**3GPP TSG-RAN WG4 Meeting # 102-e R4-2207426**

**Electronic Meeting, 21st Feb.– 03rd Mar., 2022**

**Agenda item:** 10.2.2.3, 10.2.2.4

**Source:** Moderator (OPPO)

**Title:** Email discussion summary for [102-e] [336] FR1\_TRP\_TRS\_Part2

**Document for:** Information

# Introduction

*Contributions submitted to AI 10.2.2.3 UE with multiple antennas test methodology and AI 10.2.2.4 Test time reduction of FR1 TRP TRS WI are captured in this email discussion. Test strategy and methodology on multiple antennas and test time reduction will be discussed.*

# Topic #1: Test methodology for UE with multi-antenna

*The following multi-antenna technics will be discussed in this section.*

* *UL Transmit Diversity*
* *Transmit Antenna Switch*
* *Multi Antenna Receivers*

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203637 | Huawei Tech.(UK) Co.. Ltd | Proposal 1: the correctness of TRP measurement with TAS on is verified by TRP\_i = Max (TRP1\_i, TRP2\_i) at all or majority [90%] of measurement points.  Proposal 2: if a device implements more receive antennas than the minimum required by 3GPP, TRS should be measured under device default setting. |
| R4-2203695 | Apple | Proposal 1: For the TxD TRP methodology, RAN4 should select Method B: Test TRP with both of the antennas transmitting together. |
| R4-2204508 | Qualcomm Incorporated | Proposal 1: Do not consider the test mode for the test method for TxD UEs.  Proposal 2: For Method A, to measure TRP per branch via sending TPMI 0 and TMPI 1 separately and sum them up. |
| R4-2204981 | OPPO | Proposal 1: The initial/default downlink power level should be specified and configured for every point measurement with theta and phi angles.  Proposal 2: The default downlink power level for NR is specified in TS 38.521-1 Annex C.0. And it can be a start point for further discussion for proper power level of downlink Rx signal.  Proposal 3: It is proposed to not only specify the test points on the spherical surface (i.e. theta and phi angles), but also specify the test order of test points. |
| R4-2204989 | OPPO | TP to TR38.834 on multi-antenna UE |

## Open issues summary

### Sub-topic 1-1: Test methodology for TAS ON

**Issue 1-1-1: Introduce a new figure of metric for the correctness of TRP measurement with TAS ON**

* Proposal: the correctness of TRP measurement with TAS on is verified by TRP\_i = Max (TRP1\_i, TRP2\_i) at all or majority [90%] of measurement points.
* Recommended WF
  + TBA

**Issue 1-1-2: Downlink Rx signal impact on the TAS ON test method**

* Proposal 1: The initial/default downlink power level should be specified and configured for every point measurement with theta and phi angles.
* Proposal 2: The default downlink power level for NR is specified in TS 38.521-1 Annex C.0. And it can be a start point for further discussion for proper power level of downlink Rx signal.
* Proposal 3: It is proposed to not only specify the test points on the spherical surface (i.e. theta and phi angles), but also specify the test order of test points.
* Recommended WF
  + TBA

### Sub-topic 1-2: Test methodology for TxD

**Issue 1-2-1: Test method down selection**

*Moderator’s notes: In the last RAN4 #101-bis-e meeting, two test methods for TxD are proposed and captured in the WF(R4-2203070) for further discussion. The further analysis and selection will be discussed in this meeting.*

* Option 1: For the TxD TRP methodology, RAN4 should select Method B: Test TRP with both of the antennas transmitting together.
* Option 2: For Method A, to measure TRP per branch via sending TPMI 0 and TMPI 1 separately and sum them up.
* Option 3: FFS is needed.
* Recommended WF
  + TBA

**Issue -1-2-2: Consideration on test mode for test methodology for TxD UEs**

* Proposal: Do not consider the test mode for the test method for TxD UEs.
* Recommended WF
  + TBA

### Sub-topic 1-3: Test methodology for multi antenna receivers

**Issue 1-3-1: How to deal with UE implementing more receive antennas than 3GPP minimum requirement?**

* Proposal: if a device implements more receive antennas than the minimum required by 3GPP, TRS should be measured under device default setting.

## Companies views’ collection for 1st round

### Open issues

**Sub-topic 1-1: Test methodology for TAS ON**

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| **Company** | **Comments** |
| OPPO | **Issue 1-1-1: Introduce a new figure of metric for the correctness of TRP measurement with TAS ON**  It is not our preference to introduce new figure of metric for TAS ON measurement, which is also the agreement of last meeting.  **Issue 1-1-2: Downlink Rx signal impact on the TAS ON test method**  Support the proposals as the proponent. |
| Xiaomi | **Issue 1-1-1: Introduce a new figure of metric for the correctness of TRP measurement with TAS ON**  Agree with OPPO that no new FoM should be created as agreed in the last meeting. |
| MediaTek | **Issue 1-1-1: Introduce a new figure of metric for the correctness of TRP measurement with TAS ON**  We are open for this, but maybe the first step is to find a feasible test method for TAS ON.  **Issue 1-1-2: Downlink Rx signal impact on the TAS ON test method**  Clarification on “but also specify the test order of test points.”is needed, could proponent clarify the meaning? |
| R&S | **Issue 1-1-1: Introduce a new figure of metric for the correctness of TRP measurement with TAS ON**  As commented in previous meetings, we don’t think a new figure of merit is required for TAS ON.  Besides that, we would like to ask for clarification on the proposal in R4-2203637:   * is it the intention to add that verification as a step of the measurement procedure, which would imply testing 3 times for a device with 2 possible tx antennas?   or   * is it proposed as a verification method when the TAS ON method is defined?   **Issue 1-1-2: Downlink Rx signal impact on the TAS ON test method**  Proposal 1 and Proposal 2 can be taken as starting point for the discussion, but OTA setups considerations (e.g. maximum available DL power at the test volume vs. minimizing call drops) need to be considered before defining a value.  Proposal 3, impose unnecessary requirements to certain OTA chamber/positioner implementations, and thus should be avoided. In addition, different UE's may require different test point order, what makes the standardization even more difficult.  Beside the three proposals, there is an interesting idea in the Observation 1 of R4-2203637 to reuse the sensitivity level per point from the TRS measurement for TRP TAS ON test method. Even though, this present some challenges for the real test setup: either TRS is measured prior to TRP and used to control the DL power, or RSRP is used to set the DL level (which would be quicker). |
| Huawei | **Issue 1-1-1: Introduce a new figure of metric for the correctness of TRP measurement with TAS ON**  **Feedback to OPPO and Xiaomi:**  **The proposal is a way to verify if a measurement method with TAS on is valid or not. It is not a new metric or FoM.** |
| Apple | **Issue 1-1-1**  **Proposal not supported**  In the contribution R4-2203637 Huawei recognizes the issue related to uplink path loss variation while measuring in anechoic chamber that have the uplink signalling antenna not placed on the turn table (majority of the AC test setups). An UE that adopts the DL signal to trigger TAS will have results depending on the AC implementation. Since an UE equipped with TAS will have a limited antenna switching configuration, the assumption that TRP\_i = Max (TRP1\_i, TRP2\_i) may (or may not) hold only for the AC embodiment that was tested. An AC chamber with DL placed in a different location will generate different results, due the limitation of TX array options.  **Issue 1-1-2**  **Proposal 1, not supported**.  This condition requires that all AC chambers have the same embodiment where the DL path loss is identical at every point measurement theta and phi angles. Otherwise results will vary. Currently different AC implementation has different DL antenna placement, radiation pattern consequently different path losses.  **Proposal 2. Can be supported**, more discussion is required  **Proposal 3, not supported** for the same reason stated on Proposal 1 |
| Samsung | **Issue 1-1-1: Introduce a new figure of metric for the correctness of TRP measurement with TAS ON**  As a verification method to check if TAS ON is correctly activated, the proposal is reasonable since it considers 3D test direction, but we think it may not needed to be a mandatory standardized procedure since test burden is increased unnecessarily, as TAS ON is a default mode for UE supporting it.  **Issue 1-1-2: Downlink Rx signal impact on the TAS ON test method**  We are generally fine with proposal 1 and 2 in principle and further discussion on downlink power configuration is needed.  For proposal 3, we understand the reason to make sure the test is repeatable, but it also limits test system implementation on the other hand. |
| vivo | **Issue 1-1-1: Introduce a new figure of metric for the correctness of TRP measurement with TAS ON**  We are open to further discuss whether a new FoM is helpful or not to present UE performance under TAS ON mode. Currently reusing TRP is preferred.  **Issue 1-1-2: Downlink Rx signal impact on the TAS ON test method**  For P1 and P3, we can not support it due to test system implementation. For P2 further discussion is needed.  Several general aspects for discussions first would be:  currently, for TAS ON test methodology we only consider Downlink Rx signal impact?  are we talking about FS testing or phantom based testing, which phantom? |
| OPPO | **Issue 1-1-2: Downlink Rx signal impact on the TAS ON test method**  Feedback to MediaTek:  Clarification on “but also specify the test order of test points.”In TRP test procedure, there are 266 measurements specified with 15 degree sampling step. And different chamber implementations may deploy different order/sequence to sweep 266 measurements. With the observation that whether UE trigger Tx antenna switch or not may be related to it’s previous working state, different measurement order/sequence may cause that some of measurements have different tx antenna state. To make different chambers have repeatable and consistent result on TAS ON measurement, we propose to specify the order/sequence of measurement.  Response to R&S:  Regarding P3, we agree that specifying the test order/sequence will introduce certain requirement on chamber implementations. However, to our understanding, the modifications is only related to the software to control the sweep order/sequence, but not the hardware. Because the 266 measurements compared with normal TRP test do not changed.  Feedback to Apple:  The proposals do not intend to align the DL pass loss of the OTA chambers. What to be specified is the DL power level at the centre of quite zone. Hope the clarification helps.  Response to vivo:  currently, for TAS ON test methodology we only consider Downlink Rx signal impact?  No. The concluded TAS ON test methodology is expected to be a comprehensive solution to verify TAS ON performance. According to the updated agreed potential influence factors, the Downlink Rx signal is the only one factor with high priority. Therefore, we try to proposal solutions to cover Downlink Rx signal impact. Other minor factors are also expected to be covered in.  are we talking about FS testing or phantom based testing, which phantom?  Actually, we did not consider test scenario yet. And I believe the test scenario should be further discussed with the understanding that different test scenario may trigger different Tx antenna state based on TAS algorithm of near-body sensor. |
| Apple | **Issue 1-1-2: Downlink Rx signal impact on the TAS ON test method**  Follow-up to OPPO comment:  It’s understood that the objective is to maintain the same DL power level at the center of the quiet zone. Our comment is related to the implementation, The UE perceived DL power will vary depending on the relative position against the DL signalling antenna. |

**Sub-topic 1-2: Test methodology for TxD**

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| **Company** | **Comments** |
| Huawei, HiSilicon | **Issue 1-2-1: Test method down selection**  We prefer method A.  A question to Qualcomm on option 2: the antenna port mapping is virtual, could TPMI 0 or 1 ensure the correct antenna is used?  **Issue -1-2-2: Consideration on test mode for test methodology for TxD UEs**  The test results without considering test mode could be unpredictable, although for devices with certain diversity features such as CDD (Cyclic Delay Diversity), TRP measurement results using method A and B could be very similar. Namely a prudent option is method A. |
| OPPO | **Issue 1-2-1: Test method down selection**  We agree that TPMI can not ensure that the correct physical antenna is used. Based on this understanding, Method A means that the test mode for test methodology of TxD is required. Therefore, we prefer to select Method B to avoid using test mode, while the phase difference of Method B as mentioned before should be FFS.  **Issue -1-2-2: Consideration on test mode for test methodology for TxD UEs**  Support the proposal. |
| Xiaomi | **Issue 1-2-1: Test method down selection**  We also see some problem using the TPMI method. We support to further investigate method B at this stage.  **Issue -1-2-2: Consideration on test mode for test methodology for TxD UEs**  Before figuring out the real test method, we would like to leave the test mode as one back-up method, |
| Qualcomm | **Issue 1-2-1: Test method down selection**  Theoretically, TPMI 0 or 1 could not guarantee to map to physical antenna 0 and 1, respectively since TPMI is virtual. But we still think it is feasible since it is straightforward to switch between physical antenna if TMPI is changing from 0 to 1 and vice versa. Keep all the methods open at this stage. We can further discuss pros and cons for test methods.  **Issue -1-2-2: Consideration on test mode for test methodology for TxD UEs**  Support the proposal. Test mode should be avoided otherwise it will introduce much complexity. |
| MediaTek | **Issue 1-2-1: Test method down selection**  We worry Option1 (method B)’s measurement result due to phase difference. Option2 (fixed antenna) is at least stable for us. Anyway, we are still open for the methods.  **Issue -1-2-2: Consideration on test mode for test methodology for TxD UEs**  We should reserve the possibility about test mode, before we have solid TxD test method. |
| R&S | **Issue 1-2-1: Test method down selection**  We recommend Option 1.  **Issue -1-2-2: Consideration on test mode for test methodology for TxD UEs**  We agree to the proposal. |
| Apple | **Issue 1-2-1**  **Option 1, not supported.**  **Option 2, supported**  Option 2 for method A, can be supported for UEs equipped with TxD.  Additionally, for UEs capable of UL MIMO, we would like to propose Option 2a: where an UE can optimize Tx through a dynamic TPMI, selected through a TE feedback mechanism.  We would like to ask test equipment vendors’ feedback whether it is feasible for the test equipment to calculate TPMI per UE test position and to transmit the TPMI feedback to the UE during such a TRP test.  **Option 3, supported**  **Issue 1-2-2**  **Proposal not supported.** As stated on Issue 1-2-1 Option 2 (supported),UEs capable of TxD only will require test mode to support TRP measurement per branch |
| Samsung | **Issue 1-2-1: Test method down selection**  Support Option 3: FFS is needed.  So far both methods show unsolved issues. Before we have solid solution, down selection should not be concluded abruptly.  **Issue -1-2-2: Consideration on test mode for test methodology for TxD UEs**  Test method should not be precluded before we have agreed better solution. |
| vivo | **Issue 1-2-1: Test method down selection**  FFS is needed. Before going into the test methods discussion, we want to remind the group to notice the progress of core requirement discussion, and the following aspects should be clear first:   1. The dependency of ULFPTx and TxD, are we going to define test methods for both layer 1 mode of ULFPTx, and TxD?   If yes, the TPMI can be configured for ULFPTx for 1 layer UL MIMO, to ensure the 2Tx transmission;  For TxD, the signaling is just a capability of UE, we need to confirm first whether TE can force the UE working at TxD mode or not during the whole testing, especially for UE support 23+26 PAs.  For TxD conducted test aspects, all the controversial open issues have been moved to RAN5. However, if RAN4 develop the OTA test method, the UE configuration should be defined first, as listed in section 6.3 of 38.837 v0.3.0, R4-2201590：   * how to test requirements that require power changes such as relative power control; * Power Splitting Behaviour of TxD;   We believe the above aspects for UE configuration should be concluded first, before discussing detailed test methodologies.    **Issue -1-2-2: Consideration on test mode for test methodology for TxD UEs**  For TxD core requirement discussion, test mode was not concluded after many discussions. Before adopting this approach for OTA testing, RAN4 should study other ways first, this can be considered only if it’s the single solution for OTA testing or adopted by TxD conducted testing in RAN5. |

**Sub-topic 1-3: Test methodology for multi antenna receivers**

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| **Company** | **Comments** |
| Huawei, HiSilicon | **Issue 1-3-1: How to deal with UE implementing more receive antennas than 3GPP minimum requirement?**  As the proponent of this proposal, we support this proposal as it is a safe option and simplifies tests. |
| OPPO | **Issue 1-3-1: How to deal with UE implementing more receive antennas than 3GPP minimum requirement?**  Support the proposal. |
| Qualcomm | **Issue 1-3-1: How to deal with UE implementing more receive antennas than 3GPP minimum requirement?**  OK with proposal. |
| MediaTek | **Issue 1-3-1: How to deal with UE implementing more receive antennas than 3GPP minimum requirement?**  Support the proposal. |
| Apple | **Proposal supported** |
| Samsung | **Issue 1-3-1: How to deal with UE implementing more receive antennas than 3GPP minimum requirement?**  Support the proposal. |
| vivo | **Issue 1-3-1: How to deal with UE implementing more receive antennas than 3GPP minimum requirement?**  Support the proposal. |

### 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** |
| R4-2204989 | Apple:  E.1 Test methodology and configurations for UE with UL Tx Diversity  Method A: **supported**, text need clarification indication that only one antenna is transmitting at the time  Method B: **not supported**  E.2 Test methodology and configurations for UE with Tx antenna switch ON  **Supported** |
| vivo: Thanks for the TP. Based on our comments for issue 1-2, we suggest to remove TxD related part. In addition, two test methods are just starting point for discussion, should not be added in the TR currently. Methodology can be introduced at a later stage based on clear agreements of test method and UE configuration.  For TAS ON content, we understand the motivation but we think the following statement should be removed currently, which can be refined and added into TR after clear agreements on test system and test procedure is reached.  ~~For the high priority influenced factor, i.e. Downlink Rx signal, the potential effective approach to trigger Tx antenna switch algorism is that combining the measurement antenna and the link antenna to be one unified antenna in the OTA chamber. Furthermore, introducing a dwell or wait time between the change in DL direction and the power measurement to ensure the switching state stable in the~~ |
| OPPO: support the TP as the proponent. For TxD part, we suggest to keep the text as proposed, we can find similar operation in TR 37.977 Clause 6 to provide the information as a TR. Maybe we can put the text in a sub-clause with the title of “E.1.1 Candidate measurement methodologies”.  For TAS ON part, we prefer to keep the content. It is not to specify the test methodology, but it is to present the consensus on the influenced factor of Downlink Rx signal from previous meetings. We have already spend effort on it, and it is natural to reflect the consensus in the TR for information. Wording refinement is welcome, if any. |

## 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 1-1: Test methodology for TAS ON** | **Issue 1-1-1: Introduce a new figure of metric for the correctness of TRP measurement with TAS ON**  8 companies comment on this topic. 5 of them hold negative view on that. And the clarification from the proponent of the proposal is that the intention of the proposal is to verify if a measurement method with TAS ON is valid or not, not to introduce new FoM. Considering the TAS ON is a default mode for test methodology development, as one company commented, the proposed verification procedure is not needed.  *Tentative agreements:*   * Verification procedure for TAS ON valid or not is not needed.   *Recommendations for 2nd round:*   * Capture the agreement in the WF.   **Issue 1-1-2: Downlink Rx signal impact on the TAS ON test method**  6 companies comment on the topic. And no consensus reached. Further study and discussion are needed.  *Recommendations for 2nd round:*   * Further discussion on the topic, and capture the agreement in the WF, if any. |
| **Sub-toipc 1-2: Test methodology for TxD** | **Issue 1-2-1: Test method down selection**  9 companies comment on the topic. 5 companies support Option 3, i.e. FFS. 3 companies support Method A, and 3 companies support Method B. Considering the unsolved issues on UE configurations and both methods, moderator suggests FFS on this topic.  *Tentative agreements:*   * Test methods, i.e. Method A and Method B, together with UE TxD configurations is FFS.   *Candidate options for further discussion:*   * Method A: * Option A1: To measure TRP per antenna under test mode separately and sum them up. * Option A2: To measure TRP per branch via sending TPMI 0 and TMPI 1 separately and sum them up. * Method B   *Recommendations for 2nd round:*   * Further discuss and capture the agreement in the WF.   **Issue -1-2-2: Consideration on test mode for test methodology for TxD UEs**  9 companies comment on the topic. 2 companies support test mode for TxD test methodology, 3 companies prefer to avoid test mode, and 4 companies’ view is that leave the test mode as a back-up solution at current stage.  According to the email discussion, test mode for TxD is the necessary requirement for Method A. Therefore, before we have solid TxD test method, moderator suggests to leave the test mode issue open.  *Tentative agreements:*   * Leave the test mode as one back-up solution at current stage, and consider it only if it is the single solution for TxD TRP testing.   *Recommendations for 2nd round:*   * Capture the agreement in the WF. |
| **Sub-topic 1-3: Test methodology for multi antenna receivers** | **Issue 1-3-1: How to deal with UE implementing more receive antennas than 3GPP minimum requirement?**  All of 7 commented companies support the proposal.  *Tentative agreements:*   * If a device implements more receive antennas than the minimum required by 3GPP, TRS should be measured under device default setting.   *Recommendations for 2nd round:*   * Capture the agreement in the WF. |

### CRs/TPs

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

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

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2204989 | *To be revised, further comments can be provided based on the revised version.* |

## Discussion on 2nd round

**Issue 1-1-2: Downlink Rx signal impact on the TAS ON test method**

Considering no consensus reached in the 1st round, this topic is further discussed in the 2nd round. It’s better to align the understanding of the proposals assisted with OPPO’s feedback and response in 1st round. Besides, two general aspect questions posed by vivo can be discussed under this topic.

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| **Company** | **Comments** |
| MediaTek | Thanks for OPPO’s clarification on “test order”, it’s clearer for us now. We understand it may make the test result be more consistent, however, it would also mean the potential TAS ON test method could be not practical or too sensitive. Anyway, we are open for these, and do understand & thanks for the intention. Anyway, before we have solid TAS ON method, we at least can rely on TAS OFF method. Hence, we prefer to have a real solid/stable TAS ON method. |
| Apple | Thanks OPPO for the comment, we still have concerns regarding the potential implication in the DL UE perceived power depending on test implementation. Until such limitation is better understood we prefer to rely on TAS OFF and consider TAN ON FFS. |

**Issue 1-2-1: Test method down selection**

The tentative agreement is that the test method for TxD is FFS. However, the technical discusssion on the following options are encouraged.

*Candidate options for further discussion:*

* Method A in the last meeting WF (R4-2203070):
* Option A1: To measure TRP per antenna under test mode separately and sum them up.
* Option A2: To measure TRP per branch via sending TPMI 0 and TMPI 1 separately and sum them up.
* Method B in the last meeting WF (R4-2203070)

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| **Company** | **Comments** |
| Huawei | **Issue 1-2-1: Test method down selection**  We support option A1 because it is a safe approach, albeit test mode is required. |
| MediaTek | We are fine for tentative agreement. |
| vivo | We are not ready to approve these methods as candidate methodologies for TxD OTA testing, prefer keep FFS. The technical reasons are as following:   1. Test mode is not an agreed configuration by now, Option A1 is not feasible. 2. The dependency of TxD and ULFPTx is not decided yet, whether we just focus on TxD only or also consider ULFPTx as working scope is still up in the air. For pure TxD mode, TPMI can not be used, so Option A2 is just for ULFPTx UE. 3. Method B is not a valid test method, which needs more discussions and more feedback from TE vendors. Currently, we do not see how to force UE working at TxD mode given the signaling of TxD UE feature is just a capability signaling. How to maintain TxD mode is also an open issue in main session.   Therefore, overall we are fine to further discuss the above proposed approaches in RAN4, as agreed in another email thread that TxD scope will be further discussed after core part completion. But we can not accept above briefly descriptions as candidates currently, without comprehensive analysis and more detailed thinking. |
| Xiaomi | We agree with VIVO on the limitation of current test methods. We suggest to also include these limitations in the WF and leave open for new test methods for further study. |
| Apple | **Issue 1-2-1: Test method down selection**  We support option A1 |

## Summary for 2nd round

**Issue 1-1-2: Downlink Rx signal impact on the TAS ON test method**

2 companies share views and concerns on Downlink Rx signal impact. The potential implication of DL perceived power need further study. Also, TAS ON test method is FFS.

**Issue 1-2-1: Test method down selection**

5 companies comment on this topic. Two companies prefer Option A1 that measuring under test mode. And 3 companies support further study is needed. Besides, one company points out some limitations on proposed TxD test method.

**Agreements:**

* RAN4 can further discuss the feasibility of the following approaches:
* Method A
* Option A1: To measure TRP per antenna under test mode separately and sum them up.
* Option A2: To measure TRP per branch via sending TPMI 0 and TMPI 1 separately and sum them up.
* Method B: Make UE worked in Tx Diversity mode. Test TRP with both of the antennas transmitting together. It is the TRP for the UE with Tx Diversity.
* Other methods are not precluded
* The detailed UE configuration is FFS
* RAN4 should further discuss the dependency of TxD and ULFPTx

# Topic #2: Test time reduction

*The following aspects for test time reduction will be discussed in this section.*

* *Reduce EN-DC combinations*
* *Reduce SA test time*
* *Other techniques to reduce the FR1 OTA test time*

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2004958 | vivo | Proposal 1: RAN4 further study the antenna tuning impacts on the radiation pattern of NR carrier under EN-DC.  Proposal 2: Companies are encouraged to share measurement results of antenna pattern under SA and EN-DC mode for comparison.  Proposal 3: Similar to the TAS OFF approach, to ensure the proper usage of Single Point Offset, the manufacture should provide guidance to lab on whether Single Point Offset method can be used for each band under EN-DC mode by declaration. |
| R4-2004984 | OPPO | Proposal: Adopt the Single Point Offset method as one of the alternative test methods for TRS test under EN-DC mode. |

## Open issues summary

### Sub-topic 2-1 Single Point Offset method

*Moderator’s notes: The Single Point Offset method was proposed and discussed in the last RAN4 #101-bis-e meeting. And the WF is FFS on Single Point Offset method. The topic will be further discussed based on the proposals from two contributions.*

* Proposal 1: RAN4 further study the antenna tuning impacts on the radiation pattern of NR carrier under EN-DC.
* Proposal 2: Companies are encouraged to share measurement results of antenna pattern under SA and EN-DC mode for comparison.
* Proposal 3: Similar to the TAS OFF approach, to ensure the proper usage of Single Point Offset, the manufacture should provide guidance to lab on whether Single Point Offset method can be used for each band under EN-DC mode by declaration.
* Proposal 4: Adopt the Single Point Offset method as one of the alternative test methods for **TRS** test under EN-DC mode.
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

**Sub topic 2-1 Signle Point Offset method**

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| **Company** | **Comments** |
| Huawei, HiSilicon | On proposal 4, the condition that TRP values do not change between SA and ENDC may need further clarification, e.g. if the change is less MU or a pre-determined threshold, then TRS could be measured under single point offset. |
| OPPO | Support P1 and P2.  On P4, support the proposal together with Huawei’s comments. The result gap between SA and EN-DC should be further specified. |
| R&S | We support Proposal 1, and eventually Proposal 3 is a back-up option to ensure proper testing.  Regarding Proposal 4, we expect that antenna tuning for different band combinations will have an effect on the radiation efficiency, and thus it cannot be agreed until Proposal 1 is clarified. |
| Apple | R4-2004958  Proposal 1: **supported**  Proposal 2: **supported** (as long as the UE is anonymized)  Proposal 3: **supported**  R4-2004984  **Proposal supported** |
| Samsung | Support P3.  As UE may have various implementation, manufacture declaration seems the most efficient way. |
| vivo | We support P1-P3 as proponent. |
| AT&T | We are still trying to understand why we are proposing to introduce single-point offset testing when we already agreed to guidelines to limit testing to a single EN-DC configuration.  We support P1 and P2 at this time in order to collect the necessary data to determine the feasibility and to further assess the need for single-point offset testing. |

### 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** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic 2-1 Single Point Offset method** | 7 companies comment on the topic. 5 companies support Proposal 1, and 4 companies support Proposal 2. Proposal 3 and Proposal 4 have 3 supported companies each. And one operator has concern on the need for introducing single point offset method when we already agreed to guidelines to limit testing to a single EN-DC configuration.  From the email discussion, considering no obvious objection on P1 and P2, moderator suggests the group to get consensus on P1 and P2.  *Tentative agreements:*   * RAN4 further study the antenna tuning impacts on the radiation pattern of NR carrier under EN-DC. * Companies are encouraged to share measurement results of antenna pattern under SA and EN-DC mode for comparison. * Further assess the need for single-point offset testing.   *Recommendations for 2nd round:*   * Capture the agreement in the WF. |

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

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

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on FR1 TRP TRS for UE with multi-antenna and test time reduction | OPPO |  |
|  |  |  |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2203637 | on tests with TAS on | Huawei Tech.(UK) Co.. Ltd | Noted |  |
| R4-2203695 | On TRP for TxD UEs | Apple | Noted |  |
| R4-2204508 | TRP test method for UEs with Tx diversity | Qualcomm Incorporated | Noted |  |
| R4-2204981 | Downlink Rx signal impact on TAS test method | OPPO | Noted |  |
| R4-2204989 | TP to TR 38.834 on multi-antenna UE | OPPO | Revised |  |
| R4-2004958 | Further discussion on Single Point Offset test method for EN-DC testing time reduction | vivo | Noted |  |
| R4-2004984 | On test time reduction | OPPO | 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** |
| R4-2207328 | WF on FR1 TRP TRS for UE with multi-antenna and test time reduction | OPPO | Agreeable |  |
| R4-2207329 | TP to TR 38.834 on multi-antenna UE | OPPO | Agreeable |  |

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)