**3GPP TSG-RAN WG4 Meeting #111 R4-241xxxx**

**Fukuoka City, Fukuoka, Japan, 20th – 24th May, 2024**

**Agenda item:** 7.9.3

**Source:** vivo

**Title:** Ad-hoc minutes for [111][336] NR\_FR1\_TRP\_TRS\_enh

**Document for:** Approval

# Introduction

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

# Topic #1: Test methodology related issues

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407055 | Apple | **Proposal 1: RAN4 shall continue defining the UL MIMO OTA test procedures based on the limited applicability found on the core and conformance specifications, monitoring the definition of remaining features such as Test Tolerance and scheduling.** |
| R4-2407714 | Bluetest AB | **Proposal 1: Improve the currently published RC MU with high and low frequency MU values similar to the AC MU tables.** |
| R4-2407054 | Apple | CR to TR38.870 on UL MIMO radiated output power metric |
| R4-2407120 | Huawei, HiSilicon | CR to TR 38.870 to add CA combinations to section 4.3.5 and editorial corrections |
| R4-2408274 | Bluetest AB | CR to TR 38.870 to update RC TRS definition in 5.22 and 8.6.1.1 |
| R4-2409773 | ROHDE & SCHWARZ | Editorial CR to TR 38.870 |
| R4-2409776 | ROHDE & SCHWARZ | Cat A CR |

## Open issues summary

### Sub-topic 1-1 test method issues

**Issue 1-1-1: Phase variation issues for coherent UL-MIMO**

* Proposals
  + **Proposal 1: RAN4 shall continue defining the UL MIMO OTA test procedures based on the limited applicability found on the core and conformance specifications, monitoring the definition of remaining features such as Test Tolerance and scheduling. (Apple)**
* Recommended WF
  + TBD

**Issue 1-1-2: Divide RC MU assessment into two ranges to align with AC approach, i.e., >3GHz and <3GHz**

* Proposals
  + **Proposal 1: Improve the currently published RC MU with high and low frequency MU values similar to the AC MU tables. (Bluetest)**
* Recommended WF
  + Agreeable. Discuss whether the work maintenance in RAN4 or RAN5.

### Sub-topic 1-2 CRs for approval

**Issue 1-2-1: CR on CA band combinations in CR R4-2407120, agreeable or not?**

* Proposals
  + **Option 1: Yes**
  + **Option 2: No**
* Recommended WF
  + Agreeable. Resubmission of endorsed CR last meeting

**Issue 1-2-2: Performance metric for Coherent UL MIMO in CR R4-2407054, agreeable or not?**

* Proposals
  + **Option 1: Yes**
  + **Option 2: No**
* Recommended WF
  + Some content unrelated to coherent UL MIMO should be removed. Definition of two options for coherent UL MIMO also need improvements.

**Issue 1-2-3: RC TRS definition correction in CR R4-2408274, agreeable or not?**

* Proposals
  + **Option 1: Yes**
  + **Option 2: No**
* Recommended WF
  + Check and confirm

**Issue 1-2-4: Editorial update of TR38.870 in CR R4-2409773, agreeable or not?**

* Proposals
  + **Option 1: Yes**
  + **Option 2: No**
* Recommended WF
  + Check and confirm

# Topic #2: Rel-18 TRP TRS requirements related issues

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **RC harmonization related** | | |
| R4-2407102 | Huawei, HiSilicon | **Proposal 1:** **Total harmonization MU for AC and RC harmonisation should be the AC MU.** |
| R4-2407714 | Bluetest AB | **Proposal 2: Based on the qualitative analysis, quantitative criteria for a positive harmonization conclusion can be found with confidence for the TRP measurement.** |
| R4-2408096 | vivo | Final Analysis of 3GPP TRP TRS AC lab alignment and RC harmonization measurement results |
| R4-2408897 | OPPO | ***Observation 1: All the TRP measurement results in RC labs for n78 and n28 with talk mode and browsing mode are satisfied with the pass/fail limits, and well harmonized.***  ***Observation 2: There are two TRS data for n78 browsing mode slightly exceeding the pass/fail criteria of Set Two, i.e. 0.02dB and 0.01dB separately (Pass/Fail Criteria is 1.71dB).***  ***Observation 3: LAD3 has three failed data out of five in total, with the maximum delta of 3.72dB, while the Pass/Fail Criteria is 1.82dB for Set Two and 1.76dB for Set Three.***  ***Observation 4: Due to lack of AC reference values, the harmonization activity is not performed on TRP and TRS of n28 browsing mode.***  ***Proposal 1: RC method and AC method are well harmonized on high band TRP. High band means <1GHz or <3GHz can be further discussed.***  ***Proposal 2: It is recommended to give an exemption to the two slightly exceeding data considering the LAD 3 performance stability. And therefore, it is concluded that the harmonization of RC and AC on high band TRS is achieved.***  ***Proposal 3: For low bands, especially frequencies lower than 1GHz, it is proposed to draw the conclusion based on the whole picture including both talk mode and browsing mode.*** |
| R4-2409186 | CAICT, SAICT | **Observation 1: The measurement results confirm that the RC TRP results of LAD1-LAD4 in the n78 and n28 frequency bands are closely aligned with the AC TRP reference across labs, except for one test result in the low-frequency band (n28) that slightly exceeds the range of 0.75 \* AC MU.**  **Observation 2: Measurement shows that compared to TRP, the offset between RC and AC methods is greater in TRS measurements, and RC typically produces lower values (poorer performance).**  **Observation 3: Despite minor deviations, the results of the n78 TRS are basically consistent with the AC reference, remaining within the range of 0.75 \* AC MU, reflecting good RC-AC harmonization.**  **Observation 4: N28 measurement results show that the deviation of TRS is large and significantly exceeds the 0.75 \* AC MU threshold, indicating that the RC and AC harmonization at low band is not ideal compared to higher frequency bands.**  **Proposal 1: RC method is well harmonized with AC method in high band (n78).**  **Proposal 2: The missing results in the n28 browsing mode hinders a complete RC harmonization evaluation in the low frequency range, and further exploration of RC-AC harmonization below 1GHz or 3GHz is needed.** |
|  |  |  |
| **Rel-18 TRP TRS requirements related** | | |
| R4-2407056 | Apple | ***Observation 1: The requirement for the alternate channel bandwidth may not necessarily be a linear adjustment based purely on RB scaling as empirical data shows a pessimistic bias. Therefore the agreed empirical measurement approach is critical to understand if additional allowance is required.***  ***Observation 2: Using REFSENS RB scaling provides a uniform framework that can be applied across all (low and high) bands.***  Proposal 1: Agree on REFSENS RB scaling factor to derive requirements on alternate CBW for n28/n41/n77/n78  Proposal 2: Based on measurement results across 10 devices across HO and BHH, add allowance as average of delta seen across all collected empirical data and capture in TR 38.870. The average of available empirical data is listed in the table below:  **Average\_TRS*20MHz* =Average\_TRS*100MHz* + log*10*(N*RB\_20MHz*/N*RB\_100MHz*) + X**  Additional allowance on top of scaled Browsing and Talk Mode TRS requirements for n281, n412, n772, n782   |  |  | | --- | --- | | Operating band | Allowance(dB) | | n28 | 0.51 | | n41 | 0.52 | | n77, n78 | 0.62 | | NOTE 1: Scaled requirement is for 10 MHz channel bandwidth.  NOTE 2: Scaled requirement is for 20 MHz channel bandwidth. | |   **Proposal 3: Endorse CR to TR 38.870 on framework to scale requirements for alternate CBW for n28/n41/n77/n78.** |
| R4-2407900 | Samsung | **Proposal 1: allow to update RC harmonization data in maintenance phase when the unfinished n28 testing is done.**  **Proposal 2: For simplicity to handle the measurement results uncertainty, it is proposed to adopt a simple scaling based on BW ratio, i.e. 10log(100/20)=7dB, as the scaling factor for Band n41/77/78** |
| R4-2408098 | vivo | Final Analysis of Rel-18 TRP TRS Performance Test Campaign |
| R4-2408099 | vivo | **Observation 1: RAN4 can conclude AC lab alignment activity and RC lab alignment activity, the outcome are captured in CRs to TR 38.870 [3][4].**  **Proposal 1: Adopt AC MU+0.2dB as harmonization MU value. Then based on the generated harmonization pass fail limits, RC harmonization can be concluded for band >3GHz. But for low band below 1GHz, the harmonization can not be confirmed.**  **Observation 2: RAN4 may need to discuss whether continue work is need for RC harmonization at bands below 1GHz in Rel-18 maintenance. If so, what specific work is needed?**  **Observation 3: RAN4 has concluded coherent UL MIMO performance metric. This scope can be finalized after endorsement of the CR to TR 38.870**  **Observation 4: The measurement campaign is finalized for size 1 UE at both talk mode and browsing mode in Rel-18.**  **Observation 5: The UE information collecting activity can be concluded after disclosure the statistics of UE information by RAN4 MCC (serving as neutral party of this work).**  **Proposal 2: Rel-18 handheld UE 1Tx requirement work can be concluded after concluding the TRP TRS requirements.**  **Observation 6: 2Tx requirements is not Rel-18 scope anymore and will be removed out of Rel-18 WID in RAN#104 meeting.** |
| R4-2408104 | vivo | *Updated Rel-18\_TRP TRS data collection template. The power class infor has been corrected to per-band in this version.* |
| R4-2408898 | OPPO | ***Proposal: Specify 3dB gap for PC3 TRP based on PC2 TRP value, i.e. TRP(PC3) = TRP(PC2) – 3dB.***  *Moderator note: This has been concluded in WF R4-2406081.* |
| R4-2409043 | Telecom Italia S.p.A., Vodafone, BT plc, Orange, Deutsche Telekom | ***Proposal 1:*** *Adopt the following values for the thresholds related to the devices pool:*   1. *Minimum number of devices for each band, each device size, each power class: 40* 2. *Minimum number of device models: 30* 3. *Minimum number of devices' vendors: 5* 4. *Percentage of devices from second-half 2021 to 2024: 100%* 5. *Percentage of the devices that are certified by PTCRB/GCF/NAL-CTA/CE/FCC: 100%*   ***Proposal 2:*** *The number of different device models shall be at least the 75% of the total number of device samples that have been measured.*  ***Observation 1:*** *Being the RAN#111 the last meeting of the WI, there will be no means to take any action in case the thresholds will not be meet, therefore reneging the agreed working procedure.*  ***Observation 2:*** *In general, any**x%-tail value of the CDF is mainly influenced by low value samples, while high value samples have a negligible contribution compared to the lower ones.*  ***Observation 3:*** *There are clearly some measurements values that highlight issues with the measured devices since the related performance are far below the usual range (i.e., outlier values) that can be experienced in any laboratory measurement activity.*  ***Proposal 3:*** *Measurements provided for each band must be carefully analysed in order to identify any inconsistencies and/or anomalies, outliers values. These values shall be removed from the samples on which the definition of the performance requirements will be based.*  ***Proposal 4:*** *For each band, outlier values should be properly identified through calculating (in linear) the average of all the measured values and remove the ones that are below [X] dBs of it.*  ***Observation 4:*** *It shall be highlighted that without the complete data pool of the measurement campaign it is not possible to perform any final analysis. The proposers of this contribution reserve the rights to submit a proper revision once all the data will be made available.*  ***Observation 5:*** *The discussion on the final values for the performance requirements is well known to be a difficult item to reach consensus. Therefore, it is not possible to have just one meeting (i.e., RAN4#111 meeting) to finalize the activity.*  ***Observation 6:*** *Quality of the results provided by RAN4 has the priority with respect any other issues, including time constraints. If needed, the timeline of the activities must be reviewed accordingly.*  ***Proposal 5:*** *It is proposed to extend the WI of 6 months, providing 3 additional meetings to discuss on the performance requirement values, with a new completion date set for the RAN#106 meeting in December 2024.* |
| R4-2409185 | CAICT, SAICT | ***Observation 1: The REFSENS RB scaled factor method can accurately predict the TRS performance of different devices at different bandwidths. For n78, the maximum deviation between the TRS performance obtained by this method and the measured TRS value is 0.32dB, and the average deviation is only 0.03dB, which can be ignored. For n41, the maximum observed deviation is 0.86dB, with an average deviation value of 0.37dB.***  ***Observation 2: When no additional allowance X factor is introduced, the scaling results are highly consistent with the measured results, and the distribution of positive and negative values in the deviation value is balanced, with an average deviation of almost 0dB.***  ***Observation 3: When introducing an additional allowance X factor, it significantly increases the deviation between the scaling result and the measurement result, all deviation values are positive, i.e., the scaling results of all tested devices are worse than their actual performance. The maximum deviation is 0.93dB, and the average deviation is 0.63dB.***  **Proposal 1: Use REFSENS RB scaled factor as the basic scaling factor for Band n41/77/78 without additional allowance factor.**  ***Observation 4: The EIS values obtained from SPOT are very consistent with the EIS results directly measured in each direction. The final TRS result shows a maximum deviation of only -0.61dB and an average deviation of -0.07dB. .***  **Proposal 2: The SPOT method can be used to measure the offset of TIS when using different channel bandwidth configurations on the same channel. Further clarification is needed on the specific applicable conditions.**  ***Observation 5:******Until the deadline for tdoc submission in RAN4#111, the comprehensive device information and complete test results are still absent .***  ***Observation 6:******The current work program lacks the definition and analysis of outliers in measurement results. However, some outlier test results have been observed in existing data pools, which will significantly affect the tail value of the CDF curve .***  **Proposal 3: Before delving into specific performance requirements, confirm that the sample data in the data pool is within a reasonable range and meets the threshold requirements.**  **Proposal 4: Remove the extreme data points, i.e., the minimum and maximum values from the data pool before further analysis.** |
| **Rel-18 measurement campaign submission** | | |
| R4-2407101 (not uploaded yet) | Huawei | TRP TRS results for measurement campaign |
| R4-2407099 | Sporton International Inc | 3GPP Rel-18 TRP TRS Measurement Campaign Results - Sporton Final |
| R4-2407167 | Element Materials Technology | 3GPP Rel-18 TRP TRS Performance Test Campaign |
| R4-2407623 | SRTC | Rel-18 TRP TRS Measurement campaign result from SRTC |
| R4-2407370 | SGS Wireless | Measurement results for Rel-18 TRP TRS Performance Test Campaign |
| R4-2408097 | vivo | Measurement results for Rel-18 TRP TRS Performance Test Campaign |
| R4-2408899 | OPPO | 3GPP Rel-18 TRP TRS Performance Test Campaign |
| **CRs** | | |
| R4-2408101 | vivo | CR to TR 38.870 on Rel-18 AC lab alignment activity outcome |
| R4-2408102 | vivo | CR to TR 38.870 on Rel-18 RC lab alignment and harmonization outcome |
| R4-2407057 | Apple | CR to TR38.870 on CBW scaling of the TRS requirement |
| R4-2407058 | Apple | CR to TS38.161 on PC3 scaling of the TRP requirement |
| R4-2408103 | vivo | Draft CR to TS 38.161 on FR1 TRP TRS requirements |

## Open issues summary

### Sub-topic 2-1 RC Harmonization and lab alignment

*Moderator: in WF R4-2406081, it was agreed “Pass fail limits as 0.75\*Total harmonization MU. The harmonization MU value will be decided next meeting.”*

**Issue 2-1-1: Total Harmonization MU**

* Proposals
  + **Option 1: Total harmonization MU=AC MU**
  + **Option 2: Total harmonization MU=AC MU+0.2dB**
* Recommended WF
  + TBD.

**Issue 2-1-2:** **Maintenance work for RC unavailable results**

* Proposals
  + **Proposal 1: Allow to update RC harmonization data in maintenance phase when the unfinished n28 testing is done. (Samsung)**
* Recommended WF
  + TBD

*Moderator: the RC harmonization analysis is in R4-2408096.*

**Issue 2-1-3: Rel-18 RC harmonization conclusions**

* Proposals
  + **Option 1: Conclude RC test method harmonization for bands>3GHz. FFS below 3GHz**
  + **Option 2: Conclude RC test method harmonization for bands>1GHz. FFS below 1GHz**
  + **Option 3: Conclude RC test method harmonization for bands FR1 TRP. FFS TRS**
* Recommended WF
  + Collecting views

**Issue 2-1-4: Future RC harmonization work needed or not?**

* Proposals
  + **Option 1: Further exploration of RC-AC harmonization below 1GHz or 3GHz is needed.**
    - **Low band browsing mode is also needed. Need supplemented hand-only AC results.**
  + **Option 2: other actions**
* Recommended WF
  + Collecting views

### Sub-topic 2-2 Additional CBW for band n28/n41/n77/n78 requirements

**Issue 2-2-1: Scaling factor to derive requirements on alternate narrow CBW for n28/n41/n77/n78?**

* Proposals
  + **Option 1: REFSENS RB scaled factor with additional allowance value.**
  + **Option 2: For simplicity, use 7dB for n41/77/78, with additional allowance value.**
  + **Option 3: REFSENS RB scaled factor without additional allowance value.**
* Recommended WF
  + TBD

**Issue 2-2-2: Additional allowance in issue 2-2-1**

* Proposals
  + **Option 1: Using the following allowance value**

|  |  |
| --- | --- |
| Operating band | Allowance(dB) |
| n28 | 0.51 |
| n41 | 0.52 |
| n77, n78 | 0.62 |
| NOTE 1: Scaled requirement is for 10 MHz channel bandwidth.  NOTE 2: Scaled requirement is for 20 MHz channel bandwidth. | |

* + **Option 2: other value**
* Recommended WF
  + Collecting views

**Issue 2-2-3: SPOT method for alternative CBW testing**

* Proposals
  + **Proposal 1: The SPOT method can be used to measure the offset of TIS when using different channel bandwidth configurations on the same channel. Further clarification is needed on the specific applicable conditions.**
* Recommended WF
  + Check and confirm. If confirmed, SPOT can be captured in TR.

### Sub-topic 2-3 Rel-18 TRP TRS requirements work

*Moderator: the final statistics UE information is shared by RAN4 MCC in reflector. Also copied in the Annex part of this summary.*

**Issue 2-3-1: Thresholds of UE information for measured data pool**

* Proposals
  + **Proposal 1: Adopt the following values for the thresholds related to the devices pool.** 
    - *Minimum number of devices for each band, each device size, each power class: 40*
    - *Minimum number of device models: 30*
    - *Minimum number of devices' vendors: 5*
    - *Percentage of devices from second-half 2021 to 2024: 100%*
    - *Percentage of the devices that are certified by PTCRB/GCF/NAL-CTA/CE/FCC: 100%*
* Recommended WF
  + Check and decide

**Issue 2-3-2: Additional threshold on Minimum percentage of different device models**

* Proposals
  + **Proposal 1: The number of different device models shall be at least the 75% of the total number of device samples that have been measured.**
* Recommended WF
  + Check and decide

**Issue 2-3-3: Views on modifying measurement data pool**

* Proposals
  + **Proposal 1: Measurements provided for each band must be carefully analysed in order to identify any inconsistencies and/or anomalies, outliers values. These values shall be removed from the samples on which the definition of the performance requirements will be based.**
  + **Proposal 2: For each band, outlier values should be properly identified through calculating (in linear) the average of all the measured values and remove the ones that are below [X] dBs of it.**
  + **Proposal 3: Remove the extreme data points, i.e., the minimum and maximum values from the data pool before further analysis.**
* Recommended WF
  + TBD

*Moderator: The CDF analysis of Rel-18 measurement campaign is provided in R4-2408098.*

**Issue 2-3-4: Requirements for Rel-18 TRP TRS based on measurement campaign data pool**

* Proposals
  + **Proposal 1: Discuss and decide Rel-18 TRP requirements, using the following CDF/CCDF analysis as basis.**



Propsosal 2: For each band, outlier values should be properly identified through calculating (in linear) the average of all the measured values and remove the ones that are below 3 dBs of it.

The following table reports the TRP/TRS values in the interval between the 70%-ile and the 95%-ile of the resulting CDF curves from Proposal 4. It is proposed to define the TRP and TRS minimum performance requirements based on the 70%-ile values.





* Recommended WF
  + Discuss and agree TRP/TRS requirements

### Sub-topic 2-4 CRs for approval

**Issue 2-4-1: CR to TR 38.870 on Rel-18 AC lab alignment activity outcome R4-2408101, agreeable or not?**

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

**Issue 2-4-2: CR to TR 38.870 on Rel-18 RC lab alignment and harmonization outcome** **R4-2408102, agreeable or not?**

* Proposals
  + **Option 1: Yes**
  + **Option 2: No**
* Recommended WF
  + Needs update Harmonization outcome based on conclusions

**Issue 2-4-3: CR to TR38.870 on CBW scaling of the TRS requirement R4-2407057, agreeable or not?**

* Proposals
  + **Option 1: Yes**
  + **Option 2: No**
* Recommended WF
  + Update based on agreements

**Issue 2-4-4: CR to TS38.161 on PC3 TRP requirements R4-2407058, agreeable or not?**

* Proposals
  + **Option 1: Yes**
  + **Option 2: No**
* Recommended WF
  + Needs Update

**Issue 2-4-5: CR to TS38.161 on new Rel-18 TRP/TRS requirements R4-2408103, agreeable or not?**

* Proposals
  + **Option 1: Yes**
  + **Option 2: No**
* Recommended WF
  + Needs Update based on agreed requirements

### Sub-topic 2-5 other issue

**Issue 2-5-1: WI extension for 6 more months**

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

# Annex: UE information statistics by RAN4 MCC

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Total Devices** | **81** |  |  |  |
| **Total Models** | **79** |  |  |  |
| **Total number of device vendors** | **17** |  |  |  |
| **Percentage of devices per vendor** | **10** | **12.35%** | **Vendor A** |  |
| **15** | **18.52%** | **Vendor B** |  |
| **3** | **3.70%** | **Vendor C** |  |
| **21** | **25.93%** | **Vendor D** |  |
| **12** | **14.81%** | **Vendor E** |  |
| **1** | **1.23%** | **Vendor F** |  |
| **3** | **3.70%** | **Vendor G** |  |
| **1** | **1.23%** | **Vendor H** |  |
| **6** | **7.41%** | **Vendor I** |  |
| **1** | **1.23%** | **Vendor J** |  |
| **1** | **1.23%** | **Vendor k** |  |
| **1** | **1.23%** | **Vendor L** |  |
| **1** | **1.23%** | **Vendor M** |  |
| **1** | **1.23%** | **Vendor N** |  |
| **2** | **2.47%** | **Vendor O** |  |
| **1** | **1.23%** | **Vendor P** |  |
| **1** | **1.23%** | **Vendor Q** |  |
| **Percentage of devices per power class per band** | **2** | **n1** | **PC2** | **2.47%** |
| **76** | **PC3** | **93.83%** |
| **0** | **n28** | **PC2** | **0.00%** |
| **72** | **PC3** | **88.89%** |
| **56** | **n41** | **PC2** | **69.14%** |
| **14** | **PC3** | **17.28%** |
| **65** | **n78** | **PC2** | **80.25%** |
| **6** | **PC3** | **7.41%** |
| **Percentage of devices per supported band** |  |  | **n1** | **96.30%** |
|  |  | **n28** | **88.89%** |
|  |  | **n41** | **86.42%** |
|  |  | **n78** | **87.65%** |
| **Percentage of devices per year of production** | **8** |  | **2021** | **9.88%** |
| **30** |  | **2022** | **37.04%** |
| **33** |  | **2023** | **40.74%** |
| **10** |  | **2024** | **12.35%** |
| **Percentage of devices with at least one certification** | **81** |  |  | **100.00%** |
| **Percentage of devices for each certification** | **25** |  | **GCF** | **30.86%** |
| **12** |  | **PTCRB** | **14.81%** |
| **30** |  | **NAL(CTA)** | **37.04%** |
| **30** |  | **FCC** | **37.04%** |
| **35** |  | **CE** | **43.21%** |
| **0** |  | **Not Available** |  |