**3GPP TSG-RAN WG4 Meeting #109 R4-2318227**

**Chicago, US, November 13 – 17, 2023**

**Agenda item:** 8.15.4

**Source:** Moderator (vivo)

**Title:** Topic summary for [109][335] NR\_FR1\_TRP\_TRS\_enh

**Document for:** Information

# Introduction

This summary covers the discussions for Rel-18 FR1 TRP TRS WI.

# Topic #1: Test methodology

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318105 | Huawei, HiSilicon | **Proposal 1**: consider using IE srs-TxSwitch, together with those listed in R4-2316945, to identify the number of receive chains.**Observation 1**: the procedure outlined in section 3 of R4-2318105 would work under certain assumptions.**Proposal 2**: Please comment and make suggestions on the procedure outlined in section 3 of R4-2318105 to make it viable in practice. |
| R4-2318106 | Huawei, HiSilicon,  | TP to TR 38.870 on TRP TRS test procedure for CA |
| R4-2318427 | Apple | TP to TR38.870 on MIMO radiated output power metric |
| R4-2318429 | Apple | ***Observation 1:*** *Reduced grid results postprocessed from radiation patterns with lower directivity, considered in this study < 5dBi, might lead to an incorrect conclusion that larger grid reduction can be achieved with acceptable MU. Previous analysis based on simulated radiation patterns also demonstrated optimistic results when compared with measured data, therefore reduced grid analysis based on simulated radiation patterns shall be precluded.****Observation 2:*** *Radiation patterns with higher directivity, not necessarily will have its higher directivity at horizon (90º) elevation.****Observation 3:*** *Handsets due its dimension being close to ¼ wavelength at sub-1GHz frequencies, will produce more uniform radiation patterns with higher directivity (≈3 dB) at 90º elevation in Free Space, and nulls at the poles. However, same devices can produce patterns with higher directivity at upper of lower hemisphere when tested with head and hand phantoms.****Observation 4****: As shown on Figure 13, the EiRP elevation weighting based on Clenshaw-Curtis approach is biased towards devices with antenna radiation patterns with higher directivity at the 90º elevation, i.e.: EiRP weight = 0.262 at 90º elevation, while at elevations 30º/150º the weight = 0.1315.****Observation 5:*** *The observations on this study are only valid for TRP measurements. TRS reduced grid analysis shall be performance based on refined grid EiS measurements, e.g.: 15º theta/phi resolution. TRS measurements have higher uncertainty. Tx radiation pattern might not be the best indicator for Rx directivity in many cases.***Proposal 1: RAN 4 to consider a large device data collection based on pre-defined radiation pattern directivity goals, frequency, FS vs. user case. Post-processing the results to make a final decision on reduced grid approach.****Proposal 2: RAN 4 to not consider reduced grids beyond legacy 15*º* Theta/Phi for handsets TRP and 30*º* Theta/Phi for handsets TRS measurements, until more measurement data-points are analyzed.****Proposal 3: Conclusions related to reduced grid based on EiRP should be restricted to TRP measurements. TRS reduced grid analysis shall be done based on baseline EiS/TRS measurements.** **Proposal 4: Moving forward RAN 4 shall consider reduced grid analysis based only on measurement results, simulated radiation patterns analysis shall be precluded, the reduced grid analysis shall also be done considering radiation patterns with high directivity, i.e.: >6 dBi.** |
| R4-2318431 | Apple | *TP to TR 38.870 on test time reduction adopting reduced grids* |
| R4-2318432 | Apple | ***Observation 1:*** *TRP calculated based on the average of TPMI Indexes 0, 1 and 2 produces TRP which is lower than Precoding 2 or in many cases lower than an individual dominant antenna.****Observation 2:*** *The averaging of EiRP produces even more pessimistic TRP in cases where there's a large unbalance between individual antennas TRP, e.g. EU1 n41 BHHR (high channel) where the average TRP is 1.41 dB lower than TPMI Index 2 TRP, while TRP based on the max EiRP is 0.25 higher.****Observation 3:*** *Averaging TRP (or EiRP) among TPMI Indexes 0, 1 and 2 produces over-pessimistic and unrealistic TRP results. Such proposal can’t be supported by any technical argument, such condition has no base on real field/network behavior.****Observation 4****: The measurement results presented in this contribution are conservative, considering that were gathered in a single device, and this device antenna system was not built/designed to showcase the sweep (Dynamic) TPMI Index methodology. Larger variation between fix and sweep (Dynamic) TPMI Indexes should be possible in large devices sampling.***Proposal 1: RAN4 shall not consider Option 1 (average TRP) when post-processing the sweep (Dynamic) TPMI Index.** **Proposal 2: RAN4 shall consider Option 2 (TRP calculation considering Maximum EiRP) as the only sweep (Dynamic) TPMI Index post-processing methodology for performance requirement definitions.** |
| R4-2318834 | Keysight Technologies UK Ltd | Observation 1: The original Option 2 approach [7] to consider the CDF of the maximum EIRP (per grid point) closely resembles the spherical coverage approach from FR2Observation 2: Staying with a TRP like metric for Options 1 and 2 allows the estimation of the benefit of Single-Layer UL MIMO performance when compared to SISOObservation 3: The phase differences have an insignificant impact on the standard deviation and mean of the SIAE distributions (Option 1) for sample patterns and frequencies.Observation 4: The phase differences have an insignificant impact on the standard deviation of the SIME distributions (Option 2) for sample patterns and frequencies.Observation 5: Option 2 has a non-zero impact on the mean of the SIME distributions for sample patterns and frequencies.Observation 6: The choice of just two TPMIs, e.g., TPMI2&3 or TPMI4&5, seems sufficient for Option 1, i.e., Option 1a.Observation 7: The phase differences between antennas have a larger impact on the standard deviation of Option 1 (TPMI2) and Option 2 (SIME) for non-coherent UEs when compared to coherent UEs.Observation 8: The phase differences have a smaller impact on the standard deviation of the SIME distribution (Option 2) when compared to the TPMI2 distribution (Option 1).Observation 9: The relatively small standard deviations observed for the considered pattern combinations and frequencies justify a measurement uncertainty rather than a test procedure that utilizes a test mode.Observation 10: For coherent UEs, test time for Option 1a is ~70% (3-ch) to ~77% (1-ch) that of Options 1b and 2.Observation 11: For non-coherent UEs, the test time for single TPMI2 measurement option is ~65% (3-ch) to ~73% (1-ch) that of Option 2.Observation 12: EM simulations confirm that the SIAE results for Options 1a and 1b match the sum of TRPTPIM0 and TRPTPMI1Observation 13: The observed ~2 dB variations in offsets of the SIME metric from ∑(TRPTPMI0, TRPTPMI1) seem to indicate that certain antenna design guidelines need to be taken into account to maximize the SIME offset, i.e., optimize the Option 2 single-layer UL MIMO metric.Observation 14: Even stricter antenna design requirements might be necessary if Option 2 is adoptedObservation 15: ECC does not seem to cause the variations in offsets of the SIME metric from ∑(TRPTPMI0, TRPTPMI1)Observation 16: Antennas designed to optimize DL MIMO OTA performance yield worse Option 2 (SIME) single-layer UL MIMO power offsets when compared to antennas with poor DL MIMO OTA performance.**Proposal 1: Consider the definition and naming of the Option 1 and 2 metric that resembles TRP but does not contain the term ‘TRP’, e.g., Surface Integral of Average EIRPs (SIAE), Equation 1 (Option 1a) and Equation 2 (1b) and Surface Integral of Max EIRPs (SIME), Equation 3 (Option 2).****Proposal 2: A test mode is not needed for coherent UEs as the phase variation issue can be considered insignificant.****Proposal 3: Match the requirements definition with the test methodology, e.g., define requirements and perform testing based on Option 1 or Option 2 and do not allow the requirements to be defined based on Option1 while allowing testing to be performed based on Option 2.****Proposal 4: A test mode is not needed for non-coherent UEs as the phase variation impact on the performance metric can be captured as an MU.****Proposal 5: When deciding on Options 1 (1a, 1b) and Option 2 for coherent UEs, take the summary of findings in Table 12 into account.****Proposal 6: When deciding on Options 1 (TRPTPMI2) and Option 2 (SIME) for non-coherent UEs, take the summary of findings in Table 13 into account.** |
| R4-2318835 | Keysight Technologies UK Ltd | *Observation 1: For small antenna offsets, e.g., smartphone UE, and frequencies in mid to high bands, significant and highly directive pattern lobing can be observed.**Observation 2: While the individual TPMI patterns can exhibit significant and highly directive pattern lobing, the patterns for the average EIRP metrics (Option 1) or the max EIRP metric (Option 2) show a very similar pattern in terms of directivity as the baseline pattern.**Observation 3: For the evaluated antenna pattern and antenna offsets, existing TRP measurement grids with Dq=Df=15° (traditional grids) and Dq=Df=30° (newly endorsed TRP grids for SISO) still seem to be applicable with small to moderate increases in MU when individual TPMI patterns are evaluated.**Observation 4: None of the considered metric options (1a, 1b, 2) have any significant MU and measurement grid benefits over the other.***Proposal 1: For Option 1, evaluate the combined, average pattern from the respective TPMI measurements before performing the surface integral calculations.****Proposal 2: The applicable measurement grids and preliminary MU for the considered metric options for single-layer UL MIMO are equivalent to those agreed for SISO TRP.****Proposal 3: Consider Options 1 and 2 equivalent in terms of MU impact; none of the options has a test time advantage due to measurement grids.** |
| R4-2318965 | vivo | **Reserved for** 3GPP TR 38.870 v0.7.0 |
| R4-2318966 | vivo | TP to TR 38.870 on TRP TRS test method |
| R4-2318967 | vivo | **Observation 1: RAN4 conclude the basic test procedure for 2Tx test method including TxD and single layer UL-MIMO.****Observation 2: There is no commercially available coherent UE, the performance metric verification can not be concluded based on measurements in Rel-18. After concluding the common test procedure, unfinished coherent UE performance metric aspects, if any, can be further discussed and do not impact completing the core part of the WI.****Proposal 1: RAN4 can further discuss proper performance metric for coherent UE SL UL-MIMO testing.****Observation 3: RAN4 concludes the full package of RedCap test method.****Proposal 2: RAN4 should define the basic CA test method in RAN4#109 meeting and conclude this core part objective.****Observation 4: RAN4 concludes the RC test method.** **Observation 4: RAN4 has defined the harmonization and lab alignment framework, and the activity is undergoing. AC lab alignment and RC harmonization have been merged into single activity.****Proposal 3: RAN4 should define RC harmonization pass/fail criteria in RAN4#109 meeting, and final harmonization conclusion could be made in performance part.** **Proposal 4: RAN4 can further discuss other test method related issues, e.g., ECC antenna impacts on TxD or UL-MIMO and whether MSD should be considered for CA band combinations.** |
| R4-2318972 | vivo | CR to TS 38.161 on New test configurations for Rel-18 TRP TRS |
| R4-2319270 | Samsung | **Observation 1: both ‘max’ processing of EIRPs and ‘averaging’ processing of EIRPs result in a smoothed radiation pattern.****Proposal 1: RAN4 to confirm that the coarser measurement grids for both TRP and TRS in Table 5.1.1-1 and Table 5.2.1-1 of TR38.870 are applicable for coherent UL MIMO.** |
| R4-2319776 | Orange | withdrawn |
| R4-2320175 | CAICT | **Observation 1: A common method for defining OTA metrics for TRP, TRS, FR1 MIMO, and FR2 MIMO OTA is the averaging approach.****Proposal 1: Adopt option 1 as the performance metrics of single-layer UL MIMO TRP. The metric can be named as TRPaverage\_UL\_MIMO.****Proposal 2: For option 2, encourage companies to submit more analysis results based on real UE measurements to help the group have a deeper understanding of this potential new metric.** |
| R4-2320176 | CAICT | **Proposal 1: 2Tx measurement grid analysis should be carried out using a 2Tx reference pattern with extra phase differences.****Proposal 2: Encourage OEMs to provide measurement or simulation of typical 2Tx antenna patterns with TPMI=2~5 and very fine grids.** |
| R4-2320246 | Google Inc. | **Proposal 1: For fully coherent UL-MIMO TRP test metric, it is proposed to use type 1 and type 2 to differentiate the name and metrics for option 1 and option 2.****Observation 1: As long as the TE vendor can develop the 2Tx TRP test procedure for both option 1 and option 2 as fully coherent UL-MIMO TRP test metric, it is not observed to have any big impact from regulatory and industry perspective.** |
| R4-2320379 | Qualcomm Incorporated | **Observation 1: The phase variation impact is not negligible due to the relative phase error between UE’s 2Tx. And phase variation will lead to uncertainty/non-repeatable problem since the best EIRP might be changing from time to time.****Observation 2: In the measurement, the TPMI of UE at each test point should be selected by system simulator based on UE’s SRS that can timely select the best TMPI according to phase variation of UE.****Proposal 1: In the test procedure of Option 2, the TPMI at each test point should be selected by system simulator based on UE’s SRS rather than sweeping all the applicable TPMIs.****Proposal 2: The test mode of single antenna transmission each time, i.e., UE transmits power with 2 physical antennas separately. TE measures the TRP per physical antenna, and then sum two TRP values per antenna up, should be considered as the backup option to solve the phase variation issue for coherent UE. The test mode of two antenna transmission simultaneously should be precluded.****Proposal 3: The performance metric definition for Option 1, Option 2 and Test mode could be as follows:*** **Option 1: Average of TRP-like metric**
* **Option 2: Integration of best EIRP envelop metric**
* **Test mode of single antenna transmission each time: Sum of TRP-like metric**

**Proposal 4: The test mode of single antenna transmission each time, i.e., UE transmits power with 2 physical antennas separately. TE measures the TRP per physical antenna, and then sum two TRP values per antenna up, should be considered as the backup option to solve the phase variation issue for non-coherent/partial-coherent UE. The test mode of two antenna transmission simultaneously should be precluded****Proposal 5: The test mode of single antenna transmission each time, i.e., UE transmits power with 2 physical antennas separately. TE measures the TRP per physical antenna, and then sum two TRP values per antenna up, should be considered as the backup option to solve the phase variation issue for TxD UE. The test mode of two antenna transmission simultaneously should be precluded.** |
| R4-2320380 | Qualcomm Incorporated | **TP to TR 38.870 on 2Tx TRP test method** |
| R4-2320600 | Orange | **Proposal: Add 10MHz channel bandwidth for n28 and 20 MHz channel bandwidth for n41/n77/n78 for TRP/TRS OTA requirements testing** |
| R4-2320394 | Orange | withdrawn |
| R4-2320413 | Orange | withdrawn |
| R4-2320707 | ROHDE & SCHWARZ | **Reserved for** **TP to TR 38.870 on contents for Annex B** |

*The moderator can suggest a limited number of papers which could be presented.*

## Open issues summary

### Sub-topic 1-1 Single-layer UL-MIMO TRP test method

*Moderator: some background information*

* *The TRP average is widely used for legacy TRP testing from 2G~5G,*
* *The test approach close to real UE behaviour may not be a proper way for conformance testing, e.g., TAS ON for best EIRP at each direction, is not adopted.*

**Issue 1-1-1: For fully Coherent UE support multiple TPMI index 2~5**

* Proposals
	+ **Option 1 (averaging TRPs)**
	+ **Option 2 (Max EIRPs)**
* Recommended WF
	+ Option 1 for Rel-18 TRP coherent UE baseline method. This is aligned with legacy averaging approach
	+ Option 2 as alternative method for further study
	+ FFS further requirements for coherent UE in Rel-19

Moderator: Companie’s preference on two options in issue 1-1-1 are clear, detailed proposals are not listed. The following summary for the two options can be basis for discussion

Table 12: Observations & Findings of Options 1 and 2 for coherent UEs

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Option 1a** | **Option 1b** | **Option 2a/Option 2b** |
| **Metric Name/ Mathematical formulation (Option 1a)** | SIAE: Surface Integral of Average EIRPs |  |  |
| **Metric Name/ Mathematical formulation (Option 1b)** |  | SIAE: Surface Integral of Average EIRPs |  |
| **Metric Name/ Mathematical** **formulation (Option 2)** |  |  | SIME: Surface Integral of Maximum EIRPsFor Option 2a:For Option 2b:where means the best TMPI selected based on UE’s SRS  |
| **Test Time** |  ~70%-77% of Option 1b&2 | Highest | Option 2a: HighestOption 2b: Lowest (50% of option 1a) |
| **Effect of random phase shifts on SIAE/ SIME distribution**  | insignificant | insignificant | insignificant |
| **Mean Offset [dB] from** ∑(TRPTPMI0, TRPTPMI1) | 0 | 0 | 0.0-2.8 |
| **Impact on design requirements** |  |  | * Antennas designed to optimize DL MIMO OTA performance yield worse Option 2 a/2b(SIME) single-layer UL MIMO power offsets when compared to antennas with poor DL MIMO OTA performance
* Even stricter antenna design requirements might be necessary if Option 2a/2b is adopted
 |
| **Realism** | Less real-world like (no adaptation based on gNB feedback) | Less real-world like (no adaptation based on gNB feedback) | Option 2a: more real-world like (based on assumption that gNB can consistently and reliably configure the best TPMI)Option 2b: most real-world like  |

**Issue 1-1-2: Performance metric definition for Option 1 and Option 2 methodology**

* Proposals
	+ **Proposal 1: TP to TR38.870 on MIMO radiated output power metric in R4-2318427. (Apple)**
	+ **Proposal 2: Consider the definition and naming of the Option 1 and 2 metric that resembles TRP but does not contain the term ‘TRP’, e.g., Surface Integral of Average EIRPs (SIAE), Equation 1 (Option 1a) and Equation 2 (1b) and Surface Integral of Max EIRPs (SIME), Equation 3 (Option 2). (Keysight)**
	+ **Proposal 3: Adopt option 1 as the performance metrics of single-layer UL MIMO TRP. The metric can be named as** **TRPaverage\_UL\_MIMO. (CAICT)**
	+ **Proposal 4: For option 2, encourage companies to submit more analysis results based on real UE measurements to help the group have a deeper understanding of this potential new metric. (CAICT)**
	+ **Proposal 5: For fully coherent UL-MIMO TRP test metric, it is proposed to use type 1 and type 2 to differentiate the name and metrics for option 1 and option 2. (Google)**
	+ **Proposal 6: The performance metric definition for Option 1, Option 2 and Test mode could be as follows: (Qualcomm)**
* **Option 1: Average of TRP-like metric**
* **Option 2: Integration of best EIRP envelop metric**
	+ **Test mode of single antenna transmission each time: Sum of TRP-like metric**
* Recommended WF
	+ Take Option 1 as **TRPaverage\_EIRP**
	+ Take Option 2 as **TRPmax\_EIRP**

**Issue 1-1-3: Requirements work for Option 1 and Option 2 methodology**

* Proposals
	+ **Proposal 1: Match the requirements definition with the test methodology, e.g., define requirements and perform testing based on Option 1 or Option 2 and do not allow the requirements to be defined based on Option1 while allowing testing to be performed based on Option 2. (Keysight)**
* Recommended WF
	+ Agree proposal 1

**Issue 1-1-4: Test procedure of Option 2 for fully Coherent UE**

* Proposals
	+ **Proposal 1: In the test procedure of Option 2, the TPMI at each test point should be selected by system simulator based on UE’s SRS rather than sweeping all the applicable TPMIs. (Qualcomm)**
* Recommended WF
	+ Collecting views from companies on how to align option 2 with real UE behaviour

*Moderator: the phase and amplitude shift of coherent UL-MIMO is defined in TS 38.101-1,*

**

*The conducted verification procedure is outlined in TS 38.521-1,*

**

*The coherent MIMO requirement is the difference of relative offset (amplitude and phase) within 20ms time window, if the amplitude and phase offset keep shifting within N\*20ms, then in a long time period for OTA testing, the relative difference of power and amplitude may be* ***any*** *value.*

**Issue 1-1-5: Phase variation for single-layer UL-MIMO**

* Proposals
	+ **Proposal 1: For coherent UEs as the phase variation issue can be considered insignificant. For non-coherent UEs the phase variation impact on the performance metric can be captured as an MU. [Keyishgt]**
	+ **Proposal 2: RAN4 should decide the 2Tx TRP test method for single-layer UL-MIMO and TxD taking into phase variant impact account. (Qualcomm)**
* Recommended WF
	+ A random phase and amplitude offset within a long time window should be considered in both option 1 and option 2 evaluation.

*Moderator: it was agreed 2Tx simultaneously testing is the 1st priority for single-layer UL-MIMO and TxD. The target of a potential test mode even as backup, should also try to ensure that, otherwise 2Tx UE behaviour of TxD or UL-MIMO is not presented.*

**Issue 1-1-6: Test mode for 2Tx UE configuration (including coherent/non-coherent UE)**

* Proposals
	+ **Proposal 1: The test mode of single antenna transmission each time, i.e., UE transmits power with 2 physical antennas separately. TE measures the TRP per physical antenna, and then sum two TRP values per antenna up, should be considered as the backup option to solve the phase variation issue for TxD/SL UL-MIMO coherent/non-coherent/partial coherent UE. The test mode of two antenna transmission simultaneously should be precluded. (Qualcomm)**
	+ **Proposal 2: A test mode is not needed for coherent and non-coherent UEs. (Keysight)**
* Recommended WF
	+ Collecting views

**Issue 1-1-6: Measurement grid analysis for UL-MIMO**

* Proposals
	+ **Proposal 1: RAN4 to confirm that the coarser measurement grids for both TRP and TRS in Table 5.1.1-1 and Table 5.2.1-1 of TR38.870 are applicable for coherent UL MIMO. (Samsung)**
	+ **Proposal 2: 2Tx measurement grid analysis should be carried out using a 2Tx reference pattern with extra phase differences*.* (CAICT)**
	+ **Proposal 3: Encourage OEMs to provide measurement or simulation of typical 2Tx antenna patterns with TPMI=2~5 and very fine grids. (CAICT)**
	+ **Proposal 4: For Option 1, evaluate the combined, average pattern from the respective TPMI measurements before performing the surface integral calculations.**
	+ **Proposal 5: The applicable measurement grids and preliminary MU for the considered metric options for single-layer UL MIMO are equivalent to those agreed for SISO TRP.**
	+ **Proposal 6: Consider Options 1 and 2 equivalent in terms of MU impact; none of the options has a test time advantage due to measurement grids.**
* Recommended WF
	+ Coarser measurement grids could be applicable for coherent UL MIMO testing. More analysis with simulation and measurements is encouraged.
	+ Consider the same applicable measurement grids and preliminary MU for the considered metric options for single-layer UL MIMO are equivalent to those agreed for SISO TRP

**Issue 1-1-7: ECC impacts on 2Tx related issues**

* Proposals and observations
	+ **Proposal 1: RAN4 can further discuss other test method related issues, e.g., ECC antenna impacts on TxD or UL-MIMO. (vivo)**
	+ **Observation 1: ECC does not seem to cause the variations in offsets of the SIME metric from ∑(TRPTPMI0, TRPTPMI1). (Keysight)**
* Recommended WF
	+ Collecting views

**Issue 1-1-8: Common test procedure for coherent UE**

* Proposals
	+ **Proposal 1: adopt the common test procedure described in R4-2318966. (vivo)**
* Recommended WF
	+ Refine the common procedure and capture into TR.

### Sub-topic 1-2 TxD test method

**Issue 1-2-1: Test procedure to minimize TxD phase issue**

* Proposals
	+ **Proposal 1: Please comment and make suggestions on the procedure outlined in section 3 of R4-2318105 to make it viable in practice. (Huawei)**
* Recommended WF
	+ Collecting views

**Issue 1-2-2: Test mode for TxD**

* Proposals
	+ **Proposal 1: The test mode of single antenna transmission each time, i.e., UE transmits power with 2 physical antennas separately. TE measures the TRP per physical antenna, and then sum two TRP values per antenna up, should be considered as the backup option to solve the phase variation issue for TxD/SL UL-MIMO coherent/non-coherent/partial coherent UE. The test mode of two antenna transmission simultaneously should be precluded. (Qualcomm)**
* Recommended WF
	+ Collecting views

### Sub-topic 1-3 CA test method

**Issue 1-3-1: TP on CA test procedure**

* Proposals
	+ **Proposal 1: Endorse the TP on TRP TRS test procedure for CA in R4-2318106. (Huawei, HiSilicon, Rohde & Schwarz, Orange, OPPO, vivo, Vodafone, CAICT)**
* Recommended WF
	+ Define the basic CA test method in RAN4#109 meeting and conclude this core part objective

**Issue 1-3-2: Radiated MSD issue for CA**

* Proposals
	+ **Proposal 1: RAN4 can further discuss whether MSD should be considered for CA band combinations. (vivo)**
* Recommended WF
	+ Collecting views

### Sub-topic 1-4 MU update for TR 38.870

**Issue 1-4-1: RedCap MU for RC test method**

* Proposals
	+ **Proposal 1: The RedCap MU should be finalized in RAN5 to close core part. (Moderator)**
* Recommended WF
	+ Could be finalized in RAN5 this meeting, and capture into TR.

**Issue 1-4-2: RC MU completion**

* Proposals
	+ **Proposal 1: The RC phantom impact is missing in current MU value for RC test method in TR 38.870. The MU value should be updated based on RAN5 outcome, which also has impacts on decision for RC lab alignment and harmonization criteria. (Moderator)**
* Recommended WF
	+ RAN4 should finalize the MU assessment first.

**Issue 1-4-3: Corse grid MU update**

* Proposals
	+ **Proposal 1: update coarse grid MU based on TP in R4-2318431. (Apple)**
* Recommended WF
	+ Collecting views. Consider with issue 1-5-1

### Sub-topic 1-5 Testing time reduction

*Moderator: The measurement grid and applicability were agreed from RAN4#106 in R4-2302917.*

**Issue 1-5-1: Measurement grids analysis**

* Proposals
	+ **Proposal 1: RAN 4 to consider a large device data collection based on pre-defined radiation pattern directivity goals, frequency, FS vs. user case. Post-processing the results to make a final decision on reduced grid approach. (Apple)**
	+ **Proposal 2: RAN 4 to not consider reduced grids beyond legacy 15º Theta/Phi for handsets TRP and 30º Theta/Phi for handsets TRS measurements, until more measurement data-points are analyzed. (Apple)**
	+ **Proposal 3: Conclusions related to reduced grid based on EiRP should be restricted to TRP measurements. TRS reduced grid analysis shall be done based on baseline EiS/TRS measurements. (Apple)**
	+ **Proposal 4: Moving forward RAN 4 shall consider reduced grid analysis based only on measurement results, simulated radiation patterns analysis shall be precluded, the reduced grid analysis shall also be done considering radiation patterns with high directivity, i.e.: >6 dBi. (Apple)**
* Recommended WF
	+ Collecting views.

# Topic #2: Rel-18 TRP TRS requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2318428 | Apple, Telecom Italia | **Template for TRP TRS and MIMO OTA** **Device Information Collection** |
| R4-2318968 | vivo | **Proposal 1: Similar to Rel-17 lab alignment approach, setting pass/fail limits as 0.75\*MU (talk mode) for both TRP and TRS, i.e., ±1.5dB for TRP, and ±1.76dB for TRS as starting point. Conclude phase 1 AC lab alignment in RAN4#109 meeting.****Proposal 2: Setting RC lab alignment pass/fail limits as 0.75\*MU for both TRP and TRS, i.e., ±1.1dB for TRP, and ±1.5dB for TRS, for both browsing mode and talk mode, as a starting point. Conclude phase 1 RC lab alignment in RAN4#109 meeting.****Proposal 3: Comparison of each reference value of RC lab alignment and AC lab alignment as criteria. The pass/fail limits are FFS.****Observation 1: The total measurements for each test lab to submit 15 devices for four bands to finalize the Rel-18 requirements is quite time-consuming, about 68 days. It is three times higher than Rel-17!****Proposal 4: RAN4 should check the following information to ensure the requirements can be successfully defined in Rel-18.*** **The number of DUTs (minimum 3, maximum 15) for each band they expect to be able to measure and submit to RAN4.**
* **The 3GPP member providing the DUTs check how many samples they intend to provide for each band (with support of UE pre-configuration for measurements)**

**Proposal 5: RAN4 should develop 4Rx requirements for n1 in Rel-18.** **Proposal 6: For a band supporting both PC2 and PC3, specify PC3 requirements based on finalized PC2 requirements, with [2.5] dB offset as a starting point.**  |
| **R4-2318969** | vivo | **Analysis of 3GPP TRP TRS AC lab alignment and RC harmonization measurement results** |
| R4-2320617 | TELECOM ITALIA S.p.A.,  | ***Proposal: Approve the updated working procedure for TRP TRS Performance Test Campaign for Rel-18 TRP TRS WI.*** |
| R4-2320626 | TELECOM ITALIA S.p.A.,  | ***Observation 1***: *the adoption of the coarse grid is likely to introduce larger MU with respect to one related to the legacy grid values thus having a direct impact on the definition of the minimum performance requirements.****Observation 2***: *it is a common understanding that a testing activity differs from measurements activity aiming to define the requirements as well as to certificate a device against such requirements.****Observation 3***: *the validity of the coarser sampling grid must be validated through a proper measurement campaign before being adopted for measurements aiming at the definition of the minimum performance requirements.****Observation 4****: Rel-17 requirements for band n41 and n78 in browsing mode have been defined using the legacy grid values; consistency with Rel-18 requirements must be guaranteed****Observation 5****: the ongoing laboratories alignment activity is based on the legacy grid values as reported in the adopted template for measurement results in [3]; therefore, there is no founded motivation to change that assumption for the measurement campaign****Observation 6****: according to the step 7-d in the working procedure the adoption of the coarser measurement grid is optional (i.e., “can be used”) and this is also reflected in the template for the measurements results in [4]; it would be controversial to consider together measurements performed with two different sampling grids (and different MU)****Observation 7****: the coarser sampling grid has been introduced to essentially reduce the time required to perform the measurements activity. While this can be a good motivation in other contexts, this cannot be considered as a point for the measurement campaign of the WI in which is fundamental to provide reliable results including reasonable MU.****Proposal 1****: Remove the possibility to use of the coarser grid measurement from the working procedure for Rel-18 TRP TRS Performance Test Campaign****Proposal 2****: Update the template for the measurements results in [4] accordingly.* |
| R4-2320627 | TELECOM ITALIA S.p.A. | This contribution addressed the request on the device provisioning: **Telecom Italia is planning to supply for 5 samples**. |
| R4-2318105 | Huawei, HiSilicon | **Proposal 1**: consider using IE srs-TxSwitch, together with those listed in R4-2316945, to identify the number of receive chains. |
| R4-2318103 | Huawei, HiSilicon | Measurement results for 3GPP Rel-18 TRP TRS AC lab alignment activity-Huawei |
| R4-2318104 | Huawei, HiSilicon | Measurement results for 3GPP Rel-18 TRP TRS RC harmonization-Huawei |
| R4-2318970 | vivo | Measurement results for 3GPP Rel-18 TRP TRS AC lab alignment activity |
| R4-2318971 | vivo | Measurement results for 3GPP Rel-18 TRP TRS RC harmonization activity |
| R4-2319288 | SGS Wireless | Measurement results for 3GPP Rel-18 TRP TRS AC lab alignment activity |
| R4-2319635 | SRTC | 3GPP Rel-18 TRP TRS RC harmonization from SRTC |
| R4-2319641 | SRTC | 3GPP Rel-18 TRP TRS AC lab alignment activity from SRTC |
| R4-2320177 | CAICT | CAICT measurement results for 3GPP Rel-18 TRP TRS AC lab alignment activity |
| R4-2320178 | CAICT | CAICT measurement results for 3GPP Rel-18 TRP TRS RC harmonization activity |
| R4-2320600 | Orange | **Proposal: Add 10MHz channel bandwidth for n28 and 20 MHz channel bandwidth for n41/n77/n78 for TRP/TRS OTA requirements testing** |

## Open issues summary

### Sub-topic 2-1 Rel-18 AC lab alignment activity

**Issue 2-1-1: AC lab alignment activity status**

* Proposals
	+ **Phase 1 n78 measurements have been finalized in this meeting. However, LAD4 has connection issue, n28 measurements progress has been stopped. Selecting LAD5 as back up to replace LAD4 if connection issue can not be resolved. (moderator)**
* Recommended WF
	+ Make decision on additional LAD5 this meeting, otherwise, n28 AC lab alignment can not move forward (if connection issue can not be resolved)

**Issue 2-1-2: BHH Lab alignment pass/fail limits in Rel-18**

* Proposals
	+ **Proposal 1: Similar to Rel-17 lab alignment approach, setting pass/fail limits as 0.75\*MU (talk mode) for both TRP and TRS, i.e., ±1.5dB for TRP, and ±1.76dB for TRS as starting point. Conclude phase 1 AC lab alignment in RAN4#109 meeting. (vivo)**
* Recommended WF
	+ Adopt Proposal 1

**Issue 2-1-3: Analysis of phase 1 AC Lab alignment activity**

* Proposals
	+ **Proposal 1: Based on agreed pass/fail limits and analysis in xx, RAN4 conclude phase 1 AC lab alignment activity. (moderator)**
* Recommended WF
	+ Conclude phase 1 AC lab alignment activity

Moderator: analysis summary in R4-2318969:





Figure 1: NR FR1 TRP and TRS AC lab alignment measurement results from each test lab





Figure 2: NR FR1 TRP and TRS AC lab alignment analysis, deviation between each test lab and reference value

### Sub-topic 2-2 RC Harmonization and lab alignment

**Issue 2-2-1: RC Lab alignment criteria and outcome**

* Proposals
	+ **Updated Proposal 1: Setting RC lab alignment pass/fail limits as 0.75\*MU for both TRP and TRS, MU TBD, as a starting point. Conclude phase 1 RC lab alignment in RAN4#109 meeting, if MU can be concluded early in RAN5. (vivo)**
* Recommended WF
	+ Finalize RC MU assessment first, and determine pass/fail limits

*Moderator: the RC lab alignment analysis is provided in R4-2318969*

**Issue 2-2-2: RC vs AC harmonization criteria**

* Proposals
	+ **Proposal 1: Comparison of each reference value of RC lab alignment and AC lab alignment as criteria. The pass/fail limits are FFS. (vivo)**
* Recommended WF
	+ Collecting views

### Sub-topic 2-3 Rel-18 TRP TRS measurement campaign

*Moderator: below working procedure merge the proposals in R4-2316835, R4-2315842 and R4-2315384.*

**Issue 2-3-1: updated working procedure for Rel-18 TRP TRS Performance Test Campaign to define requirements**

* Proposals
	+ **Proposal 1: Approve the following updated working procedure for TRP TRS Performance Test Campaign for Rel-18 TRP TRS WI**
1. Test results submitting:
	1. RAN4 Secretary will cover the role of the trusted and neutral third party for the whole procedure
	2. UE information disclosure: laboratories use the spreadsheet in [TBD] to submit the device information. The UE information should NOT BE CORRELATED with the order in the measurement data submitted by the same lab for the respective list of devices in c, i.e., the UE mode order in the list should be randomly disrupted.
		1. Information of the devices that are going to be measured shall be shared with the RAN4 Secretary as soon as available (i.e., before the measurement activity on such devices starts)
		2. The RAN4 Secretary updates the summary of statistical information (see point 5.e) and publishes it to 3GPP RAN4 (i.e., living document) in order to monitor the achievement of the thresholds defined in point 6.b in a timely manner and take the proper actions if these are not met
	3. Skip unchanged part.
	4. Skip unchanged part:
	5. Skip unchanged part:
2. Percentage of the devices that are certified by at least one of certification bodies as following: PTCRB ,GCF, and NAL/CTA (Chinese network access licensed test)] /FCC/CE
	* + 1. Once the device gets the above certification, for RAN4 discussion that means the device is ~~commercially available~~ not a prototype
3. Percentage of the devices that are certified for each certification body (for information only)
4. Percentage of devices that are commercially available
	1. ~~The progress in each lab are encouraged to be shared on the RAN4 reflector (for example - how many devices have been measured and on which bands)~~
		1. ~~Information of the devices that are going to be measured should be shared with the RAN4 Secretary as soon as available in order to monitor the achievement of the thresholds defined in point 8.b.~~
	2. TRP and TIS Quantities based on Clenshaw-Curtis quadrature and traditional sin(theta) weighting are both allowed during Performance campaign test. This information should be provided from each test lab when submitting measurement results.
5. Specify TRP TRS requirements:
	1. Only the results from aligned labs will be considered for specifying requirements
	2. Requirements will not be specified if the following thresholds [further check in RAN4#109] are not satisfied by the devices pool:
		1. Minimum number of devices for each band, each device size, each power class: ~~[~~40~~]~~
		2. Minimum number of device models: ~~[25~30]~~ 30
		3. Minimum number of devices' vendors: 5
		4. Percentage of devices from ~~[~~second-half 2021 to 2024~~]~~: ~~TBD%:~~ 100%
		5. Percentage of the devices that are certified at least by one certification body PTCRB/GCF/NAL-CTA/CE/FCC: ~~TBD%~~ 100%
		6. Percentage of devices that are commercially available: ~~[~~100~~]~~ %
* Recommended WF
	+ Discuss and decide whether the updated working procedure is agreeable

**Issue 2-3-2: measurement grids for Rel-18 TRP TRS Performance Test Campaign**

* Proposals
	+ **Proposal 1: Remove the possibility to use of the coarser grid measurement from the working procedure for Rel-18 TRP TRS Performance Test Campaign (Telecom Italia, Vodafone, China Telecom, Orange, T-Mobile USA)**
	+ **Proposal 2: Update the template for the measurements results in [4] accordingly. (Telecom Italia, Vodafone, China Telecom, Orange, T-Mobile USA)**
* Recommended WF
	+ Collecting views on whether overturn previous agreements
	+ Testing burden of overall performance test campaign should be considered
	+ Consider the impacts of number of devices volunteer would like to measure and submit

### Sub-topic 2-4 Rel-18 TRP TRS requirements work

**Issue 2-4-2: Device Information Collection**

* Proposals
	+ **Proposal 1: Check and confirm the Template for TRP TRS and MIMO OTA Device Information Collection in R4-2318428. Feedback from aligned volunteer test lab is needed. (Moderator)**
* Recommended WF
	+ Check and confirm

**Issue 2-4-2: Rel-18 TRP TRS measurement data pool**

* Proposals
	+ **Proposal 1: RAN4 should check the following information to ensure the requirements can be successfully defined in Rel-18. (vivo)**
		- **The number of DUTs (minimum 3, maximum 15) for each band they expect to be able to measure and submit to RAN4.**
		- **The 3GPP member providing the DUTs check how many samples they intend to provide for each band (with support of UE pre-configuration for measurements)**
* Recommended WF
	+ Check and confirm

*Moderator: Telecom Italia is planning to supply for 5 samples*

**Issue 2-4-2: number of receive antennas for n1 or n3 requirements**

* Proposals
	+ **Proposal 1: RAN4 should develop 4Rx requirements for n1 in Rel-18. (vivo)**
* Recommended WF
	+ Collect views

**Issue 2-4-2: How to identify receive antennas for n1 or n3 UE**

* Proposals
	+ **Proposal 1: consider using IE srs-TxSwitch, together with those listed in R4-2316945, to identify the number of receive chains. (Huawei)**
* Recommended WF
	+ Collect views

**Issue 2-4-2: How to define PC3 requirements based on PC2**

* Proposals
	+ **Proposal 1: For a band supporting both PC2 and PC3, specify PC3 requirements based on finalized PC2 requirements, with [2.5] dB offset as a starting point. (vivo)**
* Recommended WF
	+ Check and confirm

**Issue 2-4-2: New CBW for band n28/n41/n77/n78 requirements**

* Proposals
	+ **Proposal 1: Add 10MHz channel bandwidth for n28 and 20 MHz channel bandwidth for n41/n77/n78 for TRP/TRS OTA requirements testing. (Orange, Vodafone, AT&T, T-Mobile USA, Verizon, DISH Network, BT plc, Telecom Italia)**
* Recommended WF
	+ Collecting views and decide
	+ Should consider the RAN5 and certification body impacts, if two sets of core requirements defined in RAN4