**3GPP TSG-RAN WG4 Meeting # 100-e R4-2115624**

**Electronic Meeting, 16th – 27th Aug., 2021**

**Agenda item:** 9.2.1(related proposals), 9.2.4, 9.2.5

**Source:** Moderator (OPPO)

**Title:** Email discussion summary for [100-e] [333] FR1\_TRP\_TRS\_Part2

**Document for:** Information

# Introduction

*Contributions submitted to AI 9.2.4* UE with multiple antennas test methodology and *AI 9.2.5* Others of FR1 TRP TRS WI *and related to multiple antenna topics in AI 9.2.1* General and work plan *are captured in this email discussion. According to the RAN plenary #91-e arrangement, this is the first meeting for technical 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:* This task will start when RAN4 concludes on UL Transmit Diversity of SA
* *Transmit Antenna Switch*
* *Multi Antenna Receivers*

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2112610 | Xiaomi | **Observation 1**：One possible test method for antenna switching is to measure the EIRP with each antenna separately and save the highest value as the result of that specific test point and calculate the TRP in the last.  **Proposal**: It is proposed to study a new TRP limit representing “one virtualized antenna” for UE with multi-antenna to reflect the gain of antenna switching. |
| R4-2112861 | CMCC | **Proposal 2**: TRP test methodology of multiple antenna UE with TAS function should be studied sustainably in RAN4. |
| R4-2112863 | CMCC, Xiaomi | **Observation 1**: The TRP test results are relatively stable based on this methodology. Using one hardware in the same one chamber, the differences of TRP results among multiple tests ranges .  **Observation 2**: TRP with Tx antenna switching on is better than the TRP with any one antenna locked, which means TAS does bring some benefit and enhance the Tx performance. In the meanwhile, UE does not switch to the best antenna at some positions.  **Observation 3**: There are two test configurations need further study which have impact on TRP performance according to differences among UE TAS algorithm. One is the test delay of every test direction, another is the RSRP of SSB in center of teat zone.  **Proposal 1**: This methodology can be treated as baseline to measure TRP with UE Tx antenna switching on.  **Proposal 2**: The detail of test configurations needs further study and companies are encouraged to share views to improve this methodology. |
| R4-2113913 | OPPO | **Observation 1**: the hardware implementation of traditional SISO OTA test system will introducing measurement deviation with Tx switching function ON because of the uplink path and the measurement path inconsistent artificially.  **Observation 2**: the software adaptation with different Tx switching optimization strategy leads different UE’s behaviour even in the same measurement environment.  **Proposal 1**: Currently keep the function OFF as a common approach for UE TRP OTA test.  **Proposal 2**: Test solutions which can solve the problems mentioned above on hardware and/or software are highly encouraged. |
| R4-2113986 | ROHDE & SCHWARZ | **Observation 1**: Rx diversity is already covered with current OTA test systems and procedure.  **Observation 2**: test system implementations on anechoic chambers are capable of presenting the right conditions to test Tx switching without the need for a test mode.  **Proposal 1**: UE vendors to clarify at high-level what mechanisms are used in UE’s to control Tx antenna switching. |
| R4-2114531 | Huawei, HiSilicon | **Obsevation 1**: for Tx antenna switching based on downlink Rx signal level or uplink received power, it is difficult to simulate in the chamber the same switching mechanism that DUT will perform in real in-field environment. Therefor it lacks the rationality for “functon on” test.  **Observation 2**: pure proximity senor based solution is expected to perform the same for “function on” and “function off” tests.  **Observation 3**: In case of multiple Rx antenna, the most common implementation is to keep them all active, relying on baseband combination algorithms for optimal combined performance, i.e. receive diversity.  **Proposal 1**: aodpt “Function Off” for Tx antenna switching. Where all candidate Tx antennas should be tested, the best TRP value out of the tested Tx antennas should be used.  **Proposal 2**: In case of multiple Rx antenna, keep all antenas active and use receive diversity in the test.  **Proposal 3**: for implementations that physically select different Rx antannas according to different circumstances, apply same principle as “Tx antenna switching”, i.e. “Function Off” with minimum requirement being satisfied by the antennas with the best TRS performance. It should be noted that no limit on the maximum number of Rx antenna for one test should be imposed. |

## Open issues summary

### Sub-topic 1-1: Tx antenna switch ON/OFF

**Issue 1-1: Function OFF or ON for Tx antenna switching?**

* Proposal 1: adopt Transmit Antenna Switch function OFF under current SISO OTA methodology
* Proposal 2: TRP test methodology for TAS function ON should be studied sustainably in RAN4
* Recommended WF
  + TBA

### Sub-topic 1-2: Test Methodology for Tx antenna switch function ON

**Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**

* Option 1: measure the EIRP with each antenna separately and save the highest value as the result of that specific test point, then calculate the TRP (Xiaomi)
* Option 2: the communication tester is connected to the test antenna to provide the DL signal at the same time it performs power measurements (CMCC, ROHDE & SCHWARZ)
* Option 3: others
* Recommended WF
  + TBA

**Issue 1-2-2: Factors those influence the Tx antenna switch mechanism**

* Option 1: UE vendors to clarify at high-level what mechanisms are used in UE’s to control Tx antenna switching (ROHDE & SCHWARZ)
* Option 2: Views on methodology improvement are encouraged to refine the test configurations (CMCC)
* Option 3: others
* Recommended WF
  + TBA

**Issue 1-2-3: Metrics for evaluating radiated performance of Tx antenna switch**

* Option 1: study a new TRP limit representing “one virtualized antenna” for UE with multi-antenna to reflect the gain of antenna switching
* Option 2 (from moderator): new metrics are not needed
* Option 3: FFS is needed
* Recommended WF
  + TBA

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

**Issue 1-3-1: Is Rx diversity already covered with current OTA test systems and procedure?**

* Option 1: Yes.
* Option 2: No.
* Option 3: FFS is needed
* Recommended WF
  + TBA

**Issue 1-3-2: Test methodology/configuration for multi antenna receivers**

* Proposal 1: keep all antennas active and use receive diversity in the test.
* Proposal 2: for implementations that physically select different Rx antennas according to different circumstances, apply “Function Off” with minimum requirement being satisfied by the antennas with the best TRS performance.
* Proposal 3: It should be noted that no limit on the maximum number of Rx antenna for one test should be imposed.
* Proposal 4: others
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

**Sub-topic 1-1: Tx antenna switch ON/OFF**

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| **Company** | **Comments** |
| OPPO | **Issue 1-1: Function OFF or ON for Tx antenna switching?**  Since current OTA test system cannot get stable results on DUT with Tx antenna switch ON, it is recommended to keep the function OFF as a common approach for UE TRP OTA test. Furthermore, as a enhancement, methodology for function ON should be studied. |
| MediaTek | 1. Use “force antenna method” to do test shall be the baseline before we have solid & stable test method for “TAS ON”; 2. solid and stable test method for “TAS ON” should be studied. |
| CMCC | **Issue 1-1: Function OFF or ON for Tx antenna switching?**  Test methodology for TAS on should be studied. |
| R&S | **Issue 1-1: Function OFF or ON for Tx antenna switching?**  Several companies have provided very similar approaches to enable Tx antenna switching testing with function ON. Therefore, we think Proposal 2 is the preferred option. |
| Qualcomm | **Issue 1-1: Function OFF or ON for Tx antenna switching?**  We share the similar view as OPPO. In the current stage, we should use “TAS OFF” as the baseline for FR1 TRP/TRS measurement since this is the mature approach. We are open to further study the method for “TAS ON” but prefer to have it as 2nd priority. |
| Samsung | **Issue 1-1: Function OFF or ON for Tx antenna switching?**  Agree to use “TAS OFF” as baseline in current stage. It seems that the exact interpretation of TAS OFF is needed (test each Tx antenna respectively and choose better one?). |
| Huawei, HiSilicon | **Issue 1-1: Function OFF or ON for Tx antenna switching?**  We prefer proposal 1. Agree with Samsung that interpretation is needed. Our understanding is “*all candidate Tx antennas should be tested, the best TRP value out of the tested Tx antennas should be used.*”  Regarding proposal 2, the feasibility needs to be studied first, to justify the feasibility to correctly model the in-field environment in the chamber. |
| vivo | Function OFF. This should be basis for next-step performance related discussion, including test lab alignment and large-scale UE measurement to define requirements.  If this is agreeable. We are open to discuss new test methods for UE with antenna function ON. But no requirements will be defined based on UE with Tx antenna function ON within Rel-17 timeline. |
| Xiaomi | We agree to only define the function off limit within Rel-17 WID. However as proposed, we are interested in study the test method. It seems most of companies show interests on this topic, too. Then we might need to discuss how far we can go on this topic with limited Rel-17 time. |
| CAICT | We are interested in the discussion on “TAS ON”. However, in the current stage (R17), we should use “TAS OFF” as the baseline for the test method and the next-step requirements. Solid and stable test method for “TAS ON” could be further discussed. |
| Apple | **Issue 1-1: Function OFF or ON for Tx antenna switching?**  Support proposal 1 (TAS OFF) |

**Sub-topic 1-2: Test Methodology for Tx antenna switch function ON**

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| **Company** | **Comments** |
| OPPO | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  Option 2 is preferred. Option 1 costs more test time and need specific test mode configuration.  **Issue 1-2-2: Factors those influence the Tx antenna switch mechanism**  Both Option 1 and Option 2 are needed. A list of factors which may affect antenna switch scheme can be made like below. Then, we can select factors that need to be considered from the list.   * Near body sensor * Downlink power detection * USIM card distinguishing * Upper business * …   **Issue 1-2-3: Metrics for evaluating radiated performance of Tx antenna switch**  The required metrics need to reflect the performance with Tx antenna switch ON. So, it is recommended to postpone discussing this topic when we have a clearer picture of the enhanced test system. |
| MediaTek | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  We are a little confused on Option1, it is much like TAS OFF method (force antenna method), in our understanding; however, it is put in TAS ON sub-topic currently.  About Option2: we are interested on the method idea, deeper studies and more data would be fine before adopt it  **Issue 1-2-3: Metrics for evaluating radiated performance of Tx antenna switch**  We support Option2. TAS function is a UE capability, so maybe no need to introduce new metrics, it much like “the UE has TAS function, so the fundamental TRP performance is better than the UE w/o TAS”. |
| CMCC | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  Support Option2 as baseline to be further studied.  **Issue 1-2-3: Metrics for evaluating radiated performance of Tx antenna switch**  Agree with OPPO. A reasonable test method with UE TAS on should be clarified first. |
| R&S | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  We support option 2. Based on the inputs in R4-2112863, a “dwell time” per point could be considered to ensure the switching state is stable before performing the power measurement.  Option 1 still requires N measurements (being N the number of Tx antennas) and the final result would overestimate the actual radiated performance of the device under realistic conditions.  **Issue 1-2-2: Factors those influence the Tx antenna switch mechanism**  There is no conflict between Option 1 and Option 2.  We agree with OPPO in listing the factors and then decide on those that might affect the results. E.g.: USIM card wouldn’t be considered since these tests are performed with tests USIM cards, and thus no tuning for dedicated operator is considered.  **Issue 1-2-3: Metrics for evaluating radiated performance of Tx antenna switch**  Option 2 is preferred.  A new metric, as proposed in Option 1, combining the results from several TRP tests for each Tx Antenna would overestimate the actual radiated performance of the device under realistic condition. |
| Qualcomm | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  More clarifications are needed for option 1. Option 2 can be a start but need more date to verify the feasibility and accuracy of solution.  **Issue 1-2-3: Metrics for evaluating radiated performance of Tx antenna switch**  We support option 1. We need to discuss the term of “TRP with TAS ON” first. Traditionally, TRP is used to indicate the antenna radiated performance in a static stage while with TAS ON, we are measuring the optimal envelope of radiation performance of several antennas. That is a different concept from TRP. So we support to define a new metric to evaluate radiated performance with TAS ON. |
| Samsung | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  Is option 1 the same as TAS OFF? It seems that the exact interpretation of TAS OFF in issue 1-1 is needed.  **Issue 1-2-3: Metrics for evaluating radiated performance of Tx antenna switch**  Option 3. We agree with Qualcomm that it is new concept compared with traditional TRP, further study is needed. |
| Huawei, HiSilicon | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  Regarding option1, same feeling as MTK and Samsung, it looks like our understanding for TAS off  Regarding option2, we think it is not a comprehensive solution, the strength of DL signal is not the only method for UE TAS, as discussed in Issue 1-2-2. |
| vivo | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  This is related to Issue 1-2-2. Different Tx antenna switching approach may require different system capability.  **Issue 1-2-2: Factors those influence the Tx antenna switch mechanism**  Two typical type:   1. TX antenna switching is a function of the proximity to the user's hand, head or body, or nearby object and is usually determined by sensors contained within the device. 2. TX antenna switching is a function of inputs from an external signal/control, e.g. Rx signal level, base station control, user control, or other means, but not a function of the use case of the device.   Tx antenna switching is UE implementation, more study is required, if RAN4 agree to develop test methods for UE with Tx switching function ON.  **Issue 1-2-3: Metrics for evaluating radiated performance of Tx antenna switch**  FFS |
| Xiaomi | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  We agree with MTK and R&S comment. This option 1 is listed in our paper as one method to count the antenna switching maximum gain. The exact test method should use option 2.  **Issue 1-2-3: Metrics for evaluating radiated performance of Tx antenna switch**  As proponent, we aim to point out that with TAS on, of course we can still test the TRP using current system. However, we are testing a dynamically changing antenna pattern with TAS on. Traditionally, the antenna pattern is fixed when we do TRP testing. There might be some issue from this perspective but we need to further study. |
| CAICT | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  Option 1 is relatively time-consuming, and using the highest value of each test point to calculate TRP could not accurately reflect the performance of the UE with TAS ON in practice.  Tx antenna switching is implemented by the UE, and different mechanisms are very important for studying the test method/system. Thus, further discussion is needed.  **Issue 1-2-2: Factors those influence the Tx antenna switch mechanism**  As stated under Issue 1-2-1, mechanisms used in UE’s to control Tx antenna switching is important for studying the test method, so we suggest to further discuss.  **Issue 1-2-3: Metrics for evaluating radiated performance of Tx antenna switch**  FFS |
| Apple | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  We do not support defining any method with the TAS function set to ON  **Issue 1-2-2: Factors those influence the Tx antenna switch mechanism**  We do not think RAN4 needs to consider these factors, and if any of these factors impact the ability of the test system to configure the UE for TAS OFF, then RAN5 could address the related test configuration issue.  **Issue 1-2-3: Metrics for evaluating radiated performance of Tx antenna switch**  We do not support defining any method for evaluating radiated performance of Tx antenna switch |

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

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| **Company** | **Comments** |
| OPPO | **Issue 1-3-1: Is Rx diversity already covered with current OTA test systems and procedure?**  Option 1. Multi antenna receiving in diversity mode is already activated in previous test methodology.  **Issue 1-3-2: Test methodology/configuration for multi antenna receivers**  Support Proposal 1 and Proposal 3. |
| MediaTek | **Issue 1-3-2: Test methodology/configuration for multi antenna receivers**  Support Proposal 1 and Proposal 3. We believe the intention of test is to confirm the UEs pass the min requirement, so the UE actually can use more Rx antennas to achieve potential better performance, it’s up to UE implementation. |
| R&S | **Issue 1-3-1: Is Rx diversity already covered with current OTA test systems and procedure?**  We support option 1. Any further discussion of how multiple Rx antennas affect the performance is part of the requirement definition work, to be handled under the performance part of the WI.  **Issue 1-3-2: Test methodology/configuration for multi antenna receivers**  We support Proposal 1. |
| Qualcomm | **Issue 1-3-2: Test methodology/configuration for multi antenna receivers**  We support proposal 1 and different requirements should be defined for different Rx antenna number such as 2Rx, 4Rx. |
| Samsung | **Issue 1-3-1: Is Rx diversity already covered with current OTA test systems and procedure?**  We support option 1 (yes).  **Issue 1-3-2: Test methodology/configuration for multi antenna receivers**  We support Proposal 1 and 3. Agree with MediaTek that number of Rx antennas are up to UE implementation. |
| Huawei, Hisilicon | **Issue 1-3-1: Is Rx diversity already covered with current OTA test systems and procedure?**  Support option 1 (yes)  **Issue 1-3-2: Test methodology/configuration for multi antenna receivers**  Support proposal 1 and 3. Same understanding as MTK and Samsung. |
| vivo | **Issue 1-3-1: Is Rx diversity already covered with current OTA test systems and procedure?**  The TRS test method covers Rx diversity.  **Issue 1-3-2: Test methodology/configuration for multi antenna receivers**  Function ON. No specific action is needed for TRS testing. |
| Xiaomi | **Issue 1-3-1: Is Rx diversity already covered with current OTA test systems and procedure?**  Support option 1.  **Issue 1-3-2: Test methodology/configuration for multi antenna receivers**  Support option 1. |
| CAICT | **Issue 1-3-1: Is Rx diversity already covered with current OTA test systems and procedure?**  Support option 1. |
| Apple | **Issue 1-3-1: Is Rx diversity already covered with current OTA test systems and procedure?**  Support option 1; we should add that lab alignment (which is included in the performance part of the WI) can help to determine whether different measurement methodologies provide consistent or inconsistent results for devices with multiple Rx antennas  **Issue 1-3-2: Test methodology/configuration for multi antenna receivers**  The number of active antennas should be assumed to follow the REFSENS specification, and we agree with Qualcomm's comment that if a certain band defines different REFSENS requriements based on the number of receivers, then we should define different TRS requirements as well. |

### 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** |
| 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.*

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|  | **Status summary** |
| Sub-topic 1-1: Tx antenna switch ON/OFF | **Issue 1-1: Function OFF or ON for Tx antenna switching?**  *11 companies comment on this topic.*  *9 companies (OPPO, MediaTek, Qualcomm, Samsung, Huawei/HiSilicon, vivo, Xiaomi, CAICT, Apply) support Proposal 1 that use “TAS OFF” as the baseline for FR1 TRP TRS measurement in current stage. Meanwhile, 8 companies (OPPO, MediaTek, CMCC, R&S, Qualcomm, vivo, Xiaomi, CAICT) think that solid and stable test method for “TAS ON” should be studied/could be discussed.*  *Regarding the majority view on the topic, moderator propose the following tentative agreements.*  *Tentative agreements:*   * *Use “TAS OFF” as the baseline for FR1 TRP TRS measurement in current stage, and for Performance Part discussion.* * *Solid and stable test method for “TAS ON” will be studied and discussed in RAN4.*   *Recommendations for 2nd round:*   * Further discuss the exact interpretation of TAS OFF, and reflect the conclusion in the WF. |
| Sub-topic 1-2: Test Methodology for Tx antenna switch function ON | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  *11 companies comment on this topic.*  *As some companies commended, Option 1 is actually a method which forces TAS OFF during the measurement. So it should not be considered as a candidate solution for TAS ON measurement. In this situation, Option 2 is the only candidate proposed for TAS ON methodology discussion.*  *4 companies (OPPO, CMCC, R&S, Xiaomi) support Option 2, and 3 companies (MediaTek, Qualcomm, CAICT) think that deeper studies and more data are needed on Option 2. 2 companies (Huawei/HiSilicon, vivo) think Option 2 is not a comprehensive solution to evaluate UE TAS performance. While, 1 company (Apple) do not support defining test method with TAS ON.*  *No consensus can be achieved currently and further discussion and study are needed. From perspective of moderator, developing a comprehensive solution for UE with TAS ON is really a complex task. From this understanding, maybe we can start from a simplified question that is it a necessary condition for TAS test system that the test/measurement antenna should provide DL signal at the same time. Then, more functions/implementations will be discussed and combined later based on the outcome from Issue 1-2-2.*  *Candidate Options:*  *Is it a necessary condition for TAS test system that the test/measurement antenna should provide DL signal at the same time?*   * *Option 1: Yes.* * *Option 2: No.* * *Option 3: Other.*   *Recommendations for 2nd round:*   * *Further discuss on the necessary conditions for TAS test system, and reflect the outcomes in the WF.*   **Issue 1-2-2: Factors those influence the Tx antenna switch mechanism**  *5 companies comment on this topic.*  *4 companies (OPPO, R&S, vivo, CAICT) believe more study and discussion needed on factors those influence TAS, and 2 companies (OPPO, R&S) propose to make a list of factors for further study. 1 company (Apple) do not think RAN4 need to consider these factors.*  *Considering more study and discussion is majority view on this topic, moderator recommend further discussion in 2nd round on listing the factors.*  *Recommendations for 2nd round:*   * *Further discuss on listing the influence factors, and attitude on the factors are welcomed.*   **Issue 1-2-3: Metrics for evaluating radiated performance of Tx antenna switch**  *10 companies comment on this topic.*  *Option 1 – study new metrics: Qualcomm*  *Option 2 – new metrics not needed: MediaTek, R&S*  *Option 3 – FFS needed: OPPO, CMCC, Samsung, vivo, Xiaomi, CAICT*  *Option 4 – do not evaluate TAS performance: Apple*  *Majority view is further study is needed.*  *Recommendations for 2nd round:*   * *Postpone the discussion and restart the topic when more contributions or findings input* |
| Sub-topic 1-3: Test Methodology for multi antenna receivers | **Issue 1-3-1: Is Rx diversity already covered with current OTA test systems and procedure?**  *All of 8 commented companies choose “yes” that TRS test method covers Rx diversity.*  *Agreement:*   * *Rx diversity is already covered by OTA test method.*   *Recommendations for 2nd round:*   * Reflect the agreement in the WF.   **Issue 1-3-2: Test methodology/configuration for multi antenna receivers**  *8 out of 9 commented companies support Proposal 1 that keep all antennas active and use receive diversity in the test.*  *5 companies support Proposal 3 that no need to limit the maximum number of Rx antenna. More Rx antenna to achieve potential better performance is in scope of UE implementation. While 2 companies support to define different requirements for different Rx antenna number.*  *Tentative agreements:*   * *Keep all antennas active and use receive diversity in the test for TRS measurement*   *Recommendations for 2nd round:*   * Further discuss on whether or not to limit the maximum number of Rx antenna. It is encouraged to achieve the consensus on this topic. |

### 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)

### Sub-topic 1-1: Tx antenna switch ON/OFF

**Issue 1-1: Function OFF or ON for Tx antenna switching?**

Further discuss the exact interpretation of TAS OFF.

Based on the first round discussion, the following options about the exact interpretation of TAS OFF are provided by moderator.

* Option 1: test each Tx antenna respectively and choose better one
* Option 2: test the Tx antenna by vendor’s declaration

Option 3: other

### Sub-topic 1-2: Test Methodology for Tx antenna switch function ON

**Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**

*Following the discussion in first round, candidate Options from moderator:*

*Is it a necessary condition for TAS test system that the test/measurement antenna should provide DL signal at the same time?*

* *Option 1: Yes.*
* *Option 2: No.*
* *Option 3: Other.*

**Sub-topic 1-1: Tx antenna switch ON/OFF**

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| **Company** | **Comments** |
| MediaTek | **Issue 1-1: Function OFF or ON for Tx antenna switching?**  *Further discuss the exact interpretation of TAS OFF:*  Option3 (?)  To make it clearer, while function OFF during test. Our thought is:  Step1: Test each Tx antenna respectively, and record Tx performance at each test point.  Step2: For each test point, the better Tx performance is choose for equivalent TRP calculation. |
| R&S | **Issue 1-1: Function OFF or ON for Tx antenna switching?**  In our understanding, Option 1 is the most common interpretation of the Tx Antenna switching OFF: each antenna is tested independently, so a TRP value is obtained for each antenna and the applicable configurations (bands, channels, etc.).  The best TRP among the two antennas for each applicable configuration is then used for the performance requirement. |
| Huawei, HiSilicon | **Issue 1-1: Function OFF or ON for Tx antenna switching?**  Option1 with above further clarification from MTK, i.e. better one at each test point |
| CMCC | **Issue 1-1: Function OFF or ON for Tx antenna switching?**  **Support Option1 with clarification that test each antenna and calculate TRP respectively. There is no evidence that UE can choose best one at each test point in actual network. Proposal from MTK and Huawei is meaningless and the TRP performance will be overestimated. From the perspective of operators, we do not think it is helpful to quantify the TRP performance under any in-field environment.** |
| OPPO | **Issue 1-1: Function OFF or ON for Tx antenna switching?**  I think more clarification about Option 1 is needed. For the wording “Test each Tx antenna respectively”, my understanding is that the measurement method for TAS OFF is that every Tx antenna will be tested respectively under the common TRP test procedure, i.e. EIRP on all required theta and phi directions. The wording “choose the better one” is related to how to conduct the TRP value for TAS OFF. From the above discussion, two candidate options are proposed, summarized below.   * Sub-option 1: the TRP of TAS OFF is calculated by using the best EIRP among all the Tx antennas at each test point. * Sub-option 2: the TRP of TAS OFF is conducted by calculating TRP of every Tx antenna respectively, and then selecting the best TRP value as the TRP of TAS OFF.   Considering we are testing UE with TAS OFF, which means the profit of TAS is not considered, we tend to prefer sub-option 2. Or directly go to Option 2 that test the TRP of the Tx antenna based on vender’s declaration. |
| Qualcomm | Option 1 is a bit of confused. We have the same view as OPPO that sub-option 2 is clearer. Per our understanding, option 2, i.e, UE declaration does work fir TRP testing. |
| Samsung | **Issue 1-1: Function OFF or ON for Tx antenna switching?**  Support Option1 in principle but detailed clarification is needed to avoid confusion. Our understanding is the Sub-option 2 of OPPO comments. |

**Sub-topic 1-2: Test Methodology for Tx antenna switch function ON**

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| **Company** | **Comments** |
| MediaTek | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  *Is it a necessary condition for TAS test system that the test/measurement antenna should provide DL signal at the same time?*  Option3 (?)  We think it is worth to do deeper study and verification; however, it would be too early to say “Yes” or “No”. |
| R&S | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  As described in our contribution R4-2113986, it depends on the mechanisms used to select among Tx antennas. Our assumption is that both proximity sensors and received DL power are the most common ones. Therefore, Option 1 (i.e. DL signal provided from measurement antenna) is obviously required in order to characterize the radiated performance of the Tx switching for all angles.  In order to assess the feasibility of such a method to test with TAS function ON testing, it has to be clarified whether there are other more complex mechanisms besides the DL direction and proximity sensors. |
| Huawei, Hisilicon | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  As stated in our contribution R4-2114531, it is very difficult to model a comprehensive in-field environment in the chamber, if not impossible. Therefore, for TAS on test in the chamber, the overall feasibility needs to be justified first, before we answer yes or not to a detailed and isolated question. |
| CMCC | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  **Support Option1:Yes.** |
| Vivo | **Similar view with Huawei. Before making clear of impacted aspects of TAS ON mechanism due to different UE implementations, we can not agree on any specific solutions.** |
| OPPO | **Issue 1-2-1: Candidate solutions for TRP measurement with Tx antenna switch function ON**  We echo R&S’s comment. and agree on that inputs are needed on whether there are other more mechanisms to trigger Tx antenna switch. This is the basis for understanding TAS and further study.  Regarding Huawei’s comment, my understanding is that a comprehensive in-field environment is not the target test environment for SISO OTA. |
| Qualcomm | Option 3. Need more time to discuss the solution. |
| Samsung | Option 3. Need to discuss TAS ON mechanism firstly. |

# 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*

*Only one related contribution R4-2114026 is submitted, which combined with SA TRP TRS methodology proposals. In this meeting, the contribution will be treated in thread 332 FR1\_TRP\_TRS\_Part1. From moderator’s perspective, it is suggested that proposals on test time reduction should be submitted in dedicated contributions in the following meetings.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2114026 | Huawei | **Proposal 3**: Multiple probe approach could be considered for measurement time reduction. |

## Open issues summary

### Sub-topic 2-1

**Issue 2-1: TBA**

* Proposals
  + Option 1: TBA
  + Option 2: TBA
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

**Sub topic 2-1**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |

### 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#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

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

# Recommendations for Tdocs

## 1st round

**New tdocs**

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

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2112610 | on multi-antenna TRP/TRS test | Xiaomi | Noted |  |
| R4-2112861 | Requirements of NR Band n41 Test Configuration and Multiple Antenna Test Methodology | CMCC | Noted |  |
| R4-2112863 | Consideration on Tx Antenna Switching Test Methodology | CMCC, Xiaomi | Noted |  |
| R4-2113913 | Views on Transmit Switching | OPPO | Noted |  |
| R4-2113986 | Tx/Rx switching OTA testing considerations | ROHDE & SCHWARZ | Noted |  |
| R4-2114531 | on FR1 TRP-TRS test methodology for UE with multi-antenna switching | Huawei, HiSilicon | 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** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

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

# Annex

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|  |  |  |
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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)