PC1.5 and reuse the same requirements. |

### Sub-topic 3-4

*Sub-topic description:* Which specification part to capture the additional lower power for SRS due to not virtualizing the SRS

[**R4-2118219**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118219.zip) CR has only Clauses affected: 6.2G.4

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

**Issue 3-4: Applicable clause for lower power SRS relaxation due to TxD**

* Proposals
  + Option 1: Same as general, 6.2.4
  + Option 2 TxD suffix G
* Recommended WF
  + TBA

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| --- | --- |
| **3.2.4 Sub-topic 3-4**  Issue 3-4: Applicable clause for lower power SRS relaxation due to TxD | Option 1: Same as general, 6.2.4 (Ericsson, Oppo, Huawei)  Option 2 TxD suffix G (Samsung, ZTE, Qualcomm)  Moderator prefers and recommends (also in issue 3-1) that we specify SRS power relaxation (compared to power class) separately.  *Tentative agreements after 1st round:* Perfect tie. Suffix G is better location but group will need to converge.  *Recommendations for 2nd round:* Continue discussions. If consensus is that SRS IL due to TxD and PC1.5 indication is defined separately, then placement in suffix G might make more sense. WF.  Discussion:  Agreement: |

#### Companies views’ collection for 1st round

**Issue 3-4: Applicable clause for lower power SRS relaxation due to TxD**

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| --- | --- |
| **Company** | **Comments** |
| Ericsson | Option 1 since also applicable when the UE is not configured with UL-MIMO (the required allowance for the PA configuration mapped the supported feature rather than the implementation). Or both clauses. The case(s) of TxD perhaps moved to 6.2G.4? |
| OPPO | Option 1. TxD 6.2G.4 refers to the general section 6.2.4 |
| Samsung | Option 2. Our understanding is if UE claim its support of TxD, the requirement 6.2G.4 applies for configured power, so the SRS relaxation for TxD supported UE should be given in section with suffix G. |
| Xiaomi | Either is ok. |
| ZTE | Option 2 seems a better place for the SRS power relaxation due to TxD. |
| Qualcomm | Ericsson has a good point that the SRS usage ant sw should not be virtualized regardless of the configuration. But suffix G still seems more appropriate. Option 2. There is some dependency if we define requirements for TxD for 26+23 and 26+26 cases. |
| Huawei | Prefer option 1. |
| vivo | No strong view and there are merits for both options.  The merit of option 1 is minimized duplication can be achieved after careful planning, just as our draft CR R4-2118284. The merit of option 2 may be more dedicated requirements can be easier to draft and read, since not have to consider 1Tx/2Tx cases together. |

### Sub-topic 3-5

*Sub-topic description:* When SRS resources different usage’s than antenna switching, can the SRS transmission not be virtualized? And what about if it is shared

[**R4-2118283**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118283.zip) **Proposal 7:** Send a LS to RAN1 to explain RAN4 agreements, and ask to clarify the case about SRS resource sharing between resource sets with different usage to avoid contradiction and make revisions if necessary.

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

**Issue 3-5: SRS virtualization for other usages than antenna switching**

* Proposals
  + Option 1: SRS does not need to be virtualized when SRS usage set for antennaSwitching is shared with any of the usages: beamManagement, codebook, nonCodebook
  + Option 2: SRS must be virtualized for all other usages than antennaSwitching but not when shared with antennaSwitching
  + Option 3: SRS need to be virtualized for usage beamManagement, codebook, nonCodebook but not for usage antennaSwitching and RAN4 needs to ask RAN1 what is the expected UE behaviour in this case
* Recommended WF
  + TBA

|  |  |
| --- | --- |
| **Sub-topic 3-5**  Issue 3-5: SRS virtualization for other usages than antenna switching | Option 1: SRS does not need to be virtualized when SRS usage set for antennaSwitching is shared with any of the usages: beamManagement, codebook, nonCodebook (Oppo)  Option 2: SRS must be virtualized for all other usages than antennaSwitching but not when shared with antennaSwitching  Option 3: SRS need to be virtualized for usage beamManagement, codebook, nonCodebook but not for usage antennaSwitching and RAN4 needs to ask RAN1 what is the expected UE behaviour in this case (Ericsson, Apple)  Nokia, Samsung, Qualcomm, Huawei, ZTE(?) preferred to continue discussions in the next meeting (no option provided originally)  *Tentative agreements after 1st round:* No agreements can be made now except to continue discussions.  *Recommendations for 2nd round:* Capture further discussions outcome can be captured in to a WF.  Discussion:  Agreement: |

#### Companies views’ collection for 1st round

**Issue 3-5: SRS virtualization for other usages than antenna switching**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | A good idea to ask RAN1 for clarification on SRS resource sharing, RAN1 is studying reusing same resources among multiple usages for SRS overhead reduction. |
| Nokia | Asking RAN1 could be one of the ways if diverse views are seen in RAN4. But it would be better to discuss this in the next RAN4 meeting where we discuss one usage to usage carefully. For example, for non-codebook based transmission, if a UE uses virtualization to transmit 4 SRS resources indexed 1 - 4, and if gNB lists 1 and 4 to the UE after receiving the SRS resources, the UE should use rank 2, but when the same UE uses transmit 1 and 4 simultaneously, the UE cannot use the same antenna configurations when it transmitted SRS resources. Then, virtualization may not be good to be used for non-codebook. |
| OPPO | Others.  Antenna virtualization is UE implementation specific, it cannot be mandated to support and can be supported by UE when SRS is used for beamManagement, codebook and nonCodebook.  When SRS resources are shared between antenna switching and other usage, virtualization cannot be used since UE use same hardware to transmit the SRS.  There is no need to ask RAN1. |
| Samsung | As far as we know it is the first time to propose this possible contradicting usages for two SRS resource sets which share the same SRS resource. If RAN4 group can’t preclude this scenario, seems sending LS to RAN1 for clarification can be useful. |
| ZTE | Not clear on what is exactly “resource sharing”. |
| Qualcomm | There actually is no room for confusion. Firstly, there is SRS resource designated with resource ID. Then there is resourse set that has ‘usage’. That resource set uses specific resources (with ID). Different resource sets can use same resources. If SRS resource is scheduled, it is scheduled with resources set. So physical transmitted SRS resource always has one explicitly defined ‘usage’.  We would be aligned with Samsung on this and would like companies to check with their RAN1 delegates if this actually is a problem. |
| Huawei | It would be better to focus on SRS antenna switching for this meeting, if needed, RAN4 can further discuss other usages in next meeting. No need to rush for the clarification by RAN1. |
| vivo | The problem is that currently a SRS resource can be shared between different resource sets that have different usage, so if the assumption of virtualization have conflict, there may confusion on this. Since the resource set usage set is most discussed and designed in RAN1, and may not be that familiar for RAN4, so ask RAN1’s views would be helpful. The problem itself seems also clear.  To OPPO: Agree that virtualization is an implementation. If RAN4 can have agreements that once a SRS resource is not permitted to do virtualization, virtualization would be forbidden for it and also other related channels, PUSCH e.g. It may also solve potential conflict within RAN4. However, this may still needs further discussion and possible confirmation of the impact to RAN1.  To Qualcomm: We think there are still cases that might be problematic. For example, if the periodic SRS is considered, then there may no such 'dynamic scheduling' of SRS, the issues of different resource sets use the same periodic resource would persist.  To Nokia & Huawei: Agree that this issue may not be urgent and we can postpone it to next meeting if really deemed necessary. However, since the problem itself is not that complicated, an LS out may not be that difficult to compose. It may not be harmful to let the discussion to happen simultaneously in RAN1 and RAN4 in next meeting. |
| Apple | Having clarification from RAN1 could be an option. |

### 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 (since all CRs have companioning discussion paper, comment here about CR details, not the content since we will have a discussion)** |
| [**R4-2118879**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118879.zip) **O**ppo | Ericsson: not agreed, the IL should not be used for the purpose of decreasing the power when the reason for this is the input power to the T or R connector.  Company B |
| [**R4-2118284**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118284.zip)vivo | Ericsson: not agreed, the blanket 6 dB allowance for PC2 should not be allowed and downgrading values missing.  Vivo: To Ericsson, it is not clear what is the meaning of the question? We do not introduce any 6dB allowance for PC2 in the CR.  Company B |
| [**R4-2118134**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118134.zip)Ericsson, Apple | OPPO: For two-port SRS transmission case, there is no exceptions defined in the CR. Isn’t the 3rd and 4th antenna also need the additional 3dB/4.5dB IL in 2T4R case? |
| [**R4-2118219**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118219.zip)  Samsung | Ericsson: the Ppowerclass should be used for making sure the UE does not virtualize, should preferably not be confused with the IL.  Samsung: ΔPPowerClass = 0 dB in our CR is used to discriminate UE for expected power of 23dBm and 26dBm, which is the condition and not related to IL value. As we comment above, SRS power requirement for antenna switching should be given in suffix G, which is a clearer solution: if TxD is supported, configured power requirement in suffix G applies.  Vivo:To Ericsson: Ppowerclass may unnecessary limits the SRS transmission power for a UE equip a full-power PA and also support TxD. IL is more adaptable. Details see sub-topic 3-1. |

## 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 3-1**  Issue 3-1: use of ∆PPowerClass or 3 dB bigger IL | Option 1: use ∆PPowerClass (Ericsson, Apple, Xiaomi, ZTE)  Option 2: use larger IL (Huawei, vivo)  Option 3: Other options? (Samsung: for txd allow 3dB more IL)  Itseems difficult to converge,maybe because SRS antenna switching is complicated.  *Tentative agreements after 1st round:* Take different approach and define lower maximum power for TxD separately from current parameters. This is Samsung’s approach.  *Recommendations for 2nd round:* Continue discussions with Samsung’s approach and separately specify the impact of not virtualizing the SRS for antenna switching. WF.  Discussion:  Qualcomm (moderator): the previous agreement is that no virtulization will be used for SRS switching. 3dBm lower power. We can accept Samsung approach.  Ericsson: the main problem is the insertion loss is give blank 6dBm which results in very difference between anntenas. We would like to minimize the too large relaxation. SRS requirements will be impacted regardless of power class. Delta\_power class is the perfect. PCmax only applies for SRS transmission occasion. We do not see the conflict due to duty cycle.  Skyworks: even if UE cannot meet the maximum output, Delta-power class reflects the fact. There are a lot of discussion about the PA numbers and power, i.e., 23+23… Depending on the architecture, the requirement would be different.  Samsung: to Ericsson comment, we are not far from each other. Even for second port the insertion loss is not allowed. 3dB for both 1st and 2nd ports. How to define the 3dB needs more discussion.  Ericsson: it would be useful to have some signaling to tell network that for some port there is difference. For 2Tx cases, we see no additional issue. For 23+26, need more discussion.  Vivo: using insertion loss is more reasonable. Insertion loss is used for SRS antenna relaxation before. If we use delta-Powerclass, it means upper limit of Pcmax will be lower. Maybe some UE does not need 3dB relaxation for first port. It is reasonable to apply 3dB for lower bound. To Samsung, regarding the second port, whether it needs extra insertion loss or not, if UE would like to use TxD, then it would be more reasonable to improve the performance for second Tx. If we use 0dB for second Tx, there will be constraint and it will lead to worse performance.  OPPO: similar as VIVO especially to allow 23+26 to support TxD. If so Vivo comment is valid. Regarding 1T2R SRS, even UE with 23+23 configuration, in the implemtation UE only active one PA to transmit on all the antenna, and then 3dB and insertion loss is needed.  Huawei: Besides the issue identified by Vivo and OPPO. For some UL-MIMO configuration, the power should…  Ericsson: even if UE does not report TxD, it is still allowed 6dB relaxation blankly. If device indicates TxD, you should apply Delta\_powerclass. We should make the feature works when defining the minimum requirements which implies some implementation.  Apple: there are different UE architecture but the baseband is just 23+23. Delta-power class is useful. Both upper and lower bound should be 3dB lower. |
| **Sub-topic 3-2:**  Issue 3-2: Are SRS power relaxations condition to some UL MIMO modes | Option 1: Yes (Ericsson, Nokia, Xiaomi)  Option 2: No (Oppo, Samsung, ZTE, Qualcomm, Huawei, vivo, Apple)  Not sure about Skyworks, comment here seems to be about issue 2-4-1 but there the position is opposite, no capability?  Majority prefers not to couple SRS relaxations with any UL MIMO modes  *Tentative agreements after 1st round:* CR that allow power relaxation due to UE not virtualizing SRS for antenna switching for UE indicating TxD should not refer to any of the UL MIMO capabilities.  *Recommendations for 2nd round:* Confirm the tentative agreement. WF.  Discussion:  Skyworks: need clarification on the proposal.  Ericsson: are we going to distinguish different cases? It is related to single port relaxation discussion.  Xiaomi: the intention is to indicate the UL power mode is to single the PA architeuture. We are open to discussion on the other signaling.  Qualcomm: no way to test what UE implementation is. We should not do apply the relaxation depending on reported UL-mimo capability. SRS switching is downlink MIMO feature.  OPPO: the issue is misleading. What is the meaning of “condition to”. SRS power relaxation should not depend on UL MIMO capability.  Huawei: RAN1 sent LS to RAN4 to check if it is possible to indicate the implementation. There is no one to one mapping from UE implementation to UL-MIMO capability. There is no way to differentiate the implementation.  Ericsson: agree with Xiaomi. We have proposed to distinguish the relaxation between different implementations. RAN1 has nothing to preclude any implementation. For mode 1 the understanding is to use two half power PA. We can only do the worst case relaxation. There will be 6dB blank relaxation for all the PC2.  ZTE: there could be some UE to be equipped with two PA to only support TxD but not UL-MIMO. For such UE, if the SRS relaxation replies on UL-MIMO, then what relaxation will be applied. |
| **Sub-topic 3-3:**  If PC1.5 should be handled part of TxD for SRS IL or not.  Issue 3-3: PC1.5 handling | Option 1: Yes, PC1.5 IL is conditional to TxD (Oppo, Apple)  Option 2: No, PC1.,5 should be allowed extra 3dB only because of power class declaration (Skyworks, Ericsson, Nokia, ZTE, Qualcomm, Huawei)  To clarify the options:  if Opt1 is chosen, mentioning TxD indication in SRS IL in specification would suffice  If Opt2 is chosen means for PC1.5 need to be mentioned in the SRS IL specification.  Majority prefers to make the additional SRS power relaxation condition to PC1.5 declaration only.  *Tentative agreements after 1st round:* The additional power relaxation shall mention PC1.5 explicitly (in addition to TxD indication).  *Recommendations for 2nd round:* Confirm the tentative agreement that PC1.5 is explicitly allowed lower SRS power. WF.  Discussion:  OPPO: Option 1 and 2 are OK for us.  Huawei: no big difference between option 1 and 2.  Agreement: PC1.5 should be allowed extra 3dB only because of power class declaration |
| **3.2.4 Sub-topic 3-4**  Issue 3-4: Applicable clause for lower power SRS relaxation due to TxD | Option 1: Same as general, 6.2.4 (Ericsson, Oppo, Huawei)  Option 2 TxD suffix G (Samsung, ZTE, Qualcomm)  Moderator prefers and recommends (also in issue 3-1) that we specify SRS power relaxation (compared to power class) separately.  *Tentative agreements after 1st round:* Perfect tie. Suffix G is better location but group will need to converge.  *Recommendations for 2nd round:* Continue discussions. If consensus is that SRS IL due to TxD and PC1.5 indication is defined separately, then placement in suffix G might make more sense. WF.  Discussion:  Agreement: |
| **Sub-topic 3-5**  Issue 3-5: SRS virtualization for other usages than antenna switching | Option 1: SRS does not need to be virtualized when SRS usage set for antennaSwitching is shared with any of the usages: beamManagement, codebook, nonCodebook (Oppo)  Option 2: SRS must be virtualized for all other usages than antennaSwitching but not when shared with antennaSwitching  Option 3: SRS need to be virtualized for usage beamManagement, codebook, nonCodebook but not for usage antennaSwitching and RAN4 needs to ask RAN1 what is the expected UE behaviour in this case (Ericsson, Apple)  Nokia, Samsung, Qualcomm, Huawei, ZTE(?) preferred to continue discussions in the next meeting (no option provided originally)  *Tentative agreements after 1st round:* No agreements can be made now except to continue discussions.  *Recommendations for 2nd round:* Capture further discussions outcome can be captured in to a WF.  Discussion:  Agreement: |

### 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”.*

|  |  |
| --- | --- |
| **Title** | **Company Comments** |
| R4-21xxxx  WF on SRS antenna switching requirements for TxD and PC1.5 |  |
| R4-2119524  draft CR for TS 38.101-1 Tx diversity requirements (phase 2) |  |

# Topic #4: ULFPTx

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

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** |  | **Company** | **Proposals / Observations** |
| [**R4-2117632**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2117632.zip) | On enabling ULFPTx UEs to employ transparent TxD | Qualcomm Incorporated | Observation 1: In the case of a UE that declares a full power TPMI, the network cannot presume existence of a full-power PA if the UE also asserts the tTxD flag.  Observation 2: A PC2 UE can avail of relaxed MPRs in 6.2G.2 V17.3 simply by asserting tTxD, even if it possesses a full power PA.  Observation 3: A PC2 UE may need to assert tTxD while at the same time being compliant with single Tx MPRs rather than the relaxed MPRs in 6.2G.2.  Proposal 1: The tTxD capability shall be extended to include a third type of UE (‘TxD\_singleTxMPR’) that implements Tx diversity but complies with single Tx PC2 MPR of 6.2.2 of TS38.101-2.  Proposal 2: Redirection clause for UEs that support ULFPTx and assert tTxD:  If UE does not support Tx diversity or supports *TxD\_singleTxMPR* [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 6.2.1/2 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. For a UE that supports *TxD\_singleTxMPR* the output power is defined as the sum of the output power from both UE antenna connectors*.*  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 6.2G.1/2 apply for the power class as indicated by the *ue-PowerClass* field in capability signalling. |
| [**R4-2118135**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118135.zip) | CR: Correction to UL-MIMO requirements for single-port antenna transmission | Ericsson | Clause 6.2D.1:  The requirements in 6.2 are the baseline for single-port transmissions, exceptions granted for TxD or Mode 1  That shall meet requirements accoridng to 6.2G. Mode 2 with full-power shall meet the fallback rerquirement according to 6.2.  6.2D.2: Full power TPMI mode 2 verified against requirements according to 6.2 shall meet requirements with MPR according to 1 TX.  6.2D.3: Full power TPMI mode 2 verified against requirements according to 6.2 shall meet requirements with A-MPR according to 1 TX. |
| [**R4-2118220**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118220.zip) | Further Discussion on Transparent TxD – 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: In the Section 6.2D.1 MOP requirement for UL-MIMO, there is not requirement applicable to the UE supporting Tx diversity 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.  Observation-3: After TxD UE is introduced in Rel-17, MOP requirement of Rel-16 ULFPTx Mode-1 UE needs no revisit.  Observation-4: After TxD UE is introduced in Rel-17, MOP requirement of Rel-16 ULFPTx Mode-2 UE needs no revisit.  Observation-5: After TxD UE is introduced in Rel-17, MOP requirement of Rel-16 ULFPTx Mode-0 UE needs no revisit.  Observation 6: 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 MOP requirement for TxD UE (with or without ULFPTx configured) shall be referred to Section 6.2G.1.  Proposal 2: For UE supporting TxD (with or without ULFPTx configured), MPR requirement specified in Section 6.2G.2 shall be applied, while the requirement in Section 6.2D.2 only apply for non-TxD UE. |
| [**R4-2118221**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118221.zip) | TP to TR 38.837 for TxD’s impact on ULFPTx-related requirement | Samsung | TP for TR based on the 8220 |
| [**R4-2118601**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118601.zip) | On the relationship between NR TxD and ULFPTx | ZTE Wistron Telecom AB | Observation 1: NR TxD and ULFPTx may have different rated power class capabilities for the same band.  Observation 2: NR TxD and ULFPTx mode 1 are different in terms of number of antenna port(s), though both have single layer with both PAs active.  Proposal 1: RAN4 does not establish any association between NR TxD and ULFPTx since they are two different independent UE features. |

## 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 4-1 Mode 1 and mode 2 with TxD

*Sub-topic description:* In general, is TxD generic regardless of ULFPTx or does Ran4 set conditions between capabilities. Following proposals discuss these issues

[**R4-2118220**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118220.zip)

* Proposal 1: The MOP requirement for TxD UE (with or without ULFPTx configured) shall be referred to Section 6.2G.1.
* Proposal 2: For UE supporting TxD (with or without ULFPTx configured), MPR requirement specified in Section 6.2G.2 shall be applied, while the requirement in Section 6.2D.2 only apply for non-TxD UE.

[**R4-2118135**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118135.zip) (CR) Excludes mode 2 UE from relying on TxD requirements. Also mandates mode 1 to support TxD. Defines also 1Tx MPR for mode 2 with full power TPMI.

[**R4-2118601**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118601.zip) Proposal 1: RAN4 does not establish any association between NR TxD and ULFPTx since they are two different independent UE features.

[**R4-2117632**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2117632.zip) Proposal 2: Redirection clause for UEs that support ULFPTx and assert tTxD: (in generic, i.e. no conditionif it is mode 2 or not, see paper for text)

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

**Issue 4-1-1: Mode 2 and TxD**

* Proposals
  + Option 1: Mode 2 with full-power TPMI is not verified against 6.2G for single-antenna port transmission (Ericsson)
  + Option 2: TxD declaration is applicable for all ULFPTx modes (Qualcomm, Samsung, ZTE)
* Recommended WF
  + TBA

**Issue 4-1-2: Mode 1 and TxD**

* Proposals
  + Option 1: TxD and Mode 1 are both exempted from the requirements in 6.2 (Ericsson)
  + Option 2: Suffix G requirements apply only based on UE indicating TxD (Qualcomm, Samsung, ZTE)
* Recommended WF
  + TBA

**Issue 4-1-3: MPR requirements for UE declaring support for full power TPMI for ULFPTx mode 2**

* Proposals
  + Option 1: Full power TPMI mode 2 verified against requirements according to 6.2 shall meet requirements with MPR/A-MPR according to 1 TX (Ericsson)
  + Option 2: MPR requirements for full power TPMI according to ULFPTx mode 2 depend if UE indicates TxD or not
* Recommended WF

## Companies views’ collection for 1st round

### Open issues

**Issue 4-1-1: Mode 2 and TxD**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Option 1 as proponent. This issue is related to Issue 2-4-1.  As commented on Issue 2-4-1, we recognize that there may be modes of operation in which the UE may virtualize even if implemented with a full power PA. However, for 2TX virtualizing the SRS for two-port transmissions does appear questionable (RAN1 in fact advised against in their reply on antenna virtualization for 2TX) so UE Mode 2 with full-power TPMI should meet single-port antenna requirements for at least one connector (6.2).  From a network perspective, antenna virtualization (SRS transmissions) should be consistent such that a UE transmits 2 layers as it would for 1 layer. Furthermore, for a Mode 2 supporting both one-port and two-port SRS, the SRS port mapping should be consistent for one- and two-antenna port transmissions for predictable channel estimates. SRS transmissions are not that frequent. Therefore, we propose that the maximum power requirements in single-antenna port fallback be met per connector notwithstanding any other indication. |
| Nokia | * A; If a UE not indicating TxD, but using Mode 2 for a band, option 1 looks correct. * B; If a UE indicating TxD and also using Mode 2 for a band, option 2 looks correct.   And if above “A” may not be relevant to TxD discussion. The discussion is about how Mode 2 MOP should look.  Note that it’s difficult to understand the intention of the option 2. Why does suddenly the option 2 mention all the modes? |
| OPPO | Option 2. There is already agreements that there is no dependency between TxD and ULFPTx. |
| Samsung | Option 2. Our understanding is Mode-2 can also use TxD:   * As explained in our contribution R4-2118220, there are two modes for ULFPTx Mode-2 * For Mode-2 mechanism-1, TxD is relied for full power transmission.   <Content from R4-2118220>   * ULFPTx Mode 2 Mechanism-1 (SRS port virtualization):   + In this Mechanism-1, UE is configured multiple SRS resources having different number of ports, while the full power transmission is achieved if SRI is indicated for the SRS with one port. In this mechanism-1, the same power scaling as Rel-15 is applied.     Fig. 2. Illustration of Rel-16 ULFPTx Mode 2 (Mechanism-1, SRS port virtualization)   * ULFPTx Mode 2 Mechanism-2 (TPMI indication):   + In this Mechanism-2, UE reports existing TPMI(s) available for full power transmission, and the only difference comes from the different behaviour of power scaling:     - For full power TPMI, Rel-16 power scaling factor s = 1 is applied;     - For non-full-power TPMI, Rel-15 power scaling factor is applied, as illustrated below.     Fig. 3. Illustration of Rel-16 ULFPTx Mode 2 (Mechanism-2, TPMI indication) |
| ZTE | Option 2. A 23+26 UE can limit 26dBm-PA to 23dBm to support PC2 via TxD. It is up to UE’s implementation as long as the corresponding requirements are satisfied. |
| Qualcomm | In theory, mode 2 can use TxD but we are also ok to exclude that for Rel-17 if well justified. We can then discuss if to introduce it and network wants to control TxD usage in later relases. Option 2. |
| Huawei | Option 2. There is no direct relationship of UFLPTx modes and TxD and which mode is mapped to which specific implementation. |
| vivo | Option 2. |

**Issue 4-1-2: Mode 1 and TxD**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXXEricsson (moderator clarification based on author) | Option 1 as proponent. UEs equipped with full-power PAs and complaint with 6.2 per connector should be the “default” for single antenna-port fallback, then we allow exceptions for TxD and Mode 1 (Mode 2 without full-power TPMI could possibly be added to the list but not preferred as commented above) |
| Nokia | As far as a UE indicating TxD for a band 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, suffix G requirements apply. If this is what option 2 mentions, option 2 looks correct.  For Option 1, it seems that Mode 1 cannot be exempted if a UE does not indicate TxD, but using Mode 1 for a band. |
| OPPO | For mode 1 UE, it’s PA configuration is 23+23, thus only apply suffix G requirements and exempted from 6.2.  For TxD, it can be supported with 23+23, 23+26, or 26+26 in theory, thus which requirement (suffix G or 6.2) apply depends on how it transmit in single antenna port, i.e. if with 1Tx then 6.2 apply, if with 2Tx then suffix G apply. |
| Samsung | Option 2 but need more clarification on this option.  The requirement applicability for fallback DCI to suffix G is better to be based on TxD capability, which is clearer. So for UE is scheduled by fallback DCI and also claim its support of TxD, the requirement is redirected to suffix G, is that the understanding of Option 2? |
| ZTE | Option 2. |
| Qualcomm | Option 2 |
| Huawei | Option 2. |
| vivo | Option 2 |

**Issue 4-1-3: MPR requirements for UE declaring support for full power TPMI for ULFPTx mode 2**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Option 1 as proponent. Option 2 would imply that a UE equipped with a full-power PA but still indicating TxD could use the 2TX MPR and exploit the larger lower tolerances allowed for TxD, 3 dB instead of 2 dB at the maximum power and larger differences for larger MPR. For TxD in 6.2G  Table 6.2G.4-1: PCMAX,*c* tolerance for Tx Diverstiy   |  |  |  | | --- | --- | --- | | PCMAX,*c*(dBm) | Tolerance TLOW(PCMAX\_L,*c*) (dB) | Tolerance THIGH(PCMAX\_H,*c*) (dB) | | PCMAX,*c* = 26 | 3.0 | 2.0 | | 23 ≤ PCMAX,*c* < 26 | 3.0 | 2.0 | | 22 ≤ PCMAX,*c* < 23 | 5.0 | 2.0 | | 21 ≤ PCMAX,*c* < 22 | 5.0 | 3.0 | | 20 ≤ PCMAX,*c* < 21 | 6.0 | 4.0 |   while for 6.2  Table 6.2.4-1: PCMAX tolerance   |  |  | | --- | --- | | PCMAX,f,c (dBm) | Tolerance T(PCMAX,f,c) (dB) | | 23 < PCMAX,c ≤ 33 | 2.0 | | 21 ≤ PCMAX,c ≤ 23 | 2.0 | | 20 ≤ PCMAX,c < 21 | 2.5 | |
| OPPO | Option 1. If UE declare mode 2, then it means this UE will use 1 full power PA to transmit. Therefore, only general requirements apply.  If UE support 23+26 PAs but doesn’t declare mode 2 (e.g. doesn’t support ULPFTx feature), then this UE will be ambiguous how it transmit in single antenna port and not clear whether 6.2 or 6.2G apply. |
| Samsung | Same principle as Issue 4-1-2 shall be applied. |
| ZTE | Option 1. There is no dependency between ULFPTx and TxD. |
| Huawei | Mode 2 can also be implemented with TxD which is clarified by RAN1. No one to one mapping relation for ULFPTx modes and implementation. The applicable requirements would be better differentiated by indication of TxD. |
| vivo | Not quite clear yet. However, the basic understanding can reference the discussion Issue 4-1-1 “Mode 2 and TxD”, we think Mode 2 can also use TxD. |

### 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** |
| [**R4-2118135**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118135.zip) | OPPO: Wait for the outcome of above discussions. |
| Company B |
|  |
| [**R4-2118221**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118221.zip) | Ericsson: agreed, a good summary of the different modes (but does the TR need include the ‘study process’) |
| Samsung: The intention of this TP is to give more background for ULFPTx feature introduced in R16 eMIMO work item. More of the R16 discussion on ULFPTx is more related how to define requirement for that feature, but not that closely related to TxD (furthermore, the discussion closely related to TxD is well capture in TR already). Anyway, want to hear other companies’ view for how to improve TP. We are open to discuss. |
|  |

## 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 4-1 Mode 1 and mode 2 with TxD**  **Issue 4-1-1: Mode 2 and TxD** | Option 1: Mode 2 with full-power TPMI is not verified against 6.2G for single-antenna port transmission (Ericsson)  Option 2: TxD declaration is applicable for all ULFPTx modes (Qualcomm, Samsung, ZTE, Nokia (? assume this is for TxD), Oppo, Samsung, ZTE, Qualcomm, Huawei, vivo)  *Tentative agreements after 1st round:* Agreement is that for the UE indicating support for ULFPTx mode2, the requirements for single port configuration for that UE apply depending on TxD indication.  *Recommendations for 2nd round:* Confirm tentative agreement with WF. |
| **Sub-topic 4-1 Mode 1 and mode 2 with TxD**  **Issue 4-1-2: Mode 1 and TxD** | Option 1: TxD and Mode 1 are both exempted from the requirements in 6.2 (Ericsson, Oppo)  Option 2: Suffix G requirements apply only based on UE indicating TxD (Qualcomm, Samsung, ZTE, Nokia, Huawei, vivo)  Moderator recognizes that mode 1 and TxD UE behavior are same for RF but group preference is to keep capabilities separate.  *Tentative agreements after 1st round:* Agreement is that suffix and suffixless requirements apply regardless of ULFPTx mode 1 indication and are dependent only on TxD indication.  *Recommendations for 2nd round:* Confirm that suffix and suffixless requirements apply regardless of ULFPTx mode 1 indication and are dependent only on TxD indication. WF |
| **Sub-topic 4-1 Mode 1 and mode 2 with TxD**  **Issue 4-1-3: MPR requirements for UE declaring support for full power TPMI for ULFPTx mode 2** | Option 1: Full power TPMI mode 2 verified against requirements according to 6.2 shall meet requirements with MPR/A-MPR according to 1 TX (Ericsson, Oppo)  Option 2: MPR requirements for full power TPMI according to ULFPTx mode 2 depend if UE indicates TxD or not (Samsung, Huawei, ZTE(?), vivo)  Majority seems to prefer option2, some companies position is not very clear since option and rationale are opposite. But to follow issue 4-1-1  *Tentative agreements after 1st round:*  MPR requirements for mode 2 for single port depend on UE indicating TxD.  *Recommendations for 2nd round:* Continue discussion and confirm the tentative agreement if possible. |

### 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”.*

|  |  |
| --- | --- |
| **Title** | **Company Comments** |
| R4-21xxx  WF on ULFPTx with TxD |  |
| [**R4-2118135**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118135.zip)  CR: Correction to UL-MIMO requirements for single-port antenna transmission |  |
| R4-2118221  TP to TR 38.837 for TxD’s impact on ULFPTx-related requirement |  |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on PC2 TxD implementations with 26+23 and 26+26 PA’s | Qualcomm | Subtopic 2-3 and 2-4 |
| Draft CR on MPR of Tx Diversity (TxD) PC2 for two PC3 PA architecture | LGE | Subtopic 2-2 |
| WF on MPR table placement for dual TX | Huawei | Subtopic 2-1, also continue with revised CR R4-2118550 |
| WF on SRS antenna switching requirements for TxD and PC1.5 | Samsung | Topic #3. Check back after GTW convergence if revising draft CR R4-2119524 is possible. |
| WF on ULFPTx with TxD | Vivo | Topic#4. WF and revise Ericsson 8135 based on WF. |
| 3GPP TR 38.837 v0.2.0 | vivo | Email approval |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| Topic #1: General | | | | |
| [**R4-2117790**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2117790.zip) | 3GPP TR 38.837 v0.1.0 | vivo | Approve |  |
| [**R4-2118282**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118282.zip) | TP for TR 38.837 on capability signaling and applicable release | vivo | Approve |  |
| [**R4-2119496**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2119496.zip) | TxD work plan update | Qualcomm Incorporated | Approve |  |
| [**R4-2119525**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2119525.zip) | On release independent requirements for TxD | Huawei, HiSilicon | Note |  |
| [**R4-2119526**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2119526.zip) | draft CR for TS 38.307: release independent requirements for TxD | Huawei, HiSilicon | Revise | Samsung comments in 9525 |
| [R4-2118535](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118535.zip)  On update of TR 38.822 Rel-16 NR UE feature list | [R4-2118535](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118535.zip)  On update of TR 38.822 Rel-16 NR UE feature list | CMCC | Approve |  |
| R4-2118536  LS on Rel-16 updated RAN4 UE features lists for LTE and NR | R4-2118536  LS on Rel-16 updated RAN4 UE features lists for LTE and NR | CMCC | Approve |  |
| R4-2118537  Updated RAN4 UE features list for Rel-16 | R4-2118537  Updated RAN4 UE features list for Rel-16 | CMCC | Approve | Regarding Ericsson’s comments on applicable release, the title and content mention rel-16 and LS refers to earlier LS’s on this topic. So could Ericsson check if the language is ok as is? |
| Topic #2: Phase 1, MPR and capability | | | | |
| [**R4-2117200**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2117200.zip) | 1CC 2Tx MPR for different PAs implementations and signaling for 1CC and 2CC cases | Skyworks Solutions Inc. | Noted |  |
| [**R4-2118474**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118474.zip) | MPR of Tx Diversity (TxD) PC2 for two PC3 PA architecture | LG Electronics Inc. | Noted | Continue 2nd round to see if draft CR can be agreeable |
| [**R4-2118550**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118550.zip) | Draft CR TS 38.101-1: Move PC1.5 MPR to Clause 6.2G | Huawei, HiSilicon, Qualcomm | Revised | Continue discussion, also WF assigned |
| [**R4-2118874**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118874.zip) | R17 FR1 UL MIMO fallback to TxD and draft LS | OPPO | Noted |  |
| [**R4-2118875**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118875.zip) | Draft R17 CR on UL MIMO falllback to TxD | OPPO | Noted |  |
| [**R4-2119593**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2119593.zip) | On Using the Pseudo-Inverse to Define EVM for Transmit Diversity | Lenovo, Motorola Mobility | Noted |  |
| Topic #3: SRS antenna switching | | | | |
| [**R4-2118133**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118133.zip) | SRS antenna switching with antenna virtualization | Ericsson | Noted |  |
| [**R4-2118134**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118134.zip) | CR: Correction to Pcmax for SRS usage set as antenna switching | Ericsson, Apple | Noted |  |
| [**R4-2118218**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118218.zip) | Discussion on Transparent TxD – SRS antenna switching related | Samsung | Noted |  |
| [**R4-2118219**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118219.zip) | Draft CR on configured power requirement for TxD UE with SRS antenna switching | Samsung | Noted |  |
| [**R4-2118283**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118283.zip) | Discussion on SRS antenna switching for TxD | vivo | Noted |  |
| [**R4-2118284**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118284.zip) | Draft CR on SRS antenna switching for TxD | vivo | Noted |  |
| [**R4-2118878**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118878.zip) | R17 SRS IL for TxD | OPPO | Noted |  |
| [**R4-2118879**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118879.zip) | Draft R17 CR on SRS IL for TxD | OPPO | Noted |  |
| [**R4-2119287**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2119287.zip) | Discussion on TxD and SRS antenna switching | Apple | Noted |  |
| R4-2119524 | draft CR for TS 38.101-1 Tx diversity requirements (phase 2) | Huawei, HiSilicon | Return to |  |
| Topic #4: ULFPTx | | | | |
| [**R4-2117632**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2117632.zip) | On enabling ULFPTx UEs to employ transparent TxD | Qualcomm Incorporated | Noted |  |
| [**R4-2118135**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118135.zip) | CR: Correction to UL-MIMO requirements for single-port antenna transmission | Ericsson | Revised | Waiting for Ericsson feedback |
| [**R4-2118220**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118220.zip) | Further Discussion on Transparent TxD – ULFPTx related | Samsung | Noted |  |
| [**R4-2118221**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118221.zip) | TP to TR 38.837 for TxD’s impact on ULFPTx-related requirement | Samsung | Revise | Seems agreeable but proponent self wants to listen to the improvements. |
| [**R4-2118601**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_101-e/Docs/R4-2118601.zip) | On the relationship between NR TxD and ULFPTx | ZTE Wistron Telecom AB | 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

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-211xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-211xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-211xxxx | 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

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)