**3GPP TSG-RAN WG4 Meeting # 102-e R4-2206328**

**Electronic Meeting, 21 February – 03 March 2022**

**Agenda item:** 10.7

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for [128] NR\_TxD

**Document for:** Information

# Introduction

This document is a summary of discussions in thread [128] Tx Diversity that facilitates discussion targeted to complete objectives in WID RP-211940.

# Topic #1: Big CRs and TR maintenance

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

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| R4-2204595 | 3GPP TR 38.837 v0.4.0 | vivo | N/A, for email approval |
| [**R4-2204968**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204968.zip) | TP for TR 38.837 on Power Class Clarification for SA | vivo | TP for power class application for fallback DCI |
| R4-2205574 | Big CR for TS 38.101-1 Tx diversity requirements (phase 2) | Huawei, HiSilicon, Qualcomm, vivo | N/A, for 2nd round or email approval |
| [**R4-2205575**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205575.zip) | Big CR for TS 38.307: release independent requirements for TxD | Huawei, HiSilicon | CR For Rel-17 TS 38.307. TxD release indep from Rel-15 with section G requirements |

### CRs/TPs comments collection

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

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2205575 Big CR for TS 38.307: release independent requirements for TxD | ZTE: One question for clarification: TxD is not listed as one of the clauses in TS 38.307 Rel-15, how does it work if TxD is claimed to be release independent from Rel-15? |
| Huawei: to ZTE’s comments, the release independent manner is also discussed in the maintenance threads in this meeting. The general principle discussed there is only list the requirements in the latest specification, which is also aligned with our understanding. |
| Samsung: Do we really need to mention “6.2D.2 UE maximum output power reduction for UL MIMO (2Tx MPR)” in the Table B.4.8-1? Seems only mention 6.2G.2 in which the requirement refer to 2TX MPR table is enough. This row can be removed. |
|  |
| R4-2204968 TP for TR 38.837 on Power Class Clarification for SA | ZTE: Reference [1] should be RP-211597, not RP-211587, though it is not intended for being included in the TR. |
| Company B  Vivo: Thanks for ZTE for this. However, considering that this would not be included in the TR, we may not need to update it. |
|  |

## Summary for 1st round

### Open issues

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

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

### CRs/TPs

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

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

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| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| 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)

Issue 1-1: The implementation of agreement:

* In RAN4 spec, capture that PC1.5 implies TxD even if UE does not indicate TxD in UE capability.
* Option 1: 'Table 6.2.1-1: UE Power Class’ with text “Note 5: Power Class 1.5 is achieved via dual Tx and implies Tx Diversity even if UE does not indicate txDiversity-r16 in UE capability. The UE is not required to signal txDiversity-r16 capability for this power class.”
* Option 2: Other

|  |  |
| --- | --- |
| **Issue** | **Company comments** |
| 1-1 PC1.5 = TxD, where to caprture | Qualcomm: Ok with option1  Nokia:  The direction looks OK but we’d like to better understand the meaning of it.  What is the reason to still keep capturing “dual Tx”?  Is “imply” is really appropriate? How can we interpret this text? It’s not clear if a UE supports PC1.5 for a band shall meet all the requirements for TxD or not. If it shall meet them, it must be written in such a way.  “Note 5: Power Class 1.5 is achieved via ~~dual Tx and implies~~ Tx Diversity even if UE does not indicate txDiversity-r16 in UE capability. The UE is not required to signal txDiversity-r16 capability for this power class while the UE shall also comply with the requirements for Tx Diversity.”  OPPO: Option 1 with Nokia revision. Using the word “imply” in Option 1 should be avoided which has many different interpretations.  Apple: Thanks to Nokia for the proposed revision. We are fine with the updated wording.  Skyworks: we support option 1 with rewording. I think essentially the text should make clear that without signalling TxD for PC1.5, TxD requirements apply.  Huawei: As the requirements for TxD is different from single Tx, how to ensure the UE to pass the test w/o TxD indication? E.g. the MOP for TxD is based on sum of measurement of two antenna connectors. If such sum is based on declaration, it’s should also be ok, but some further clarification is needed in the spec.  “Note 5: Power Class 1.5 is achieved via ~~dual Tx and implies~~ Tx Diversity even if UE does not indicate txDiversity-r16 in UE capability. The UE is not required to signal txDiversity-r16 capability for this power class while the UE shall also comply with the requirements for Tx Diversity. For Power Class 1.5 UE not indicating TxD capability, the measurement of dual Tx requirements are based on declaration for supporting TxD.”  vivo: support companies’ proposal that the requirements applicability should also be clearly defined in the requirements.  Intel: We are fine with the proposed new wording.  T-Mobile USA: We think that going forward UEs that support PC1.5 should indicate txDiversity-r16 in case at some point in a future release there is a single PA PC1.5 solution. At that point it would be necessary to differentiate between PC1.5 UEs that use TxD and those with a single PA. However, we realize that there may already be PC1.5 UEs that don’t indicate txDiversity-r16. We would prefer that signalling txDiversity-r16 not be completely optional for PC1.5 going forwards. Therefore we propose a further revision to the Nokia proposal:  “Note 5: Power Class 1.5 is achieved via Tx Diversity even if UE does not indicate txDiversity-r16 in UE capability. The UE is not required to signal txDiversity-r16 capability for Rel-17.4.0 and earlier for this power class while the UE shall also comply with the requirements for Tx Diversity. From Rel-17.5.0 onward a UE that supports PC1.5 shall indicate txDiversity-r16.”  This will not guarantee that the gNB always knows if the UE supports TxD since early PC1.5 UEs may not indicate txDiversity-r16, but it will minimize ambiguity in the future. If a single Tx PC1.5 solution is ever added, the signalling of txDiversity-r16 would become optional based on if the UE supports PC1.5 with single Tx or TxD. |
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### CRs/TPs comment collection

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| --- | --- |
| **CR** | **Company comments** |
| Revision of**R4-2205575** Big CR for TS 38.307: release independent requirements for TxD  [Link to](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_102-e/Inbox/Drafts/%5B102-e%5D%5B128%5D%20NR_TxD/Round%202/CR%20on%2037307) [folder](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_102-e/Inbox/Drafts/%5B102-e%5D%5B128%5D%20NR_TxD/Round%202/CR%20on%2037307) |  |
| Revision of**R4-2205578** draft CR for TS 38.101-1: move 2Tx MPR to Clause 6.2D (Rel-16)  [Link to folder](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_102-e/Inbox/Drafts/%5B102-e%5D%5B128%5D%20NR_TxD/Round%202/CR%20on%20moving%20tables%20to%20D) |  |

# Topic #2: MPR

*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** |
| [**R4-2205578**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205578.zip) | draft CR for TS 38.101-1: move 2Tx MPR to Clause 6.2D (Rel-16) | Huawei, HiSilicon, Qualcomm | R16 mirror of moving the MPR tables to section D |
| [**R4-2206133**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206133.zip) | TP to TR38.837 on MPR evaluation for 2Tx PC2 and PC1.5 operation | Skyworks Solutions Inc. | TP with MPR agreements |

## Open issues summary

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

### 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** |
| R4-2205578 draft CR for TS 38.101-1: move 2Tx MPR to Clause 6.2D (Rel-16 | Skyworks: in R17, Table 6.2D.2-1 is used for PC3 2Tx vs PC1.5 in R16. Can this cause issues? |
| Company B |
|  |
| 1 | Skyworks: due to heavy load before the meeting and during the meeting, it is not likely that we will be able to update the TP. Without a complete update, there is no real value in the TP, it can thus be noted. We will work on providing a section for the MPR evaluation for May meeting. |
| vivo: It is ok to have this in May meeting. |
|  |

## Summary for 1st round

### Open issues

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

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

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

# Topic #3: SRS IL

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

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2205224**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205224.zip) | Draft CR on SRS IL for NR TxD | ZTE Wistron Telecom AB | Draft CR with changes among others  3dB when UE indicating *txDiversity-r16* and *SRS-TxSwitch* capability t1r1-t1r2’ or ‘t1r1-t1r2-t1r4’' and applied during SRS transmission occasions with *usage* in *SRS-ResourceSet* set as ‘antennaSwitching’ with configured SRS resources as the second resource in each SRS resource set(s) consisting of one SRS port;  - 3dB when UE indicating *txDiversity-r16* and *SRS-TxSwitch* capability 't2r4' and applied during SRS transmission occasions with *usage* in *SRS-ResourceSet* set as ‘antennaSwitching’ with configured SRS resources as the second resource in each SRS resource set(s) consisting of two SRS ports;  The value of ∆TRxSRS is 4.5dB for bands whose FUL\_high is higher than the FUL\_low of n79 and 3 dB for bands whose FUL\_high is lower than the FUL\_low of n79 when the device is capable of power class 3 or power class 5 or power class 1.5 in the band, or when the device is capable of power class 2 in the band and ΔPPowerClass = 3 dB, or when UE indicating *txDiversity-r16*~~.~~  The value of ∆TRxSRS is 7.5dB for bands whose FUL\_high is higher than the FUL\_low of n79 and 6 dB for bands whose FUL\_high is lower than the FUL\_low of n79 during SRS transmission occasions with configured SRS resources consisting of one SRS port when the device is capable of power class 2 in the band and ΔPPowerClass = 0 dB and not indicating *txDiversity-r16*. |
| [**R4-2204616**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204616.zip) | Pcmax for SRS usage set as antenna switching for TxD and UL-MIMO features | Ericsson | Draft CR with changes among others   * 3dB during SRS transmission occasions of configured SRS resources consisting of one SRS port in SRS resource set(s) with *usage* in *SRS-ResourceSet* set as ‘antennaSwitching’ for a UE indicating *txDiversity-r16* or indicating the feature *ul-FullPwrMode1-r16* or power class 1.5 for a band entry;   The value of ∆TRxSRS is 4.5dB for bands whose FUL\_high is higher than the FUL\_low of n79 and 3 dB for bands whose FUL\_high is lower than the FUL\_low of n79, except for UEs supporting power class 2 and *ul-FullPwrMode2-TPMIGroup-r1*6 or *maxNumberMIMO-LayersCB-PUSCH* without indicating *txDiversity-r16* for which the value of ∆TRxSRS is 7.5dB for bands whose FUL\_high is higher than the FUL\_low of n79 and 6 dB for bands whose FUL\_high is lower than the FUL\_low of n79 during SRS transmission occasions with configured SRS resources consisting of one SRS port in case ΔPPowerClass = 0 dB. |
| [**R4-2204836**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204836.zip) | Draft R17 CR on SRS IL for TxD | OPPO | Draft CR with changes among others   * 3dB when power class 2 or power class 1.5 capable UE indicating *txDiversity-r16* and *SRS-TxSwitch* capability 't1r1-t1r2' or 't1r1-t1r2-t1r4' and applied during SRS transmission occasions with *usage* in *SRS-ResourceSet* set as ‘antennaSwitching’ with configured SRS resources in the SRS resource set(s) consisting of one SRS port;   The value of ∆TRxSRS is 4.5dB for bands whose FUL\_high is higher than the FUL\_low of n79 and 3 dB for bands whose FUL\_high is lower than the FUL\_low of n79 when the device is capable of power class 3 or power class 5 or power class 1.5 in the band, or when the device is capable of power class 2 in the band and ΔPPowerClass = 3 dB, or when UE indicating *txDiversity-r16*~~.~~  The value of ∆TRxSRS is 7.5dB for bands whose FUL\_high is higher than the FUL\_low of n79 and 6 dB for bands whose FUL\_high is lower than the FUL\_low of n79 during SRS transmission occasions with configured SRS resources consisting of one SRS port when the device is capable of power class 2 in the band and ΔPPowerClass = 0 dB and not indicating *txDiversity-r16*. |
| [**R4-2204837**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204837.zip) | R17 FR1 TP to 38.837 for TxD SRS IL | OPPO | TP with CR 4836 contents |
| [**R4-2204921**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204921.zip) | R17 FR1 SRS IL for TxD and ULFPTx | OPPO | Observation 1: When UE is configured with 2 SRS port transmission, all ULFPTx modes have the same SRS IL, i.e. there is no need to consider ULFPTx modes in this case.  Observation 2: If follow RAN1 assumption that no restriction on UE implementation to achieve ULFPTx modes then there is no one to one mapping between ULFPTx modes and full power PA.  Observation 3: The concept of UE “implement” which kind of PAs are different from how UE “apply” PAs. And RAN4 can only define requirements based on UE “applied” PA but not “implemented” PA.  Proposal 1: Clarify that RAN4 can only define requirements based on the behavior of how UE “apply” PA but no restriction on how UE “implement” PA as long as requirements for the UE indicated capabilities are met.  Observation 4: Up to now there is agreed restriction on UE “apply” PA for TxD feature, i.e. only two half rated PAs applied but no restriction on ULFPTx feature, i.e. any kind of PAs (full or half rated) can be applied.  Observation 5: When configured for 1T4R SRS switch  • For UE indicates TxD with or w/o ULFPTx, the SRS power at main antenna has 3dB power back off  • For UE w/o indicating TxD, SRS full power can be reached at main antenna  Proposal 2: Update SRS IL according to TxD capabilities, i.e. if UE indicate TxD capability then delta Ppowerclass = 3dB is applied. |
| [**R4-2204969**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204969.zip) | Further discussion on SRS antenna switching for TxD | vivo | Observation 1: Considering the TxD architecture assumption for Rel-17, whether delta\_powerclass would only apply to Pcmax\_L should make no difference.  Proposal 1: Take the majority view and agree either option on whether Delta\_power class would apply only to Pcmax\_L.  Proposal 2: Prefer not to specifically mention ULFPTx modes for SRS insertion loss.  Proposal 3: Do not consider more clarification or LS to other WGs for SRS sharing. |
| [**R4-2203681**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203681.zip) | TxD and SRS antenna switching | Apple | Observation 1: The options from RAN4#101-e WF on ∆TRxSRS and ∆PPowerClass represent the fundamental decision between altering Pcmax lower bound only or the upper bound as well.  Observation 2: A UE with two half power amplifiers has no potential to transmit SRS with full power during antenna switching if it stays true to the agreement that no antenna virtualization is used. With using ∆PPowerClass the virtualization aspect would be ruled out entirely.  Proposal 1: To simplify the discussion and to simplify the specification work, it is proposed that the architecture assumption for deriving the TxD requirements is a UE with two half power amplifiers (e.g. for PC2 this would mean a 23+23 configuration).  Proposal 2: Use ∆PPowerClass to reduce the lower and upper Pcmax bounds. |
| [**R4-2205223**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205223.zip) | Discussion on SRS sharing and antenna switching | ZTE Wistron Telecom AB | Proposal 1: One SRS resource can be indicated by two resource sets with different usages.  Proposal 2: RAN4 does not need to send an LS on the SRS sharing issue.  Proposal 3: SRS power difference for antenna switching is not dependent on other features than TxD |
| [**R4-2205576**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205576.zip) | On SRS IL for TxD | Huawei, HiSilicon | Observation 1: the 3dB SRS power reduction with impact to PCMAX,H is only valid for some specific power classes.  Proposal 1: Removing PCMAX\_L,f,c condition but with clear description for specific power classes or keep it as a general case not differentiating power classes.  Proposal 2: TxD indication is enough for the relevant SRS IL requirement, no need to consider ULFPTx modes additionally or mix them together in the spec. |

## Open issues summary

Everyone seems to be aligned that also the upper limit for power can be reduced for SRS transmission power so no need to discuss that. An agreement can be captured in the form of a CR. Two issues seem to have opposing proposals: if ULFPTx modes need to be coupled in the conditions on what SRS IL applies and if and what power classes need to be mentioned in the IL requirements.

It should be noted that we should concentrate in CR text in this meeting since WI will close.

### Sub-topic 3-1: Does supported ULFPTx mode have impact on SRS IL

*Sub-topic description:*

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

**Issue 3-1-1: Mode1 SRS IL**

* Proposals
  + Option 1: Mode1 SRS IL should be lower by 3 dB (Ericsson)
  + Option 2: Mode1 is not separately specified in the SRS IL section
* Recommended WF
  + TBA

**Issue 3-1-2: UEs supporting power class 2 and ul-FullPwrMode2-TPMIGroup-r16 or maxNumberMIMO-LayersCB-PUSCH without indicating txDiversity-r16 IL**

Proposals

* + Option 1: UEs supporting power class 2 and ul-FullPwrMode2-TPMIGroup-r16 or maxNumberMIMO-LayersCB-PUSCH without indicating txDiversity-r16 and ΔPPowerClass = 0 dB is the only case when SRS IL is 6/7.5 dB (Ericsson)
  + Option 2: UEs supporting power class 2 and ul-FullPwrMode2-TPMIGroup-r16 or maxNumberMIMO-LayersCB-PUSCH without indicating txDiversity-r16 is not mentioned specifically in the CR
* Recommended WF
  + TBA

### Sub-topic 3-2: Power class identifications in SRS IL sentence

*Sub-topic description*

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

**Issue 3-2: How are power classes mentioned in the spec**

* Proposals
  + Option 1: Only power class 2 is distinguished as a condition for the 6/7.5 dB and otherwise the power classes are left as is(ZTE, Oppo)
  + Option 2: Other, why
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

**Issue 3-1-1: Mode1 SRS IL**

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| **Company** | **Comments** |
| Nokia | Option 1 |
| ZTE | Option 1 if no antenna virtualization is assumed for SRS. |
| Huawei | Option 2. |
| OPPO | Option 2. For this issue one important condition is whether there is restriction on PA configuration in mode 1, for example if mode 1 UE only allow PC3+PC3 then 3dB IL will be, however, with the LS from RAN1 there seems no restriction on PA configurations that means UE with PC3+PC2 or PC2+PC2 and also support mode 1. Then there is no chance to allow 3dB SRS IL only based on the mode 1 capability. |
| vivo | Option 2.  Even there is some reason for option1, it may also be regarded as a maintenance and not necessarily to be included. |
| Apple | Option 1: We would see the primary use of mode 1 for half power architecture (PC2 = PC3+PC3). What benefit would a mixed architecture obtain by using mode 1 instead of mode 2? Especially as mode 1 is expected to have slightly weaker UL performance compared to mode 2. |
| Samsung | To avoid the discussion of whether or not PC2 UE with 26+23dBm can claim its support of Mode-1, why we just use the capability TxDiversity to differentiate that?  In other words, PC2 UE with 23+23dBm needs to claim its support of TxDiversity if it want to support Mode-1. We don’t believe there is Rel-16 ULFPTx Mode-1 UE in the market, if yes, it can still use TxDiversity IE introduced in Rel-16.  So the changes introduced in Ericsson’s CR R4-2204616 can be simplified as:  - 3dB during SRS transmission occasions of configured SRS resources consisting of one SRS port in SRS resource set(s) with *usage* in *SRS-ResourceSet* set as ‘antennaSwitching’ for a UE indicating *txDiversity-r16* ~~or indicating the feature~~ *~~ul-FullPwrMode1-r16~~* or power class 1.5 for a band entry; |
| Ericsson | Option 1 with the assumption that Mode 1 is implemented with two half-power rated PAs. It might also indicate TxD for meeting the power class for other single-port transmissions like PUCCH (the power class also apply for PUCCH).  A Mode 1 would presumably also indicate 2T4R if AS supported, which means it has to produce half the power class per SRS port/connector no matter the PA configuration (also for 23PA + 26PA) |
| Qualcomm | Mode1 is implemented with two ½ power PA’s and then this UE would need to indicate TxD for fall back DCI purposes and therefore option 1 provides more transparency. But what if that is not the case, UE declares mode1 but not TxD and then it is tested against 6.2 requirements for single antenna connector and passes that somehow, maybe with full power PA. Nothing in the RAN4 requirements are broken. I would like to hear proponents of option 1 what goes broken beyond expectations of RAN4 delegates knowledge? Similarly, why option 2 is needed, is there maybe some secret implementation that enables this that is not discussed in ran4?  We are ok with both options but would favor the option 1 for better spec quality and transparency. |
| Intel | Option 1 – Mode 1 SRS IL lower by 3dB. |

**Issue 3-1-2: UEs supporting power class 2 and ul-FullPwrMode2-TPMIGroup-r16 or maxNumberMIMO-LayersCB-PUSCH without indicating txDiversity-r16 IL**

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| **Company** | **Comments** |
| Nokia | Option 1 |
| ZTE | Option 2. Need more time to check if Option 1 is the only case. However, the case described in Option 1 is included in Option 2, therefore a safer choice is Option 2 at this moment. |
| Huawei | Option 2. |
| OPPO | Option 2. As commented in issue 3-1-1, it depends on whether there is restriction on PA configurations for this capability. If not, for example 23+23 or 23+26 or 26+26 all can support this capability then Option 2 seems the only choice. |
| Vivo | Option 2 |
| Apple | We could accept both options. |
| Ericsson | Option 1. The exception should only be granted for 23PA + 26PA implementations of Mode 2 with full-power TPMI and UL-MIMO Rel-15 (we assume a UL-MIMO Rel-15 with 23PA + 23PA indicates TxD). It should not be a blanket relaxation for PC2 for a carrier/band for which UL-MIMO is not supported for example.  We are aware that RAN1 specifications allow implementation flexibility, but there was also an intention with the full-power UL-MIMO modes in terms of PA capabilities. |
| Qualcomm | We would favor option 2 just because this change introduces new requirements for UE that does not have anything to do with TxD. It removes the agreed UE requirements from R4-2011341, R4-2011342 since 6 dB was allowed in case UE has multi band PA module that can be used for RX port sounding and even if the UE does not support MIMO for that band. What Ericsson is saying the comment “it should not be a blanket…” was already agreed so they should have raised the concern in RAN4#96e.  In addition, it is not clear what this means:  Is it for both cases separately below:  Case 1: UEs supporting power class 2 and ul-FullPwrMode2-TPMIGroup-r16  or Case 2: maxNumberMIMO-LayersCB-PUSCH without indicating txDiversity-r16 regardless of power class.  or is it  Ues supporting power class 2 and one of the following   * ul-FullPwrMode2-TPMIGroup-r16 or maxNumberMIMO-LayersCB-PUSCH * without indicating txDiversity-r16   or is it:  Ues supporting power class 2 and one of the following:   * ul-FullPwrMode2-TPMIGroup-r16 without indicating txDiversity-r16 * maxNumberMIMO-LayersCB-PUSCH without indicating txDiversity-r16   If proponent really wants this complicated exclusion, it should be clear what is specified. |

**Issue 3-2: How are power classes mentioned**

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| **Company** | **Comments** |
| Nokia | Option 1  We guess at this moment, PC2 alone can have such an assumption like 26 dBm + 23 dBm. PC1.5 is assumed 26 dBm x 2. PC3 does not have to dare to assume 23 dBm + 20 dBm. |
| ZTE | Option 1. |
| Huawei | Option 1 is ok for us. |
| Skyworks | We agree that only PC2 has the option of applying one “full” power PA or not. PC5 and PC3 assumptions are that “full” PA is available then no delta is needed. For PC1.5 only “half” PAs are available then delta is always needed. We support focusing on PC2 only for differentiating the UE applying “full” power or not. We also think that t2r4 may require a specific handling since in that case the 3dB delta should not apply as each PA is already supposed to use half power. |
| OPPO | Option 1. Currently there is only PC2 has the situation that one full power PA + one half power PA are implemented. |
| vivo | Option 1. |
| Ericsson | Option 1 is acceptable, we assume that PC3 is always implemented with a full-power PA.  To Skyworks: for 2T4R and two-port SRS transmissions the power per SRS port shall be split equally, half the advertised power class for each port/connector no matter the PA capability. |
| Qualcomm | We would favor not stating power classes in the generic relaxations. What happens to the PC1.5 when there is 23 dBm PA available for RX ports is the same case as the PC2 case described in R4-2011341. |

### 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** |
| R4-2205224  Draft CR on SRS IL for NR TxD | Nokia:  1st comment: we’d like to understand why the below text is needed. The total power stays when t2r4 is being used.  3dB when UE indicating *txDiversity-r16* and *SRS-TxSwitch* capability ‘t2r4’ and applied during SRS transmission occasions with *usage* in *SRS-ResourceSet* set as ‘antennaSwitching’ with configured SRS resources as the second resource in each SRS resource set(s) consisting of two SRS ports  ZTE: Yes, the total power stays when t2r4 is being used. However, since two SRS ports are transmitted simultaneously, the power for each SRS port is actually half of the total power. The purpose of this sub-bullet is to reflect this. If UE vendors assume already in the implementation, and there is no need to reflect this in specs, we are ok to remove it.  2nd comment: We think that mentioning t1r2 and t1r4 is enough. We understand the motivation of adding t1r1-t1r2 and t1r1-t1r2-t1r4. But without including of t1r2 and t1r4, the specification is non-backward compatible. In addition, RAN2 spec says that t1r1-t1r2 or t1r1-t1r2-t1r4 is indicated, the UE shall report t1r2 or t1r4, respectively. Thus, we don’t need to mention t1r1-t1r2 and t1r1-t1r2-t1r4. Otherwise, we will see many capability information in Rel-17… Or we even don’t mention capability of t1r2 or t1r4 as Ericsson’s CR. From the number of SRS port, which capability should be supported is already clear enough. Also the information on PC2 and PC1.5 must be needed.  3dB when UE indicating *txDiversity-r16* and *SRS-TxSwitch* capability t1r1-t1r2’ or ‘t1r1-t1r2-t1r4’’ and applied during SRS transmission occasions with *usage* in *SRS-ResourceSet* set as ‘antennaSwitching’ with configured SRS resources as the second resource in each SRS resource set(s) consisting of one SRS port;  ZTE: Agree, only primitive usage is enough, applicable for a combined usage including the concerned primitive usage.  Huawei: Similar question as Nokia for t2r4. Also 3dB relaxation is only valid for PC2 and PC1.5 based on the agreed UE implementation assumption for TxD.  OPPO: For 2T4R UE can achieve the full power due to two SRS are transmitted simultaneously and no 3dB back off is needed.  Vivo: Share OPPO’s view that, even for TxD case, two SRS transmitted simultaneously for t2r4 can ensure the overall power do not need 3dB back off.  Qualcomm: Ok with the CR |
| Company B |
|  |
| R4-2204837  R17 FR1 TP to 38.837 for TxD SRS IL | Nokia: This discussion should be postponed until the relevant draft CR is agreed. |
| vivo: It is ok to postpone the TP to Email approval or next meeting, depending on the preogress. |
|  |
| R4-2204836  Draft R17 CR on SRS IL for TxD | Nokia: We have a similar comment as mentioned in R4-2205224. We think that mentioning t1r2 and t1r4 is enough. We understand the motivation of adding t1r1-t1r2 and t1r1-t1r2-t1r4. But without including of t1r2 and t1r4, the specification is non-backward compatible. In addition, RAN2 spec says that t1r1-t1r2 or t1r1-t1r2-t1r4 is indicated, the UE shall report t1r2 or t1r4, respectively. Thus, we don’t need to mention t1r1-t1r2 and t1r1-t1r2-t1r4. Otherwise, we will see many capability information in Rel-17… Or we even don’t mention capability of t1r2 or t1r4 as Ericsson’s CR. From the number of SRS port, which capability should be supported is already clear enough.  ZTE: Similar comments to indicate primitive usage.  Huawei: In general we are ok with the CR. Regarding t1r2 and t1r4 or t1r1-t1r2 and t1r1-t1r2-t1r4 as mentioned by Nokia, we are open to use simplified manner in the spec.  OPPO: Regarding t1r4 or t1r1-t1r2-t1r4 or both, though we prefer to be precise, we are ok to simplify if agreed.  Vivo: Also slightly prefer on only use Rel-15 t1r2/t1r4, though no strong view.  Samsung: Share the same view as Nokia, see below IE description marked as yellow. The rel-16 IE is optional to report (see below description marked as red), so it is possible a Rel-17 UE still use Rel-16 signaling (supportedSRS-TxPortSwitch, rather than *supportedSRS-TxPortSwitch-v1610*), so ONLY using Rel-16 IE will cause problem. Below is from TS38.306 for reference:   |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | | *supportedSRS-TxPortSwitch* indicates SRS Tx port switching pattern supported by the UE, which is mandatory with capability signaling. The indicated UE antenna switching capability of ′xTyR′ corresponds to a UE, capable of SRS transmission on ′x′ antenna ports over total of ′y′ antennas, where ′y′ corresponds to all or subset of UE receive antennas, where 2T4R is two pairs of antennas. *supportedSRS-TxPortSwitch-v1610*, which is optional to report, indicates downgrading configuration of SRS Tx port switching pattern. If the UE indicates the support of downgrading configuration of SRS Tx port switching pattern using *supportedSRS-TxPortSwitch-v1610*, the UE shall report the values for this as below, based on what is reported in *supportedSRS-TxPortSwitch*.   |  |  | | --- | --- | | *supportedSRS-TxPortSwitch* | *supportedSRS-TxPortSwitch-v1610* | | *t1r2* | *t1r1-t1r2* | | *t1r4* | *t1r1-t1r2-t1r4* | | *t2r4* | *t1r1-t1r2-t2r2-t2r4* | | *t2r2* | *t1r1-t2r2* | | *t4r4* | *t1r1-t2r2-t4r4* | | *t1r4-t2r4* | *t1r1-t1r2-t2r2-t1r4-t2r4* | |   Qualcomm: Why power classes need to be mentioned in delta P\_Power class sentence? |
| R4-2204616  Pcmax for SRS usage set as antenna switching for TxD and UL-MIMO features | Nokia: We basically support this CR.  But the CR would not need to mention all the introduced capabilities in Rel-16 like ‘t1r1-t1r2’, ‘t1r1-t1r2-t1r4’ or ‘t1r1-t1r2-t2r2-t1r4-t2r4’ as we commented in other CRs.  ZTE: In addition to primitive usage, also relates to the conclusion of Issue 3-1-2 for SRS IL.  Huawei: We don’t think specific ULFPTx modes need to be considered in the draft CR.  OPPO: As commented to issue 3-1-1 and 3-1-2, without the agreement of PA configuration limitation it is impossible to use ULFPTx modes to indicate the PA capability since in that case any kind of PA configurations can support any ULFPTx modes.  Samsung: Same comments for “t1r1-t1r2” and other Rel-16 IEs, which is not necessarily to be introduced in CR: (1) Strictly speaking, if this revision is needed, it should be introduced in Rel-16 rather than Rel-17; (2) t1r2 is enough as mentioned above.  Furthermore, the below revision is not correct:  “b) UE transmits SRS on the second, third and fourth SRS resources of configured SRS resource set(s) with four SRS resources consisting of one SRS port when the *SRS-TxSwitch* capability is indicated as 't1r4', 't1r4-t2r4', ‘t1r1-t1r2-t1r4’ or ‘t1r1-t1r2-t2r2-t1r4-t2r4’; or”  From RAN1 perspective, it is possible to have (a) 1 SRS resource set with 4 resources, or (b) two SRS resource sets with 1+3 or 2+2 SRS resources. That is the reason we use “the total 4 SRS resources from all configured SRS resource sets(s)” in our original Rel-15 maintenance CR. See below RAN1 spec from 38.214:   |  | | --- | | * For 1T4R, zero or one SRS resource set configured with higher layer parameter *resourceType* in *SRS-ResourceSet* set to 'periodic' or 'semi-persistent' with four SRS resources transmitted in different symbols, each SRS resource in a given set consisting of a single SRS port, and the SRS port of each resource is associated with a different UE antenna port, and * For 1T4R, zero or two SRS resource sets each configured with higher layer parameter *resourceType* in *SRS-ResourceSet* set to 'aperiodic' and with a total of four SRS resources transmitted in different symbols of two different slots, and where the SRS port of each SRS resource in the given two sets is associated with a different UE antenna port. The two sets are each configured with two SRS resources, or one set is configured with one SRS resource and the other set is configured with three SRS resources. … |   Qualcomm: Not ok since this tightens Rel-15 UE requirements and is therefore in NBC for existing implmentations. |

## 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** |
| **Issue 3-1-1: Mode1 SRS IL** | * + Option 1, mode 1 SR*S IL shall be lower by 3 dB (Nokia, ZTE, Apple, Erics*son, Qualcomm, Intel)     - Depending the UE declaration for mode 1. If the UE with 23+26 or 26+26, lowering 3dB is not applied.     - 3dB does not include insertion loss   Option 2, ~~mode 1 shall sound same power as power class~~ Mode1 is not separately specified in the SRS IL section (vivo, Oppo, Huawei)   * + Option 2, Mode1 is not separately specified in the SRS IL section (vivo, Oppo, Huawei)     - Tx   Alternative (Samsung) use TxD indication only.  Tentative agreements: Majority is with Option 1 and this is supported by the assumptions for the implemented PAs.  Recommendations for 2nd round: Revise the CR according to option 1.  Agreement: For Topic #3 and Topic #4, the following principles are agreed   * + For UE supporting mode 1 and indicating TxD per band, then 3dB relaxation will be applied.   + For UE supporting mode 1 only, then 3dB relaxation won’t be applied.   + TxD requirements do not apply to UE supporting mode 0 and mode 2 with full power TMPI   Oppo: TxD is the clear signaling. We may use it.  Ericsson: We consider it in terms of performance. Option 2 is for 23+26dBm UE. UE uses the different PA to do SRS switching. If agreeing on Option 2, any UE can apply 6dBm relaxation. SRS has to meet the power class. TxD is not clear in the way to specify in the RAN4. There is rule for UE with Mode X can indicate TxD. We accept the TxD as implementation. It can be viewed as fall back. RAN2 can make it clear that UE supporting mode 2 with full power won’t indicate TxD.  Vivo: we can also accept Option 1.  T-Moible: for PC1.5, TxD is indicated. Some early UE supporting PC1.5 but do not indicate TxD.  Samsung: One way is to have some restriction from RAN2 perspective. For Mode 1 UE can indicate TxD. For Mode 0 UE cannot indicate TxD.  Huawei: Comment from Ericsson includes two aspects: one relation between full power mode and TxD; the other is for PC2 23+26. Disagree to have limitation from RAN2. RAN1 had LS that for mode 1 and mode 0 capable UE can indicate TxD. The concern from Ericsson that UE may indicate TxD in order to relax the requirement. But in RAN4, only some specific UE will indicate TxD. We can add some note in RAN4 spec.  OPPO: From RAN1/2, single antenna port and two layer are separate features. There is no UE restriction. We can only rely on TxD. UE with 23+26 and 23+23 may support mode 1.  Ericsson: we know there is no restriction from RAN1. The intention of RAN1 original discussion is that different PA architecture uses different modes. Either we make restriction in RAN2 or we differentiate the requirement in RAN4.  Apple: full power mode has different assumption of architectures. Combining the TxD and full power blurs the boundary.  Intel: We are in favor of Option 1, which is more simple. |
| **Issue 3-1-2: UEs supporting power class 2 and ul-FullPwrMode2-TPMIGroup-r16 or maxNumberMIMO-LayersCB-PUSCH without indicating txDiversity-r16 IL** | UEs supporting power class 2 and ul-FullPwrMode2-TPMIGroup-r16 or maxNumberMIMO-LayersCB-PUSCH without indicating txDiversity-r16 and ΔPPowerClass = 0 dB  Option 1: Condition 6 dB with the text (Nokia, Ericsson)  Option 2: Do not condition 6 dB with the text (ZTE, Huawei, Oppo, vivo, Qualcomm)  Tentative agreements: Do not put that condition to the 6 dB relaxation.  Moderators note that this change also changes rel-15 behavior and is out of scope for TxD WI.  Recommendations for 2nd round: Revise the CR according to option 2. |
| **Issue 3-2: How are power classes mentioned in the spec** | Option 1: Only power class 2 is distinguished as a condition for the 6/7.5 dB and otherwise the power classes are left as is(ZTE, Oppo, Nokia, vivo, Ericsson)  Option 2: Other, why (Qualcomm: better not make TxD power class dependent)  Tentative agreements: 6/7.5 dB clause is for PC2 only.  Recommendations for 2nd round: Revise the CR R4-2205224 according to option 1 |

Agreement:

* The following changes for R4-2205224 are agreed
* 3dB when PC2 capable UE indicating txDiversity-r16 or PC1.5 [and *SRS-TxSwitch* capability ‘t1r1-t1r2’ or ‘t1r1-t1r2-t1r4’ and] applied during SRS transmission occasions with usage in SRS-ResourceSet set as ‘antennaSwitching’ with configured SRS resources in each SRS resource set(s) consisting of one SRS port
* Remove the following sentence from R4-2205224
  + 3dB when UE indicating txDiversity-r16 and SRS-TxSwitch capability 't2r4' and applied during SRS transmission occasions with usage in SRS-ResourceSet set as ‘antennaSwitching’ with configured SRS resources as the second resource in each SRS resource set(s) consisting of two SRS ports;
* In RAN4 spec, capture that PC1.5 implies TxD even if UE does not indicate TxD in UE capability.

## Discussion on 2nd round (if applicable)

CR shall be revised accordingly to the agreement copied here

Agreement:

* The following changes for R4-2205224 are agreed
* 3dB when PC2 capable UE indicating txDiversity-r16 or PC1.5 [and *SRS-TxSwitch* capability ‘t1r1-t1r2’ or ‘t1r1-t1r2-t1r4’ and] applied during SRS transmission occasions with usage in SRS-ResourceSet set as ‘antennaSwitching’ with configured SRS resources in each SRS resource set(s) consisting of one SRS port
* Remove the following sentence from R4-2205224
  + 3dB when UE indicating txDiversity-r16 and SRS-TxSwitch capability 't2r4' and applied during SRS transmission occasions with usage in SRS-ResourceSet set as ‘antennaSwitching’ with configured SRS resources as the second resource in each SRS resource set(s) consisting of two SRS ports;

|  |  |
| --- | --- |
| CR | Comments |
| Revision of**R4-2205224** Draft CR on SRS IL for NR TxD  [Link to folder](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_102-e/Inbox/Drafts/%5B102-e%5D%5B128%5D%20NR_TxD/Round%202/CR%20on%20SRS%20IL) | OPPO: Some updates to make the sentence better organized. And add the legacy SRS antenna switch capability, i.e. t1r2 or t1r4. The reason to specify the detailed SRS capability is that the 3dB SRS IL is only apply to these two capabilities and not be applied to t1r1 which might be included with current wording like “*consisting of one SRS port*”.    vivo: The highlightened part may not be essential, but we can accept to still have them if companies prefer to have more clarity. |

# Topic #4: ULFPTx

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

## Companies’ contributions summary

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **Title** | **Company** | **Proposals / Observations** |
| [**R4-2204618**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204618.zip) | TxD and UL-MIMO requirements for single-port antenna transmission | Ericsson | Draft CR output power requirements  TxD or Mode 1 -> G  Mode 2 -> 6.2 (no suffix) |
| [**R4-2204828**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204828.zip) | Draft R17 CR on UL MIMO allback to TxD | OPPO | Draft CR output power requirements  TxD->G only |
| [**R4-2204617**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204617.zip) | Single-antenna fallback for TxD and UL-MIMO (including ULFPTx) | Ericsson | Proposal 1: for 2 TX connectors, the single-antenna fallback requirements for UL-MIMO for TxD and the ULFPTx modes should be set as follows  • “Default” are the requirements in 6.2 per connector, where the UE can reach full power for a TX connector  • For Mode 0 and Mode 2 with full-power TPMI  o Mode 2 with full-power TPMI shall meet the requirements in 6.2 with MPR for 1 TX for at least one Tx connector, regardless of any TxD indication, since UEs with full power TPMI support should be able to transmit full power on a Tx connector  o Mode 0 shall meet 6.2 for both connectors, since such UEs will support full power on both Tx chains.  O Alternatively, a restriction in the RAN2 specifications (38.306) that UE indicating support of the features ul-FullPwrMode-r16 (Mode 0) or ul-FullPwrMode2-TPMIGroup-r16 for a band entry does not indicate txDiversity-r16 for this band.  • UEs supporting UL-MIMO with TxD and/or ULFPTx Mode 1 shall meet the requirements in 6.2G  • UEs that support Mode 2 without support of full-power TPMI are not specified in Table 6.2D.1-3 for two-port transmission so are therefore not specified for single-antenna port fallback. |
| [**R4-2204835**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204835.zip) | R17 FR1 TxD and ULFPTx fallback | OPPO | Observation 1: It was agreed that “the applicability of transparent TxD is NOT related to UE supporting or not supporting Rel-16 ULFPTx” and “no dependency between txDiversity-16 and ul-FullPowerTransmission”.  Observation 2: It was well recognized that when RAN4 define requirements certain UE architectures will be referred, however, there is no restriction in UE implementation as long as it can meet the requirements.  Proposal 1: No dependency in UE implementation of PAs between TxD and ULFPTx since these capabilities are independent as already agreed and RAN4 only use reference architecture to define requirements rather than limit UE implementations.  Proposal 2: Decouple TxD and ULFPTx UE requirement mapping, and only rely on UE capabilities to decided which requirement UE shall meet.  Proposal 3: For UE support TxD, when it fallback from ULFPTx modes, the TxD requirements apply. For UE not support TxD, when it fallback from ULFPTx modes, the 1Tx requirements apply. |
| [**R4-2205225**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205225.zip) | ULFPTx requirements for fallback and TxD | ZTE Wistron Telecom AB | Proposal: RAN4 to specify ULFPTx requirements for TxD as above table (None of the three listed alternatives). |
| [**R4-2205577**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205577.zip) | On ULFPTx and applicable MPR requirements for different PA configurations | Huawei, HiSilicon | Observation 1: There is no one-to-one mapping relationship between the UE implementation architectures and the ULFPTx modes according to RAN1 confirmation.  Observation 2: Using ULFPTx mode 1 as exception indication would have the same issue as TxD for the concern if valid for using the relaxed requirements, and it causes more ambiguous situation.  Proposal 1: It is proposed to distinguish the applicable requirements for 2Tx implementation just based on TxD indication, and additional note is added in the specification to reflect the agreed UE implementation assumption for TxD. |
| [**R4-2205884**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205884.zip) | TxD and ULFPTx requirements | Qualcomm Incorporated | Observation 1: TxD and ULFPTx requirement setting is pending a principal agreement if possible combinations of feature are limited or not  Observation 2: Precluding TxD indication from ULFPTx mode 0 or mode 2 for same band is feasible with the assumptions what justified ULFPTx modes and TxD.  Observation 3: RAN4 has not agreed what requirements would apply for each combination of TxD and ULFPTx modes.  Proposal : RAN4 should agree what feature combinations are supported by specifications for TxD and ULFPTx |
| [**R4-2205887**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205887.zip) | Further discussion on transparent TxD – ULFPTx related | Samsung | Observation 1: ULPFTx Mode-1 is introduced to enable 1layer TPMI=2 transmission for UE not capable of 2TX fullCoherent CB.  Observation 2: Rel-15 UE capable of fullCoherent CB (which is already capable of 1layer TPMI = 2 transmission) needs to support full power by using 1TX antenna connector, if fallback DCI is scheduled.  Observation 3: The same treatment of fallback DCI behaviour shall be applied for (1) UE capable of ULFPTx Mode-1; (2) UE capable of fullCoherent CB.  Proposal-1: For UE supporting ULFPTx Mode-1 but not explicitly indicating its support of TxD, UE needs to use single Tx to fulfil MOP for “fallback DCI”.  Proposal-2: For UE supporting ULFPTx Mode-2 Mechanism-1 but not explicitly indicating its support of TxD, UE needs to use single Tx to fulfil MOP for “fallback DCI”.  Proposal-3: For UE supporting ULFPTx Mode-2 Moechansm-2 or ULFPTx Mode-0, but explicitly indicating its support of TxD, the following treatments are possible and acceptable:  (1) De-prioritized (no need to be mentioned explicitly in TS38.101);  (2) Not allowed (explicitly in TS38.306);  (3) Required to achieve full power for fallback DCI by using 1TX.  Proposal-4: The proposed applicability rule for fallback DCI with UE’s support of TxD and ULFPTx is summarized as:  Table 1. Single antenna-port (“fallback DCI”) Requirements applicability    Proposal-5: RAN4 adopt the following text proposal for the MOP requirement if UE is scheduled by fallback DCI and UE support TxD: |
| R4-2204970 | Discussion on ULFPTx with TxD | vivo | withdrawn |

## Open issues summary

Different possible approaches for setting requirements for TxD UE with ULFPTx are proposed.

1. Do not couple TxD with any ULFPTx modes (Huawei, Oppo, Samsung)
2. Mode 1 shall meet single port output power according to section G (Ericsson, ZTE)
3. Mode 2 shall meet single port output power according to sections 6.2 (no suffix) (Ericsson, ZTE)
4. Mode full power0 meets either suffix less or section G (ZTE). Note, this does not need to be written, result is same as option 1

Separate issue is if e.g. option 2 means UE supporting mode 1 shall also indicate TxD and if UE supporting mode 2 shall not indicate TxD.

The underlying assumptions in RAN4 discussion support detailing each ULFPTx mode to either TxD or 1Tx requirements but also if no coupling is made in requirements, it is up to the UE to meet the requirements based on its TxD indication.

The two draft CRs R4-2204618, R4-2204828 and change proposal 5 in R4-2205887 are good quality so group should agree which approach to take.

**Please comment your support on CRs in the CR comments sections.**

### Sub-topic 4-1: Requirement couplings

*Sub-topic description:*

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

**Issue 4-1-1: Will mode 1 direct to suffix G only?**

* Proposals
  + Option 1: Yes, CR will indicate that UE declaring mode 1 is required to meet 1-port power according to section G
  + Option 2: No, nothing is written in requirements but 1-port requirements are based on TxD indication alone regardless of ULFPTx mode
* Recommended WF
  + TBA

**Issue 4-1-2: Will mode 2 direct to suffixless only**

* Proposals
  + Option 1: Yes, CR will indicate that UE declaring mode 2 is required to meet 1-port power according to section 6.2
  + Option 2: No, nothing in TS but 1-port requirements are based on TxD indication alone
* Recommended WF
  + TBA

**Issue 4-1-3: Will mode0 1-port requirements be detailed directing somewhere?**

* Proposals
  + Option 1: Yes, CR will indicate that UE declaring mode 0 is required to meet 1-port power according to either section 6.2 or section under suffix G
  + Option 2: No, nothing in TS but 1-port requirements are based on TxD indication alone
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

**Issue 4-1-1: Will mode 1 direct to suffix G only?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Yes, it will. |
| ZTE | Option 2. ULFPTx mode 1 is two-port-1-layer transmission. |
| Huawei | No. Option 2. It is also RAN1 understanding based on clarification from their LS that no specific implementation architecture can be mapped to certain ULFPTx mode. |
| LGE | Prefer option 2. It is based on the indication of TxD from UE |
| OPPO | Option 2. ULFPTx is the capability for UL MIMO, and TxD is capability for single antenna port, when we discussing the requirements in single antenna port should only refer to TxD since there is no one to one mapping between ULFPTx and TxD.  That’s why we think RAN4 spec can only rely on UE capabilities in single antenna port to decide which requirement to be met rather than refer to ULFPTx modes. |
| Apple | Option 1. The primary use case of mode 1 should be for half power architecture. Directing to suffice G should avoid specifying the same requirements twice. |
| Samsung | Option 2.  The UE supporting ULFPTx Mode-1 shall also claim its support of transparent TxD. We see no issue for “legacy” Rel-16 UE implementation, because we question that there is Mode-1 UE in the market? For the UE to be developed, it is able to claim its support transparent TxD capability IE which is introduced in Rel-16 already. If needed, we can suggestion RAN2 to add some restriction, i.e., “The UE supporting ULFPTx Mode-1 shall also claim its support of transparent TxD”. |
| Ericsson | Option 1 unless it is expected that Mode 1 also indicates TxD as discussed by Samsung. We assume that Mode 1 is implemented by two half-power rated PAs. |
| Qualcomm | I suppose there is a third option, option 2 for RAN4 requirements and then LS to RAN2 with capability couplings. Same comments as in issue 3-1-1 from us. It is unfortunate that this e-meeting format favors opinion based agreement where technical dialogue is left to the back ground. Option1 is more technically justified based on all discussion. TxD and WI was justified because of one specific implementation version of PC2 and 3GPP accommodated this implementation. But now in this discussion, option 2 supporters are not owning that this implementation and what is the obvious result of this implementation but refer that implementation flexibility should be allowed without any justification.  We are fine with both options but would favor option 1 for transparency. |
| T-Mobile USA | Option 1. ULFP Mode 1 uses 2 antenna ports and TPMI index 2 according to 38.101-1 Table 6.2D.1-3. |

**Issue 4-1-2: Will mode 2 direct to suffixless only**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Not all the mode 2, but rather only *ul-FullPwrMode2-TPMIGroup-r16* will be directed to suffix-less. |
| ZTE | Option 1. ULFPTx mode 2 is single port transmission with Rel-16 scaling factor. |
| Huawei | No. Option 2. |
| LGE | Prefer option 2. It is based on the indication of TxD from UE |
| OPPO | Option 2, similar as comment to issue 4-1-1. |
| Apple | Prefer option 1. The primary use case of mode 2 should be for mixed architecture (full and half power PA) using the full power TPMI to indicate the full power PA. While use of TxD is not precluded the usage without TxD should be considered primarily. |
| Samsung | Same as Issue 4-1-2. It is still possible to use Rel-16 TxDiversity IE for Mode-2 UE supporting ul-FullPwrMode2-SRSConfig-diffNumSRSPorts-r16. |
| Ericsson | Mode 2 with full-power TPMI should be directed to suffix-less only no matter TxD indication (even if not expected).  Alternatively, a restriction in the RAN2 specifications (38.306) that UE indicating support of the features *ul-FullPwrMode-r16* (Mode 0) or *ul-FullPwrMode2-TPMIGroup-r16* for a band entry does not indicate *txDiversity-r16* for this band. These features are indicated per *FeatureSetUplink* (FS) corresponding to a band entry of a band combination; all operating bands supported by a UE are also indicated as ‘band combinations’ with their associated features. This could be captured in 38.306 as follows:    One complication is that TxD is indicated in the NR-band capability whereas supported full-power modes are indicated in the FS (there is a related discussion in RAN2). However, all supported bands with their capabilities are also included in the BC (NR non-CA).  TxD should not be the “default” for support of higher power classes with and without UL-MIMO. |
| Qualcomm | Fine with both options. Would vote option 1 for implementation transparency. |
| T-Mobile USA | Option 1. UE indicating ULFP Mode 2 should have at least one full power PA. |

**Issue 4-1-3: Will mode0 1-port requirements be detailed directing somewhere?**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | No. Since no exception applies. |
| Huawei | No. Option 2. |
| LGE | We think that there is no exception for mode 0. |
| OPPO | Option 2, similar as comment to issue 4-1-1. |
| Apple | Prefer option 1: UEs with half power PAs should not indicate mode 0 with TxD but mode 1. |
| Samsung | No. Since no exception applies. |
| Ericsson | No exception should apply for Mode 0 and expect that TxD will not be indicated, hence should meet the requirement per connector. |
| T-Mobile USA | Option 1. A UE declaring ULFP mode 0 should have two full power PAs. Even when using dual Tx, because each PA is backed off by 3 dB it should be able to meet the MPR requirements in 6.2. |

Agreement:

* The following changes are endorsed.

If the UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2 apply for at least one antenna connector for the power class as indicated by the *ue-PowerClass* field in capability signalling with the following exceptions: for UEs indicating [*txDiversity-r16*] ~~or the feature~~ *~~ul-FullPwrMode1-r16~~* for a band entry, the requirements in clause 6.2G for the power class indicated by the *ue-PowerClass*.

A UE indicating the feature *ul-FullPwrMode2-TPMIGroup-r16* or [*ul-FullPwrMode0-r16 (NOTE: for Mode 0)]* for a band entry shall meet the requirement in clause 6.2 for at least one antenna connector when scheduled for single antenna-port transmission by DCI format 0\_0 or by DCI format 0\_1 for codebook-based transmission on a single antenna port.

* R4-2204618 with the additional changes above (highlighted by yellow) are agreeable.

### 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** |
| R4-2204618  TxD and UL-MIMO requirements for single-port antenna transmission  Ericsson | Nokia: In principle we support the CR. But we cannot agree with the following yellow. It seems that whatever features are implemented, once TxD is indicated, the requirements for TxD “only” applies. TxD should not be the basis. If UE wants to implement TxD as well as the other features like ULFPTx, both requirements shall be met.  with the following exceptions: for UEs indicating [*txDiversity-r16*] or the feature *ul-FullPwrMode1-r16* for a band entry, the requirements in clause 6.2G for the power class indicated by the *ue-PowerClass* |
| Huawei: Disagree with specific ULFPTx mdoes mentioned for the fall back requirements. If concern is just for the relaxation for the applicable requirements, some clarification can be considered. |
| Skyworks: There are already changes in those sections in last meeting draft CR R4-220349. There is potential overlap and there is already some mapping of MR based on TxD and ULFPTx. We may need to verify how to merge.  OPPO: Need to be discussed further after the agreements for the above open issues are reached. |
| Samsung: Still prefer the simplified method by just relying on TxDiversity capability for fallback DCI’s redirection. To make progress in this very last meeting of Rel-17, we think one compromise can be: UE supporting Mode-1 or ul-FullPwrMode2-SRSConfig-diffNumSRSPorts-r16 needs to also support TxDiversity. Note: TxDiveristy is already introduced in Rel-16. |
| Ericsson: the CR can be simplified if the relation between TxD and full-power modes is specified in 38.306, see comment to 4-1-2. We support this CR as proponent. |
| R4-2204828  Draft R17 CR on UL MIMO falllback to TxD  OPPO | Nokia: Our preference is to take R4-2204618 as the basis. We could discuss an alternative from Huawei meaning that spec captures TxD implementation is allowed only for 23 dBm x 2 for PC2 and 26 dBm x 2 for PC1.5. But if we go with this, the spec should not mention in this way. But rather we need to mention in a way that the outpower power per antenna shall not exceed PC3 for PC2 TxD something like that. But this completely excludes the implementation of e.g., ULFPTx mode 0 and TxD. |
| Huawei: We support this CR. If needed, a clarification note for the agreement of TxD implementation assumption for PC2 and PC1.5 can be added. |
| Skyworks: There are already changes in those sections in last meeting draft CR R4-220349. There is potential overlap and there is already some mapping of MR based on TxD and ULFPTx. We may need to verify how to merge. |

## 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** |
| **Issue 4-1-1: Will mode 1 direct to suffix G only?** | Option 1: Yes, CR will indicate that UE declaring mode 1 is required to meet 1-port power according to section G (Nokia, Apple, Ericsson, TMO, Qualcomm)  Option 2: No, nothing is written in requirements but 1-port requirements are based on TxD indication alone regardless of ULFPTx mode (ZTE, Huawei, LGE, Samsung)  Tentative agreements: CR will indicate that the mode 1 required to meet 1-port port according to section G  Recommendations for 2nd round: Revise the CR R4-2204618 according to option 1 |
| **Issue 4-1-2: Will mode 2 direct to suffixless only** | Option 1: Yes, CR will indicate that UE declaring mode 2 is required to meet 1-port power according to section 6.2 (ZTE, Apple, Ericsson, Qualcomm)  Option 2: No, nothing in TS but 1-port requirements are based on TxD indication alone (Nokia, Huawei, Oppo, Samsung)  Tentative agreements: ??  Recommendations for 2nd round: Discuss in GTW. |
| **Issue 4-1-3: Will mode0 1-port requirements be detailed directing somewhere?** | Option 1: Yes, CR will indicate that UE declaring mode 0 is required to meet 1-port power according to either section 6.2 or section under suffix G (Apple, TMO)  Option 2: No, nothing in TS but 1-port requirements are based on TxD indication alone (Nokia, Huawei, Oppo, Samsung, LGE, Ericsson)  Tentative agreements: Mode0 will not refer to neither suffixless or section G explicitly.  Recommendations for 2nd round: Revise the CR R4-2204618 according to option 2 |

### 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)

CR shall be revised with the agreement copied here:

Agreement:

* The following changes are endorsed.

If the UE is scheduled for single antenna-port PUSCH transmission by DCI format 0\_0 or by DCI format 0\_1 for single antenna port codebook based transmission, the requirements in clause 6.2 apply for at least one antenna connector for the power class as indicated by the *ue-PowerClass* field in capability signalling with the following exceptions: for UEs indicating [*txDiversity-r16*] ~~or the feature~~ *~~ul-FullPwrMode1-r16~~* for a band entry, the requirements in clause 6.2G for the power class indicated by the *ue-PowerClass*.

A UE indicating the feature *ul-FullPwrMode2-TPMIGroup-r16* or [*ul-FullPwrMode0-r16 (NOTE: for Mode 0)]* for a band entry shall meet the requirement in clause 6.2 for at least one antenna connector when scheduled for single antenna-port transmission by DCI format 0\_0 or by DCI format 0\_1 for codebook-based transmission on a single antenna port.

* R4-2204618 with the additional changes above (highlighted by yellow) are agreeable.

|  |  |
| --- | --- |
| **CR/TP number** | **Comments** |
| Revision of **R4-2204618** TxD and UL-MIMO requirements for single-port antenna transmission  [Link to folder](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_102-e/Inbox/Drafts/%5B102-e%5D%5B128%5D%20NR_TxD/Round%202/CR%20on%20ULFPTx) | OPPO:   1. “entry” is suggested to be removed from “band entry”, the TxD/ULFPTx discussed here are per band requirements. 2. For other UL MIMO requirements as below similar changes are needed since currently they all pointed to single port requirements rather than TxD.   6.3D Output power dynamics for UL MIMO  6.4D Transmit signal quality for UL MIMO  6.5D Output RF spectrum emissions for UL MIMO |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| Revision of**R4-2205575** Big CR for TS 38.307: release independent requirements for TxD | Huawei, HiSilicon | Accommodate Samsung and ZTE (?) comments |
| Revision of**R4-2205578** draft CR for TS 38.101-1: move 2Tx MPR to Clause 6.2D (Rel-16) | Huawei, HiSilicon, Qualcomm | Align table numbering either in this or in big CR. 6.2D.2-1 can have different content between releases |
| Revision of**R4-2205224** Draft CR on SRS IL for NR TxD | ZTE | Revised based on comments. Wait for outcome of #3 |
| Revision of **R4-2204618** TxD and UL-MIMO requirements for single-port antenna transmission | Ericsson | Revised based on comments. Wait for outcome of #4 |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2204595 | 3GPP TR 38.837 v0.4.0 | vivo | Email approval |  |
| **R4-2204968** | TP for TR 38.837 on Power Class Clarification for SA | vivo | Approve |  |
| R4-2205574 | Big CR for TS 38.101-1 Tx diversity requirements (phase 2) | Huawei, HiSilicon, Qualcomm, vivo | Email approval |  |
| **R4-2205575** | Big CR for TS 38.307: release independent requirements for TxD | Huawei, HiSilicon | Revised | Accommodate Samsung and ZTE (?) comments |
| **R4-2205578** | draft CR for TS 38.101-1: move 2Tx MPR to Clause 6.2D (Rel-16) | Huawei, HiSilicon, Qualcomm | Revised | Align table numbering either in this or in big CR. 6.2D.2-1 can have different content between releases |
| **R4-2206133** | TP to TR38.837 on MPR evaluation for 2Tx PC2 and PC1.5 operation | Skyworks Solutions Inc. | Noted | Postponed? |
| **R4-2205224** | Draft CR on SRS IL for NR TxD | ZTE Wistron Telecom AB | Revised | Revised based on comments. Wait for outcome of #3 |
| **R4-2204616** | Pcmax for SRS usage set as antenna switching for TxD and UL-MIMO features | Ericsson | Noted |  |
| **R4-2204836** | Draft R17 CR on SRS IL for TxD | OPPO | Noted |  |
| **R4-2204837** | R17 FR1 TP to 38.837 for TxD SRS IL | OPPO | Noted |  |
| **R4-2204921** | R17 FR1 SRS IL for TxD and ULFPTx | OPPO | Noted |  |
| **R4-2204969** | Further discussion on SRS antenna switching for TxD | vivo | Noted |  |
| **R4-2203681** | TxD and SRS antenna switching | Apple | Noted |  |
| **R4-2205223** | Discussion on SRS sharing and antenna switching | ZTE Wistron Telecom AB | Noted |  |
| **R4-2205576** | On SRS IL for TxD | Huawei, HiSilicon | Noted |  |
| **R4-2204618** | TxD and UL-MIMO requirements for single-port antenna transmission | Ericsson | Revised | Revised based on comments. Wait for outcome of #4 |
| **R4-2204828** | Draft R17 CR on UL MIMO falllback to TxD | OPPO | Noted |  |
| **R4-2204617** | Single-antenna fallback for TxD and UL-MIMO (including ULFPTx) | Ericsson | Noted |  |
| **R4-2204835** | R17 FR1 TxD and ULFPTx fallback | OPPO | Noted |  |
| **R4-2205225** | ULFPTx requirements for fallback and TxD | ZTE Wistron Telecom AB | Noted |  |
| **R4-2205577** | On ULFPTx and applicable MPR requirements for different PA configurations | Huawei, HiSilicon | Noted |  |
| **R4-2205884** | TxD and ULFPTx requirements | Qualcomm Incorporated | Noted |  |
| **R4-2205887** | Further discussion on transparent TxD – ULFPTx related | Samsung | Noted |  |
| R4-2204970 | Discussion on ULFPTx with TxD | vivo | withdrawn |  |

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** |
| R4-22xxxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-22xxxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-22xxxxx | 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

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
|  |  |  |

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)