**3GPP TSG-RAN WG4 Meeting # 102-e R4-22XXXXX**

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

**Agenda item:** 10.1.1

**Source:** Moderator (CAICT)

**Title:** Email discussion summary for [102-e][334] NR\_MIMO\_OTA

**Document for:** Information

# Introduction

*Contributions submitted to AI 10.1 NR MIMO OTA WI and AI 5.1.5.5 MIMO OTA SI maintenance are captured in this email discussion.*

*List of candidate target of email discussion for 1st round and 2nd round*

* 1st round: agree draft CR in AI 5.1.5.5, discuss open issues of NR MIMO OTA WI.
* 2nd round: agree TPs, make decisions on the open issues.

# Topic #1: General and Testing methodologies

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2204570**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204570.zip) | CMCC | PDP validation results for CDL-C UMa and reference values for Umi  **Observation 1: Except the cluster around 300ns of beam1, the differences between the reference and measurement values are all within +/- 1dB, and the difference of 2.45GHz and 3.6GHz cluster around 300ns is -2dB and -1.8dB, respectively. The delay differences are all within 5ns. All of the PDP measurement results meet the pass/fail limits requirement.**  **Proposal 1: Adopt the calculating results in Table 5 and Table 6 as the CDL-C UMi PDP reference values.**  **Table 5. Reference values of CDL-C UMi 2.45GHz beam1**   |  |  |  | | --- | --- | --- | | **Combined Clusters index** | **Delay(ns)** | **Power(dB)** | | 1 | 0 | -30.7 | | 2-5 | 20 | -19.2 | | 6-9 | 65 | 0 | | 10 | 80 | -33.0 | | 11-12 | 130 | -31.4 |   **Table 6. Reference values of CDL-C UMi 3.6GHz beam1**   |  |  |  | | --- | --- | --- | | **Combined Clusters index** | **Delay(ns)** | **Power(dB)** | | 1 | 0 | -30.7 | | 2-5 | 20 | -19.2 | | 6-9 | 65 | 0 | | 10 | 80 | -33.1 | | 11-12 | 130 | -31.4 | |
| [**R4-2204985**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204985.zip) | OPPO | PDP pass/fail limit for FR1  **Observation: The largest deviations to the reference come from Cluster 9-10 for 2.45GHz and Cluster 9 for 3.6GHz.**  **Proposal: It is proposed to make the option 2 of the WF as the PDP pass/fail limit for CDL-C UMa, i.e. +/-10dB at 290ns and +/-5dB for others.** |
| [**R4-2205036**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205036.zip) | CAICT, SAICT | Views on PDP reference and pass/fail limits for FR1 MIMO OTA channel model validation  **Proposal 1: Apply +/-10dB power tolerance for all taps with path loss from 30 to 40dB for FR1 CDL-C UMi channel model validation.**  **Proposal 2:** **Adopt the approach in R4-2118587 to generate the PDP reference values for FR1 CDL-C UMi channel model.** |
| [**R4-2205130**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205130.zip) | Xiaomi | On channel model validation  **Observation 1: Given the performance requirement of MIMO OTA WID only requires rank4 and hence Uma channel model will be used, there is no urgency to define the Umi channel model validation for rank 2.**  **Proposal 1:** **To postpone the decision of Umi channel model validation reference for rank 2 till specific band is agreed.** |
| [**R4-2203696**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203696.zip) | Apple, MVG | FR1 MIMO OTA Lab Alignment, Channel Model Validation update  **Observation1:** Looking at the comparison between original model and agreed reference seems the agreed references are targeted for 40MHz CE BW  **Observation 2:** PDPs are within the agreed tolerances  **Observation 1**: Doppler has been measured for both Beam1 and Beam2 configuration by using the frequency domain technique which is the only method of testing agreed in TS38.151 Annex C.3.3.  **Observation 1**: The az points from 20 to 24 which are the furthest az points from the reference (270deg). cannot be modelled with 16 probes layout (more probes are needed).  **Proposal**: The following options are proposed to access the tolerance limit for the mentioned az points:  Option1: Set 0.2 as the maximum error for measured correlation below 0.65  Option2: make a distance dependent’s limits |
| [**R4-2205236**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205236.zip) | Spirent Communications | Channel Emulator BW Impact on PDP validation targets and pass/fail  Proposal 1. While RAN4 does not set the CE BW, use the PDP pass/fail limits in [3] and [4] Option 1.  Proposal 2. Take into account the CE BW when setting the PDP validation targets. |
| [**R4-2205621**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205621.zip) | Keysight Technologies UK Ltd | On FR1 Channel Model Validation  **Proposal 1: Adopt the Option 2 for the PDP pass/fail limits of FR1 MIMO OTA UMa CDL-C for the paths from 30 to 40 dB from the peak.**  **Proposal 2: Adopt the pass/fail limits for FR1 CDL-C UMi listed in Table 1**  Table 1: Pass Fail Limits for FR1 CDL-C UMi   |  |  |  | | --- | --- | --- | |  | **Power Tolerance** | **Delay Tolerance** | | **Paths from 0dB to 30dB** | [±2.5dB] | [±6ns] | | **Paths beyond 30dB** | [±5dB] | [±6ns] |   **Proposal 3: Change the cluster group 3 (clusters 6-8) delay from 235 ns delay to 230 ns for CDL-C UMa for both beams and frequency ranges.**  **Proposal 4: Adopt the FR1 CDL-C UMi reference values in Tables 2 and** **3.**  **Table 2: CDL-C UMi PDP Reference Values at ≤ 2.5 GHz**   |  |  |  | | --- | --- | --- | | **Cluster** | **Delay [ns]** | **Power [dB]** | | 1 | 0 | -30.7 | | 2-5 | 20 | -19.2 | | 6-10 | 65 | 0 | | 11-12 | 130 | -31.4 | | 13 | 215 | -40.8 | | 14 | 460 | -41.5 |   **Table 3: CDL-C UMi PDP Reference Values at > 2.5 GHz**   |  |  |  | | --- | --- | --- | | **Cluster** | **Delay [ns]** | **Power [dB]** | | 1 | 0 | -30.7 | | 2-5 | 20 | -19.2 | | 6-10 | 65 | 0 | | 11-12 | 130 | -31.4 | | 13 | 215 | -41 | | 14 | 460 | -41.6 | |
| [**R4-2205181**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205181.zip) | MVG Industries | TP to TS38.151 on FR1 Temporal Correlation Validation – Time domain technique |
| [**R4-2204572**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204572.zip) | Samsung | TP to TS 38.151 on FR1 MIMO OTA test parameter |
| [**R4-2204950**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204950.zip) | vivo, CAICT, Spirent | TP to TS38.151 on channel model validation limits |
| R4-2204945  (reserved) | vivo | 3GPP TS 38.151 v0.8.0 |

## Open issues summary

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

### Sub-topic 1-1 FR1 channel model validation

**Issue 1-1-1: PDP reference for FR1 channel model validation**

*Moderator’s note: In the last RAN4 meeting, this issue has been discussed and the agreements in WF [R4-2203063] are as below:*

Agreements:

* Option 2: Adopt the approach in R4-2118587 to generate the PDP reference values, the detailed reference values of CDL-C Uma are listed:
* 2.45GHz Beam1

|  |  |  |
| --- | --- | --- |
| **Combined Clusters index** | **Delay(ns)** | **Power(dB)** |
| 1 | 0 | -34.3 |
| 2-5 | 80 | -19.5 |
| 6-8 | 235 | 0.0 |
| 9-10 | 290 | -33.0 |
| 11 | 450 | -35.8 |
| 12 | 480 | -34.0 |

* 2.45GHz Beam2

|  |  |  |
| --- | --- | --- |
| **Combined Clusters index** | **Delay(ns)** | **Power(dB)** |
| 1 | 0 | -27.9 |
| 2-5 | 80 | 0.0 |
| 6-8 | 235 | -18.4 |
| 9-10 | 290 | -27.8 |
| 11 | 450 | -27.9 |
| 12 | 480 | -28.0 |

* 3.6GHz Beam1

|  |  |  |
| --- | --- | --- |
| **Combined Clusters index** | **Delay(ns)** | **Power(dB)** |
| 1 | 0 | -34.2 |
| 2-5 | 80 | -19.3 |
| 6-8 | 235 | 0.0 |
| 9 | 290 | -34.7 |
| 10 | 450 | -35.8 |
| 11 | 480 | -34.7 |

* 3.6GHz Beam2

|  |  |  |
| --- | --- | --- |
| **Combined Clusters index** | **delay(ns)** | **power(dB)** |
| 1 | 0 | -27.8 |
| 2-5 | 80 | 0.0 |
| 6-8 | 235 | -18.3 |
| 9-10 | 290 | -28.9 |
| 11 | 450 | -28.1 |
| 12 | 480 | -28.8 |

* RAN4 will make decision on the PDP target values for 2.45GHz and 3.6GHz UMi channel model in RAN4#102-e meeting.
* Proposals
  + Proposal 1: Adopt the calculating results in the following Tables as the CDL-C UMi PDP reference values. (CMCC)
* **Table 5. Reference values of CDL-C UMi 2.45GHz beam1**

|  |  |  |
| --- | --- | --- |
| **Combined Clusters index** | **Delay(ns)** | **Power(dB)** |
| 1 | 0 | -30.7 |
| 2-5 | 20 | -19.2 |
| 6-9 | 65 | 0 |
| 10 | 80 | -33.0 |
| 11-12 | 130 | -31.4 |

* **Table 6. Reference values of CDL-C UMi 3.6GHz beam1**

|  |  |  |
| --- | --- | --- |
| **Combined Clusters index** | **Delay(ns)** | **Power(dB)** |
| 1 | 0 | -30.7 |
| 2-5 | 20 | -19.2 |
| 6-9 | 65 | 0 |
| 10 | 80 | -33.1 |
| 11-12 | 130 | -31.4 |

* + Proposal 2: Adopt the approach in R4-2118587 to generate the PDP reference values for FR1 CDL-C UMi channel model. (CAICT)
  + Proposal 3: Adopt the FR1 CDL-C UMi reference values in the following Tables. (Keysight)
* **Table 2: CDL-C UMi PDP Reference Values at ≤ 2.5 GHz**

|  |  |  |
| --- | --- | --- |
| **Cluster** | **Delay [ns]** | **Power [dB]** |
| 1 | 0 | -30.7 |
| 2-5 | 20 | -19.2 |
| 6-10 | 65 | 0 |
| 11-12 | 130 | -31.4 |
| 13 | 215 | -40.8 |
| 14 | 460 | -41.5 |

* **Table 3: CDL-C UMi PDP Reference Values at > 2.5 GHz**

|  |  |  |
| --- | --- | --- |
| **Cluster** | **Delay [ns]** | **Power [dB]** |
| 1 | 0 | -30.7 |
| 2-5 | 20 | -19.2 |
| 6-10 | 65 | 0 |
| 11-12 | 130 | -31.4 |
| 13 | 215 | -41 |
| 14 | 460 | -41.6 |

* + Proposal 4: Change the cluster group 3 (clusters 6-8) delay from 235 ns delay to 230 ns for CDL-C UMa for both beams and frequency ranges. (Keysight)
  + Proposal 5: Take into account the CE BW when setting the PDP validation targets. (Spirent)
* Recommended WF
  + Companies are invited to share views. The target is to conclude this issue in this meeting.

**Issue 1-1-2: PDP pass/fail limits for FR1 channel model validation**

*Moderator’s note: In the last RAN4 meeting, this issue has been discussed and the agreements in WF [R4-2203063] are as below:*

Agreements:

* Option 2: Adopt the following relaxed PDP pass/fail limits

|  |  |  |
| --- | --- | --- |
|  | **Power Tolerance** | **Delay Tolerance** |
| **Paths from 0dB to 10dB** | [±1dB] | [±6ns] |
| **Paths from 10dB to 20dB** | [±2.5dB] | [±6ns] |
| **Paths from 20dB to 30dB** | [±5dB] | [±6ns] |
| **Paths from 30dB to 40dB** | TBD  Option 1: \_+/-10 dB  Option 2:   * +/-10 dB at 290 ns for UMa * +/-5 dB for others | [±6ns] |

* Note: above agreement with TBD has no impact on MIMO OTA lab alignment activity and timeline.
* RAN4 will make decision on remaining open issues on PDP pass/fail limit in RAN4#102-e meeting.
* Proposals
  + Proposal 1: Adopt the Option 2 for the PDP pass/fail limits of FR1 MIMO OTA UMa CDL-C for the paths from 30 to 40 dB from the peak. (Keysight, OPPO)
  + Proposal 2: While RAN4 does not set the CE BW, use the PDP pass/fail limits in R4-2119093 and Option 1 in the WF R4-2203063. (Spirent)
  + Proposal 3: Apply +/-10dB power tolerance for all taps with path loss from 30 to 40dB for FR1 CDL-C UMi channel model validation. (CAICT)
  + Proposal 4: Adopt the pass/fail limits for FR1 CDL-C UMi listed in the following Table. (Keysight)

Table 1: Pass Fail Limits for FR1 CDL-C UMi

|  |  |  |
| --- | --- | --- |
|  | **Power Tolerance** | **Delay Tolerance** |
| **Paths from 0dB to 30dB** | [±2.5dB] | [±6ns] |
| **Paths beyond 30dB** | [±5dB] | [±6ns] |

* + Proposal 5: To postpone the decision of Umi channel model validation reference for rank 2 till specific band is agreed. (Xiaomi)
* Recommended WF
  + Companies are invited to share views. The target is to conclude this issue in this meeting.

**Issue 1-1-3: Spatial Correlation pass/fail limits for FR1 channel model validation**

*Moderator’s note: In the last RAN4 meeting, this issue has been discussed and the agreements in WF [R4-2203063] are as below:*

Agreement:

* + Adopt the Spatial Correlation pass/fail limits proposed in R4-2119093, i.e., Pass/Fail limits are formed as bands of [±10%] of correlation capped at 100% for the upper limit for target correlation of 35% and above. For target correlations below 35%, the band is widened to [±20%] capped at 0%.
* Proposal (Apple): The following options are proposed to access the tolerance limit for the mentioned az points:
  + Option1: Set 0.2 as the maximum error for measured correlation below 0.65
  + Option2: make a distance dependent’s limits
* Recommended WF
  + Companies are invited to share views.

## Companies views’ collection for 1st round

### Open issues

*One of the two formats, i.e. either example 1 or 2 can be used by moderators.*

Sub-topic 1-1 FR1 channel model validation

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei, HiSilicon | **Issue 1-1-1: PDP reference for FR1 channel model validation**  It is preferred not to overload test labs with both UMa and UMi work at the same time. Perhaps UMi channel models can be agreed in this meeting, but the UMi related work is carried out after the completion of UMa activities.  On UMi reference channel model, we prefer proposal 3, but without cluster 13 and 14 because paths with amplitude below -40dB may not contribute much to throughput.  **Issue 1-1-2: PDP pass/fail limits for FR1 channel model validation**  We prefer option 1.  **Issue 1-1-3: Spatial Correlation pass/fail limits for FR1 channel model validation** |
| OPPO | **Issue 1-1-1: PDP reference for FR1 channel model validation**  P1&P3: Generally agree with the proposals. The difference is Cluster 10, which has 15 ns time delay with the strongest clusters and over 30dB power gap. From the experience of CDL-C UMa, the Cluster 10 will inevitably be covered by the sidelobe of Cluster 6-9 in the measured PDP curve. In this case, the reference PDP of CDL-C UMi can be defined, however, Cluster 10 can not be verified in labs. Also, Cluster 1 and Cluster 2-5 have 20ns time delay and about 10 dB power gap. It’s not clear how much they will be affected by each other until measurement results are provided from labs.  P2: support the proposal.  P4: support the proposal which matches with the results provided by CMCC in R4-2204570. It is noted that the change should be applied only for CDL-C UMa Beam 1 but not for Beam 2. Is my understanding correct?  P5: support the proposal. CE BW will affect the shape of PDP curve especially for CDL-C UMi that clusters closer to each other.  **Issue 1-1-2: PDP pass/fail limits for FR1 channel model validation**  P1: considering the measurement results from labs are relatively small except clusters around 290ns, we support the proposal that loose limit only for clusters around 290ns.  Considering the CE BW impact on the measured PDP curves is not clear for CDL-C UMi, we support to postpone the decision on CDL-C UMi.  **Issue 1-1-3: Spatial Correlation pass/fail limits for FR1 channel model validation** |
| Keysight | **Issue 1-1-1: PDP reference for FR1 channel model validation**  Proposal 1: In principle, we are aligned with this proposal other than that we require delays at 65ns and 80ns to be combined  Proposal 2: In principle, we are aligned with this proposal but the reference values are missing in this proposal. Proposals 1 and 3 follow this proposed approach though.  Proposal 3: as proponent, we support  Proposal 4: as proponent, we support  Proposal 5: no specific PDP reference values/target for CDL-C UMi and UMa were provided. For UMa, the approach R4-2118587 was leveraged in RAN4#101-bis-e; the same/similar approach should be used for UMi.  **Issue 1-1-2: PDP pass/fail limits for FR1 channel model validation**  Proposal 1: as proponent, we support. This approach will allow current implementations to pass with a wider tolerance for the tab at 290ns while keep a modest power tolerance beyond 20dB.  Proposal 2: we believe the tolerance is too wide for the entire range beyond 30dB and should be limited to 5dB (other than the tab at 290ns).  Proposal 3: we have not seen any evidence for observations that lead to Proposal 1; our own measurements contradict CAICT’s conclusion.  Proposal 4: as proponent, we support  Proposal 5: we do not believe UMi pass/fail limits should be deferred  **Issue 1-1-3: Spatial Correlation pass/fail limits for FR1 channel model validation**  Proposal: support |
| Spirent | **Issue 1-1-1: PDP reference for FR1 channel model validation**  The CE BW determines the overall response. Thus far, no company has indicated the CE BW that needs to be used, or even if the CE BW needs to be standardized. This makes it very difficult to settle on the method to come up with the PDP targets.  **Issue 1-1-2: PDP pass/fail limits for FR1 channel model validation**  The CE BW determines the overall response. Thus far, no company has indicated the CE BW that needs to be used, or even if the CE BW needs to be standardized. This makes it very difficult to settle on the method to come up tighter limits.  **Issue 1-1-3: Spatial Correlation pass/fail limits for FR1 channel model validation**  Question for KS: What proposal does KS support? |
| Keysight: | **Issue 1-1-1: PDP reference for FR1 channel model validation**  Feedback to Huawei:  Regarding the UMi reference, we would prefer to keep clusters 13 and 14 since they are above 40 dB in the agreed theoretical model and drop below 40 dB just because of summing some of the strongest taps; these clusters may have some impact to channel model delay spread and frequency domain fading characteristics.  Feedback to Oppo:  Regarding the UMi reference, we assume that the other clusters expect cluster 10 are distinguishable. Please find measurement results below supporting our observations/proposals.    Regarding the clarification question on Proposal 4; this proposal applies to both beams.  Feedback to Spirent:  The approach to define the PDP reference was decided for CDL-C UMa in the last meeting which was supported by Spirent. We are curious why Spirent is objecting to this approach for UMi as we believe the same approach should apply to both UMa and UMi. Does Spirent have a concrete concern with the approach endorsed in the last meeting and/or alternate proposal?  **Issue 1-1-2: PDP pass/fail limits for FR1 channel model validation**  Feedback to Oppo:  Regarding postponing the UMi limit decision, it is not clear why the CE BW can be used to defer CDL-C UMi considering the same approach was used to determine the CDL-C UMa PDP limits in the last meeting. The same principles should apply for UMi and UMa. The CE BW impact is expected to affect only the closest cluster (at 79.4ns) from strongest main cluster. This cluster should be excluded from the reference as proposed in R4-2205621.  Feedback to Spirent:  Based on the PDP results presented from various labs so far, all labs have passed the tighter limits presented in option 2. We therefore do not see the need to select Option 1.  **Issue 1-1-3: Spatial Correlation pass/fail limits for FR1 channel model validation**  Feedback to Spirent:  We support both options with a preference for option 2, i.e., 0.2 tolerance for the points beyond TBD lambda threshold distance. |
| Spirent | **Issue 1-1-1: PDP reference for FR1 channel model validation**  We have a legitimate concern about the methods not taking the CE BW into account. For example, in KS’ PDP figure, it seems to use a relatively wide CE BW, and the cluster at 130ns appears relatively clean of the sidelobes of the combine cluster at 65ns. What would happen if the CE BW is narrowed down? This is also true for the impact on the other side, for the cluster at 20ns. Furthermore, this will also cause the cluster at 0ns to be impacted by the sidelobes of the cluster at 20ns. Our concrete proposal is to take into account the CE BW. This is expressed in R4-2205236 submitted for this meeting. Again, either the CE BW is standardized, or the pass/fail limits remain wider to allow any CE BW implementation. As very few companies have shown interest in setting the CE BW, the proposal that makes sense is to allow wider limits. This would also set the PDP targets in proposals 3 as acceptable (i.e., the PDP targets in proposal 3 are acceptable as long as wider pass/fail limits in R4-2119093 are acceptable).  **Issue 1-1-2: PDP pass/fail limits for FR1 channel model validation**  As before, very few companies have added the CE BW used for their validations. Again, either the CE BW is standardized, or the pass/fail limits remain wider to allow any CE BW implementation. As very few companies have shown interest in setting the CE BW, the proposal that makes sense is to allow wider limits. This would also settle the PDP targets in proposals 3 as acceptable.  **Issue 1-1-3: Spatial Correlation pass/fail limits for FR1 channel model validation**  Looking at the spatial correlation values in R4-2203696 for fc=3600MHz, it appears that the frequency domain techniques were used. This may be exposing a problem with the lack of samples (limited to 1000 traces). This can be remedied using more traces, or by using time domain techniques. |
| Xiaomi | **Issue 1-1-2: PDP pass/fail limits for FR1 channel model validation**  Proposal 5 as proponent. The CDL-C Uma channel model reference and pass/fail limit is defined together with many of the test labs have already finished the validation test. However, for CDL-C UMi channel model, it seems the test result are quite few. Furthermore, as currently no rank 2 band is specified for testing, we think it is no urgent to finish the Umi channel model in Rel-17. |
| OPPO | **Issue 1-1-1: PDP reference for FR1 channel model validation**  Feedback to KS:  Thanks for providing the measurement result on PDP of UMi. If it is typical result of labs, we would like to support to combine clusters around 65ns and 80ns. Measurement results from other labs are also welcome.  If Proposal 4 applies to both beams, we do not support the proposal.  The reference PDP is approved in R4-2119379 as below.    For Beam 1, the strongest cluster in the group appears at 232.4ns, so it’s reasonable to move the grouped cluster from 235ns to 230ns.  For Beam 2, the strongest cluster is at 235.4ns. The reference cluster for this group should keep it as it is at 235ns. |
| CAICT | **Issue 1-1-1: PDP reference for FR1 channel model validation**  Proposal 2: Support, as proponent. It is reasonable to use the same approach to generate the PDP reference values for both UMa and UMi channel models.  Proposals 1&3: Both of the proposals follow the approach in R4-2118587 and align with Proposal 2. Cluster 10 will be inevitably covered by Clusters 6-9 in measurement, so we prefer Proposal 3 which combines Clusters 6-10.  **Issue 1-1-2: PDP pass/fail limits for FR1 channel model validation**  Proposal 4: Support, as proponent. For CDL-C UMi channel model validation, we believe +/-10dB power tolerance should be applied to all taps with path loss from 30 to 40dB. As shown below, compared with CDL-C UMa, the weaker clusters are closer to the strongest cluster, and thus more likely to be covered by the sidelobes of the strongest cluster in measurement (similar to the tap at 290ns in CDL-C UMa). This phenomenon will be more obvious when narrow CE BW (e.g. 40MHz) is used. We agree that the pass/fail limits should allow any CE BW implementation.  In short, the power tolerance for the taps with path loss from 30 to 40dB in CDL-C UMi should not be narrower than that for the tap at 290ns in CDL-C UMa.   1. CDL-C UMa (b) CDL-C UMi   Figure. Previous Reference X2V PDP of CDL-C UMa and CDL-C UMi beam 1 at ≤ 2.5 GHz (R4-2205036)  Proposal 5: This is the last RAN4 meeting before the target core part completion date of the WI, so we prefer to decide the pass/fail limits for FR1 CDL-C UMi in this meeting. We suggest the following PDP pass/fail limits as the starting point. The square brackets can be remained for further checking when more measurement results are obtained.  Table 1: PDP Pass Fail Limits for FR1 CDL-C UMi   |  |  |  | | --- | --- | --- | |  | **Power Tolerance** | **Delay Tolerance** | | **Paths from 0dB to 20dB** | [±2.5dB] | [±6ns] | | **Paths from 20dB to 30dB** | [±5dB] | [±6ns] | | **Paths beyond 30dB** | [±10dB] | [±6ns] | |
| MVG | **Issue 1-1-3: Spatial Correlation pass/fail limits for FR1 channel model validation**  We can confirm that frequency domain technique was used and 1000 traces were recorded for each azimuth points. Below is a plot showing SCF reference, theory, and measured on top of each other:  Chart, line chart  Description automatically generated  16 probes layout cannot synthesize the azimuth points in between 20 and 24. Those are the furthest az points from the 270deg reference. That’s why our proposal to increase the tolerance for those az points. |
| MediaTek | **Issue 1-1-2: PDP pass/fail limits for FR1 channel model validation**  Proposal 1/3 are okay for us. |
| CMCC | **Issue 1-1-1: PDP reference for FR1 channel model validation**  P1 & P3：About the CDL-C Umi PDP reference value, we are fine that the cluster #80ns can be integrated with the combined cluster #65ns，however, we hold the view that #cluster13 and #cluster14 which power below -40dB may not contribute much to the Tput testing results, so we suggest that these two weak clusters are not included in the target value of CDL-C Umi.  **Issue 1-1-2: PDP pass/fail limits for FR1 channel model validation**  We support Option2 for the CDL-C UMa channel model.  For CDL-C UMi, considering most labs do not have the measurement results of CDL-C Umi at this stage, we support Proposal 5 to postpone the decision of CDL-C Umi channel model pass/fail limits. |
| Keysight | **Issue 1-1-1: PDP reference for FR1 channel model validation**  Feedback to Spirent: We encourage Spirent to provide measurements to answer their questions/comments. We also do not believe that stating CE BW should be considered in the PDP reference definition is a concrete proposal and suggest Spirent to share tables for UMa and UMi PDP reference values instead.  **Issue 1-1-2: PDP pass/fail limits for FR1 channel model validation**  Feedback to Spirent:  Since all submitted results (including the min CE BW) have met the tighter limits (which we still consider very wide), we believe these limits should be acceptable.  Feedback to Oppo regarding P4:  You are correct. The proposed change should only apply to beam 1. We have revised the contribution to clarify the proposed changes for beams 1 and 2, i.e., we suggest to replace P4 with the following instead:  Proposal 4a: Change the cluster group 3 (clusters 6-8) delay from 235 ns delay to 230 ns for CDL-C UMa for beam 1.  Proposal 4b: Change the cluster group 2 (clusters 2-5) delay from 80 ns delay to 75 ns for CDL-C UMa for beam 2. |
| vivo | **Issue 1-1-1: PDP reference for FR1 channel model validation**  For UMi reference values, we also prefer to remove the clusters below 40dB, based on previous agreements of 40dB threshold.  **Issue 1-1-2: PDP pass/fail limits for FR1 channel model validation**  For UMi pass/fail limits, RAN4 should conclude this item this meeting to finalize core part work. The impact of different CE bandwidth should be considered, given this is not standardized and should be CE implementation.  Option 1: \_+/-10 dB for 30 to 40 dB for both UMa and UMi. |

### 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.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2204950**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204950.zip)  (on channel model validation limits) | OPPO: In Clause C4.4, the example of Spatial correlation uses frequency of 2132.5MHz. it is proposed to use frequency 2450MHz or 3600MHz, as they are actually used for lab alignment. |
| Keysight: generally agree but need to await discussion on SCF limits in Issue 1-1-3. Additionally, the limits should be presented not just with graphs but tables as well, i.e., the tables for pass/fail limits are missing. |
| MVG: we would like to wait the discussion in Issue 1-1-3. Support the comment from Keysight about having tabulated limits. |
| vivo: thanks for all the valuable comments, this TP can be revised to accommodate tabulated limits and final pass/fail limits of UMi and UMa; |
| [**R4-2205181**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205181.zip)  (on FR1 Temporal Correlation Validation) | Keysight: The carriage return in Figure C.3.3-2 after ‘Signal’ needs to be removed to show ‘Signal Analyser’ |
| MVG: Thanks Keysight for spotting that. |
| vivo: thanks for the TP, we support adding time domain technique for Temporal correlation validation. The number of titles for latter figure and tables should be updated also. |
| [**R4-2204572**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204572.zip)  (on FR1 MIMO OTA test parameter) | vivo: thanks for the TP, we support. |
| 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 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.*

|  |  |
| --- | --- |
| **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)

# Topic #2: Performance requirement

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2203576**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203576.zip) | SGS Wireless | Our Status (SGS TW) for the 3GPP RAN4 5G FR1 SA MIMO OTA Lab Alignment Activity  **Proposal: If everyone agrees, SGS TW can be arranged to test the Performance Alignment Devices (PADs) in the last labs. (The shipping order for these PADs will be Beijing China 🡪 Shanghai, China 🡪 Cupertino, USA 🡪 New Taipei City, Taiwan)** |
| [**R4-2204951**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204951.zip) | vivo | Further views on framework for FR1 MIMO OTA lab alignment activity  **Proposal 1: Inverse average the measurement results submitted by test labs.**  **Proposal 2: RAN4 should discuss whether apparent outlier (if identified) will be considered in the average processing to derive reference value.** |
| [**R4-2204949**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204949.zip) | vivo | Further views on Pass/Fail limit for FR1 MIMO OTA lab alignment activity  **Proposal 1: Define the maximum deviation of TRMS between test lab and Averaged Value as +/- 1.5 dB for bands<3GHz, and +/- 1.7 dB for bands>3GHz.** |
| [**R4-2204089**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204089.zip) | Huawei Tech.(UK) Co.. Ltd | On pass or fail criteria for MIMO OTA lab alignment  **Observation 1**: one MU as pass/fail criterion for lab alignment is a technically justifiable choice. |
| [**R4-2205131**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205131.zip) | Xiaomi | On FR1 lab alignment  **Observation 1: The reference value and pass/fail limit should be discussed together.**  **Observation 2: For the averaging method to calculate the reference, if the submitted results vary too much, none of the labs can meet the TRMS pass/fail limit.**  **Observation 3: The number of results per PAD and per band should be discussed for judging a LAB to pass or fail the alignment.**  **Proposal: It is proposed to define the reference and pass/fail limit of lab alignment together.** |
| [**R4-2204987**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204987.zip) | OPPO | Views on Pass/Fail limit for lab alignment  **Observation 1: The derived TRMS requirement can be affected by the biased data, and bigger bias may bring larger offset on the TRMS requirement.**  **Observation 2: The TRMS requirement will not be affected if the data from biased lab are far from the derived TRMS.**  **Proposal 1: It is proposed to adopt option 2 as pass/fail limit for lab alignment, i.e. +/-3dB for bands <3GHz and +/-3.4dB for bands >3GHz.**  **Proposal 2: On deriving TRMS requirements, it is proposed to perform the following procedure.**   * **Examine whether there are measurement data in the range of +/-3dB for bands <3GHz and +/-3.4dB for bands >3GHz.** * **If yes, examine whether the data come from those labs with the gaps bigger than 0.5MU in lab alignment campaign.** * **If yes, the data is marked as those may affect the derived TRMS.** * **The derived TRMS requirement from CDF curve can be fine-tuned based on those marked data.** |
| [**R4-2204986**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204986.zip) | OPPO | Views on how to avoid the same UE model measured in labs  **Proposal 1: The proposal from MediaTek in the second-round email discussion of RAN4 #101-bis-e is acceptable as a comprehensive recommendation.**  **Proposal 2: To avoid the repeated model as possible, the following instructions are hereby proposed.**   * **The lab should share the intended commercial device list among the aligned labs as soon as possible after the confirmation of the aligned labs.** * **Every lab can update the list afterwards, including adding and removing UE models. However, the UE models which are already in other lab’s shared list are not allowed to be added.** * **The maximum number of repeated models measured in one lab needs be specified. In each lab, the percentage of repeated models should not exceed 25%.** |
| [**R4-2205035**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205035.zip) | CAICT, vivo | Framework for FR1 MIMO OTA performance test campaign  **Proposal 1: Approve the above Framework for FR1 MIMO OTA performance test campaign.** |
| [**R4-2204571**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204571.zip) | Samsung | Discussion on mechanical mode of FR1 MIMO OTA performance  **Observation 1: TRMS requirement is derived mainly based on bar type smart phone but will also apply for foldable type smart phone.**  **Proposal 1: the TRMS requirements only apply to the primary mechanical mode for devices having multiple mechanical modes.** |
| [**R4-2204499**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204499.zip) | Qualcomm Incorporated | On FR2 MIMO OTA requirements  **Observations 1: The pros of option 1 is we can leverage the same UE assumptions including GainANT, GainBF, and Noisethermal as Rel-15 FR2 UE which should be acceptable for the companies since all the UE shall pass Rel-15 EIS requirements.**  **Proposal 1:** **RAN4 to considering the following two options for MIMO sensitivity values calculation by simulation results. Option 1 is with high priority.**   * **Option 1: derive the MIMO sensitivity per Rel-15 EIS requirements**   + **With EIS requirements, MIMO sensitivity at the beam peak direction can be calculated as :**      - **MIMO sensitivity at beam peak direction= REFSENS + SNRBB -(-1) (reference SNR for REFSENS) + 3dB (diversity gain)**   + **MIMO sensitivity at direction X can be calculated by:**     - **MIMO sensitivity at test direction X = MIMO sensitivity at beam peak direction + (SNRSIM at test direction X - SNRSIM at peak direction)** * **Option 2: derive the MIMO sensitivity per UE implementation assumptions**   + **The parameters of GainANT, GainBF, and Noisethermal can be obtained per UE implementation assumptions.**   + **With GainANT, GainBF and SNRBB for different test directions, the MIMO sensitivity could be derived.**   **Proposal 2:** **RAN4 to use the limits of FR2 channel model validation for power and delay tolerance, and AoA/ZoA offsets to evaluate the maximum impact on the FR2 MIMO OTA simulation results.**  **Observation 2: Per the formula of MACS defined in TS38.151, the MASC of meeting 70% maximum throughput is calculated as -138.8dBm/Hz based on the latest simulation results.**  **Proposal 3: To take the simulation results in Figure 2 into account when specifying the FR2 MIMO OTA requirements.** |
| **[R4-2205002](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205002.zip)** | Huawei,HiSilicon | Discussion FR2 MIMO OTA performance requirements  **Observation 1: According to the formula defined in TS38.151, the MASC of meeting 70% maximum throughput is calculated as -133.1dBm/Hz.** |
| [**R4-2205003**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205003.zip) | Huawei,HiSilicon | Discussion on preliminary MU assessment for FR2 MIMO OTA  **Proposal 1: RAN4 to evaluate the MU budget for FR2 MIMO OTA 3D-MPAC.** |
| [**R4-2204501**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204501.zip) | Qualcomm Incorporated | On preliminary MU assessment for FR2 MIMO OTA  **Proposal 1: To agree the above MU budget for FR2 MIMO OTA 3D-MPAC as the start point.** |
| [**R4-2204948**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204948.zip) | vivo | TP to TS38.151 on FR1 MPAC MU budget |
| R4-2204500  (reserved) | Qualcomm Incorporated | Summary results for FR2 MIMO OTA |

## Open issues summary

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

### Sub-topic 2-1 FR1 MIMO OTA lab alignment activity

**Issue 2-1-1: Reference value for FR1 MIMO OTA lab alignment**

*Moderator’s note: the agreement in the WF [R4-2203063] is as below:*

Agreement:

* The reference value of each PAD should be the average of the PAD measurement results submitted on or before 12:00 UTC 30th April 2022, based on the condition at least 3 labs’ results collected. Submission with measurement data after 12:00 UTC 30th April can be considered for lab alignment, but will not change the reference TRMS value*.*
* Proposals:
  + Proposal 1: Inverse average the measurement results submitted by test labs. (vivo)
  + Proposal 2: RAN4 should discuss whether apparent outlier (if identified) will be considered in the average processing to derive reference value. (vivo)
  + Proposal 3: Define the reference and pass/fail limit of lab alignment together. (Xiaomi)
* Recommended WF
  + Companies are invited to share views.

**Issue 2-1-2: Pass/fail limit for FR1 MIMO OTA lab alignment**

*Moderator’s note: In the last RAN4 meeting, this issue has been discussed and the agreements in the WF* *[R4-2203063] are as below:*

Agreements:

* The pass/fail limit for lab PAD alignment: the maximum deviation of TRMS between each performance alignment lab and Averaged Value; candidate options as following:
  + *For band <3GHz* 
    - *Option 1: +/- 1.5 dB (half MU)*
    - *Option 2: +/- 3 dB (one MU)*
  + *For bands >3GHz,* 
    - *Option 1: +/- 1.7 dB (half MU)*
    - *Option 2: +/- 3.4 dB (one MU)*
* RAN4 will make decision in RAN4#102-e meeting.
* Options:
  + Option 1: Define the maximum deviation of TRMS between test lab and Averaged Value as +/- 1.5 dB for bands<3GHz, and +/- 1.7 dB for bands>3GHz. (vivo)
  + Option 2: Adopt option 2 as pass/fail limit for lab alignment, i.e. +/-3dB for bands <3GHz and +/-3.4dB for bands >3GHz. (OPPO)
  + Option 3: Others
* Recommended WF
  + Companies are invited to share views.

**Issue 2-1-3: Arrangement of PAD test**

*Moderator’s note: As stated in R4-2203576,* *SGS plans to submit the channel model validation test results to 3GPP RAN4 in May.*

* Proposal (SGS):
  + If everyone agrees, SGS TW can be arranged to test the Performance Alignment Devices (PADs) in the last labs. (The shipping order for these PADs will be Beijing China **🡪** Shanghai, China **🡪** Cupertino, USA **🡪** New Taipei City, Taiwan)
* Recommended WF
  + Companies are invited to share views.

### Sub-topic 2-2 FR1 MIMO OTA performance test campaign

**Issue 2-2-1: Framework for FR1 MIMO OTA** **performance test campaign**

*Moderator’s note: The framework for FR1 MIMO OTA performance test campaign in R4-2205035 is as below. It is suggested to update R4-2205035 to capture the agreements on Issues 2-2-2 and 2-2-3 after the 1st round, if applicable.*

1. The purpose of the test campaign is to collect measurement results of commercial devices for the definition of FR1 MIMO OTA performance requirements. Only aligned labs can share measurement results into MIMO OTA data pool to define the requirements.
2. Test cases for FR1 MIMO OTA performance test campaign:
   1. Test bands: n41, n77, and n78 (first stage)
   2. Operation mode: NR Standalone (SA) (first stage)
3. Commercial Device (Smartphone) selection criteria for FR1 MIMO OTA performance test campaign:
   1. DUT capability: support for all the Bands n41, n77, n78, and n79 listed in the WID is preferred, but devices supporting only a subset of the above bands can equally be used in the test campaign for such supported bands
   2. DUT variety: the selection of commercial devices should cover various of devices in the market. The measured commercial devices from every aligned lab should cover the low, middle and high price range
   3. The following selection criteria can also be considered:
      1. Year of production: [2020-2022]
      2. Brand variety
      3. Popularity
      4. Number of bands supported
   4. Intended for which market: no limitation
   5. Power Class: PC3
4. Commercial devices preparation: the labs can prepare and collect commercial devices by themselves based on the above selection criteria.
5. Test results submitting:
   1. The number of all NR bands each UE supports shall be provided for information when measured TRMS data are submitted.
   2. Using the same worksheet template to submit the measurement results (the FR1 MIMO OTA Performance Test Campaign Template will be shared later)
   3. The measurement results should be submitted to RAN4 by anonymous approach (the UE model should not be disclosed), and based on the contribution-driven manner.
   4. The maximum number of measurement results for each band that each lab can submit is [8]. The labs are also encouraged to submit as much data as possible.
   5. Only the results from aligned labs will be considered for defining requirements.
   6. The progress in each lab is encouraged to be shared on the RAN4 reflector (e.g., how many devices have been measured and on which bands).
6. Specify FR1 MIMO OTA performance requirements:
   1. The TRMS requirements should be derived from measurement results of commercial devices
   2. Minimum number of devices for defining requirements for each band: 15
   3. [85%] percentile of the CDF is picked from the overall CDF of TRMSaverage,70
   4. Performance part of the work will proceed in a contribution-driven manner

* Proposal (CAICT, vivo):
  + Approve the above Framework for FR1 MIMO OTA performance test campaign.
* Recommended WF
  + Companies are invited to share views.

**Issue 2-2-2: How to avoid the same UE model measured in several labs**

*Moderator’s note: This issue has been discussed in the last RAN4 #101-bis-e meeting. The proposals from companies in the email discussion (R4-2203096) are as below* *for information:*

* Proposal 1: Regarding the measurement data on the same UE model from several test labs, take the average of the measurement data as one data in the data pool. (OPPO)
* Proposal 2: Every lab shares their plan of measurement UE list before starting the test, and removes the repeated model in advance to avoid the same model be tested. In this situation, the way of sharing and maintaining the planed measurement UE list should be further discussed. (OPPO’s proposal from the 1st round)
* Proposal 3: The supported bands information of each UE should be shared. (CAICT’s proposal from the 1st round)
* Proposal4: Lab volunteer shall share UE model name with band information and test band information to all Lab volunteers, to avoid repeated model as possible. If the repeated data is still happened, then take the average of the measurement data as one data in the data pool. (MediaTek’s proposal from the 2nd round)
* Proposals:
  + Proposal 1: The proposal from MediaTek in the second-round email discussion of RAN4 #101-bis-e is acceptable as a comprehensive recommendation. (OPPO)
  + Proposal 2: To avoid the repeated model as possible, the following instructions are hereby proposed. (OPPO)
    - The lab should share the intended commercial device list among the aligned labs as soon as possible after the confirmation of the aligned labs.
    - Every lab can update the list afterwards, including adding and removing UE models. However, the UE models which are already in other lab’s shared list are not allowed to be added.
    - The maximum number of repeated models measured in one lab needs be specified. In each lab, the percentage of repeated models should not exceed 25%.
* Recommended WF
  + Companies are invited to share views. The target is to decide feasible solutions in this meeting.

**Issue 2-2-3: FR1 MIMO OTA TRMS requirements development**

* Proposal (OPPO):
  + On deriving TRMS requirements, it is proposed to perform the following procedure.
    - Examine whether there are measurement data in the range of +/-3dB for bands <3GHz and +/-3.4dB for bands >3GHz.
    - If yes, examine whether the data come from those labs with the gaps bigger than 0.5MU in lab alignment campaign.
    - If yes, the data is marked as those may affect the derived TRMS.
    - The derived TRMS requirement from CDF curve can be fine-tuned based on those marked data.
* Recommended WF
  + Companies are invited to share views.

### Sub-topic 2-3 Mechanical mode of FR1 MIMO OTA performance

**Issue 2-3: How to treat the mechanical mode in FR1 MIMO OTA performance requirement**

* Proposal (Samsung):
  + The TRMS requirements only apply to the primary mechanical mode for devices having multiple mechanical modes.
* Recommended WF
  + Companies are invited to share views.

### Sub-topic 2-4 FR2 MIMO OTA performance requirements

**Issue 2-4-1: How to calculate the sensitivity values by simulation SNR**

* Proposal (Qualcomm): RAN4 to considering the following two options for MIMO sensitivity values calculation by simulation results. Option 1 is with high priority.
  + Option 1: derive the MIMO sensitivity per Rel-15 EIS requirements
    - With EIS requirements, MIMO sensitivity at the beam peak direction can be calculated as:

MIMO sensitivity at beam peak direction= REFSENS + SNRBB -(-1) (reference SNR for REFSENS) + 3dB (diversity gain)

* + - MIMO sensitivity at direction X can be calculated by:

MIMO sensitivity at test direction X = MIMO sensitivity at beam peak direction + (SNRSIM at test direction X - SNRSIM at peak direction)

* + Option 2: derive the MIMO sensitivity per UE implementation assumptions
    - The parameters of GainANT, GainBF, and Noisethermal can be obtained per UE implementation assumptions.
    - With GainANT, GainBF and SNRBB for different test directions, the MIMO sensitivity could be derived.
* Recommended WF
  + Companies are invited to share views.

**Issue 2-4-2: How to evaluate the offset of equivalent SNR due to the non-ideal factors**

* Proposal (Qualcomm):
  + RAN4 to use the limits of FR2 channel model validation for power and delay tolerance, and AoA/ZoA offsets to evaluate the maximum impact on the FR2 MIMO OTA simulation results.
* Recommended WF
  + Companies are invited to share views.

**Issue 2-4-3: FR2 MIMO OTA simulation results for 36 test directions**

*Moderator’s note: Qualcomm (R4-2204499) and Huawei (R4-2205002) provided their simulation results for 36 test directions, based on which the MASC of meeting 70% maximum throughput is calculated as -138.8dBm/Hz and -133.1dBm/Hz, respectively.*

* Proposal (Qualcomm):
  + To take the simulation results in Figure 2 in R4-2204499 into account when specifying the FR2 MIMO OTA requirements.
* Recommended WF
  + Companies are invited to share views.

### Sub-topic 2-5 MU budget for FR2 MIMO OTA

**Issue 2-5: MU budget for FR2 MIMO OTA 3D-MPAC**

* Proposals:
  + Proposal 1: To agree the below MU budget for FR2 MIMO OTA 3D-MPAC as the start point. (Qualcomm)

Table 1: Measurement uncertainty budget for FR2 3D-MPAC

| UID | Description of uncertainty contribution | Example value (26.5GHz≤f≤29.5GHz) | Example value (37GHz ≤f≤40GHz) | Distribution of the probability | Details in |
| --- | --- | --- | --- | --- | --- |
| Stage 2: DUT measurement | | | | | |
| 1 | Mismatch for measurement process | [1.30] | TBD | U-Shaped | B.2.2.1 |
| 2 | Measure distance uncertainty | [0.15] | TBD | [Rectangular] | B.2.2.2 |
| 3 | Quality of quiet zone | [1.20] | TBD | [Actual] | B.2.2.3 |
| 4 | Base Station simulator | TBD | TBD | [Normal] | B.2.2.4 |
| 5 | Channel Emulator  -absolute value  -stability  -linearity | [2.90] | TBD | Normal | B.2.2.5 |
| 6 | Amplifier uncertainties | [2.10] | TBD | [Normal] | B.2.2.6 |
| 7 | Random uncertainty | [0.50] | TBD | [Normal] | B.2.2.7 |
| 8 | Throughput measurement: output level step resolution | [0.23] | TBD | Rectangular | B.2.2.8 |
| 9 | DUT sensitivity drift | TBD | TBD | Rectangular | B.2.2.9 |
| 10 | Signal flatness | TBD | TBD | Normal | B.2.2.10 |
| Stage 1: Calibration measurement | | | | | |
| 11 | Mismatch for calibration process  - loopback cable path  - system input path  - reference antenna | [0.00] | TBD | U-Shaped | B.2.2.11 |
| 12 | Reference antenna positioning misalignment | [0.00] | TBD | [Rectangular] | B.2.2.12 |
| 13 | Quality of quiet zone | [0.4] | TBD | [Actual] | B.2.2.3 |
| 14 | Total uncertainty of the Network Analyzer | [0.73] | TBD | [Normal] | B.2.2.13 |
| 15 | Uncertainty of an absolute gain of the calibration antenna | [0.6dB] | TBD | [Normal] | B.2.2.14 |
| 16 | Offset of the Phase Center of the Reference Antenna | [0.47] | TBD | [Rectangular] | B.2.2.16 |

* + Proposal 2: RAN4 to evaluate the below MU budget for FR2 MIMO OTA 3D-MPAC. (Huawei)

Table 1: Measurement uncertainty budget for FR2 3D-MPAC

| UID | Description of uncertainty contribution | Example value (26.5GHz≤f≤29.5GHz) | Example value (37GHz ≤f≤40GHz) | Distribution of the probability | Details in |
| --- | --- | --- | --- | --- | --- |
| Stage 2: DUT measurement | | | | | |
| 1 | Mismatch for measurement process | [1.30] | TBD | [Actual] | B.2.2.1 |
| 2 | Measure distance uncertainty | [0.15] | TBD | [Rectangular] | B.2.2.2 |
| 3 | Quality of quiet zone | [1.20] | TBD | [Actual] | B.2.2.3 |
| 4 | Base Station simulator | TBD | TBD | [Normal] | B.2.2.4 |
| 5 | Channel Emulator  -absolute value  -stability  -linearity | TBD | TBD | Normal | B.2.2.5 |
| 6 | Amplifier uncertainties | [2.10] | TBD | [Normal] | B.2.2.6 |
| 7 | Random uncertainty | [0.50] | TBD | [Normal] | B.2.2.7 |
| 8 | Throughput measurement: output level step resolution | TBD | TBD | [Rectangular] | B.2.2.8 |
| 9 | DUT sensitivity drift | TBD | TBD | [Rectangular] | B.2.2.9 |
| 10 | Signal flatness | TBD | TBD | [Normal] | B.2.2.10 |
| Stage 1: Calibration measurement | | | | | |
| 11 | Mismatch for calibration process  - loopback cable path  - system input path  - reference antenna | [0.14] | TBD | [Normal] | B.2.2.11 |
| 12 | Reference antenna positioning misalignment | [0.01] | TBD | [Rectangular] | B.2.2.12 |
| 13 | Quality of quiet zone | [0.4] | TBD | [Actual] | B.2.2.3 |
| 14 | Total uncertainty of the Network Analyzer | [0.73] | TBD | [Normal] | B.2.2.13 |
| 15 | Uncertainty of an absolute gain of the calibration antenna | [0.6dB] | TBD | [Normal] | B.2.2.14 |
| 16 | Offset of the Phase Center of the Reference Antenna | [0.47] | TBD | [Rectangular] | B.2.2.16 |

* Recommended WF
  + Companies are invited to share views.

## Companies views’ collection for 1st round

### Open issues

Sub topic 2-1 FR1 MIMO OTA lab alignment activity

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| **Company** | **Comments** |
| Huawei, HiSilicon | **Issue 2-1-1: Reference value for FR1 MIMO OTA lab alignment**  Proposal 1 is agreeable. On Proposal 2, measurement values within one MU of the average should be included. The criteria for “apparent outlier” should be clearly defined.  **Issue 2-1-2: Pass/fail limit for FR1 MIMO OTA lab alignment**  We support option 2 for the reasons stated in our contribution R4-2204089.  **Issue 2-1-3: Arrangement of PAD test**  The arrangement of PAD test is fine. |
| OPPO | **Issue 2-1-1: Reference value for FR1 MIMO OTA lab alignment**  P1: support the proposal.  P2: it is good to pre-process the apparent outlier data. The problem is that how to identify the apparent outlier. And does it mean that the lab providing apparent outlier data will not pass the alignment campaign?  P3: our preference is defining the way of deriving the reference and pass/fail limit together in this meeting considering the tight performance campaign.  **Issue 2-1-2: Pass/fail limit for FR1 MIMO OTA lab alignment**  We support Option 2. This pass/fail limit is used for judging whether the volunteer labs can submit commercial device measurement results for performance campaign. According to our analysis in R4-2204987, labs with larger deviation will not necessarily derive “untrustable” TRMS requirement. While, more labs provide more commercial device measurement data, which benefit for getting universal CDF curve. On the other hand, because of labs with larger deviation involved, the procedure in Issue 2-2-3 need to be considered.  **Issue 2-1-3: Arrangement of PAD test** |
| Keysight | **Issue 2-1-1: Reference value for FR1 MIMO OTA lab alignment**  Proposal 2: Removal of outliers should be considered only if a minimum number of labs have submitted their results on time, e.g., top and bottom outlier to be removed if 5 of more labs have submitted data.  **Issue 2-1-2: Pass/fail limit for FR1 MIMO OTA lab alignment**  Support Option 1 as the tolerance of ≥6dB is just too wide. The changes for NR FR1 MIMO compared to LTE MIMO OTA are not significant to justify an increase of the pass/fail limit tolerance from 2dB to 6dB.  **Issue 2-1-3: Arrangement of PAD test** |
| Samsung | **Issue 2-1-1: Reference value for FR1 MIMO OTA lab alignment**  For proposal 1, thanks vivo for the proposal, we think the averaging method is important and may need further discussion. Inverse average in mW unit is used for TRS and TRMS calculation which reflects the fact that UE antenna gain is dominated by peak gain performance. But for the average value among labs, if inverse average in mW unit is adopted, the lab yielding larger TRMS will be easily to be ruled out unfairly. Assume the reference value is averaged from 3 labs whose test results are -77dBm, -80dBm, -83dBm. The inverse average in mW unit is -80.7dBm while linear average in dBm unit is -80dBm. If inverse average in mW unit is adopted, the lab yielding -77dBm results will have larger deviation from the average than the lab yielding -83dBm results, leading to unfair situation for labs yielding larger TRMS test results (lower weights for them) or even just ruled out (easily fail the pass/fail limit).  Totally there are 4 average methods:   * inverse average in mW unit (the one used in TRS and TRMS equations) * inverse average in dBm unit * linear average in mW unit * linear average in dBm unit   Based on above analysis, average method in mW unit will lead to average value dominated by extreme data. Average method in dBm unit will be more like mathematical average which seems more suitable for the reference value derivation. Between inverse average in dBm unit and linear average in dBm unit, our initial thought is that linear average in dBm unit may be better.  For proposal 2, it seems reasonable to carefully to treat the apparent outlier values before average calculation.  For proposal 3, in case Issue 2-1-2 could not be agreed quickly, this proposal could also be considered option.  **Issue 2-1-2: Pass/fail limit for FR1 MIMO OTA lab alignment**  Generally speaking half MU will pave better way for subsequent performance campaign. On the other hand one MU also makes sense from practical lab implementation perspective. It is encouraged to converge on the pass/fail limit value as much as possible to guarantee a better aligned performance campaign results.  **Issue 2-1-3: Arrangement of PAD test**  Support the proposal. |
| Qualcomm | **Issue 2-1-1: Reference value for FR1 MIMO OTA lab alignment**  Support option 1 and option 2. For option 1, the averaging approach, i.e., in mW or dBm should be decided.  **Issue 2-1-2: Pass/fail limit for FR1 MIMO OTA lab alignment**  Support option 1. |
| Xiaomi | **Issue 2-1-1: Reference value for FR1 MIMO OTA lab alignment**  Proposal 2 and 3. Prop 2 is also presented in our discussion paper when analysing the LTE MIMO OTA requirement,  **Issue 2-1-2: Pass/fail limit for FR1 MIMO OTA lab alignment**  Support option 2 as stated in our contribution, for half MU, there might exist the situation that no lab can pass the limit. |
| CAICT | **Issue 2-1-1: Reference value for FR1 MIMO OTA lab alignment**  P1: All the labs should be equally treated. Given that both the conversion from mW to dBm and the inverse average calculation are non-linear, we support linear average in mW unit.  P2: In principle, we agree that apparent outlier should be removed in average processing to derive reference value. How to identify the apparent outlier should be carefully considered.  To OPPO: Our understanding is that the lab providing apparent outlier data doesn’t mean the lab cannot pass the alignment campaign, it just means the reference value will not be affected by the outlier data.  P3: We are OK to further discuss the reference value after obtaining PAD test results from some labs.  **Issue 2-1-2: Pass/fail limit for FR1 MIMO OTA lab alignment**  We prefer Option 2. Option 1 is reasonable only when the reference value is a “true” statistical mean. However, the reference value will be derived from no more than 6 labs, which will inevitably deviate from the “true” statistical mean. Thus, wider pass/fail limits are needed in practice.  **Issue 2-1-3: Arrangement of PAD test**  Basically OK with the proposal. Labs should complete the channel model validation procedure before participating in the alignment activity, so we suggest the following proposal:  “After submitting valid channel model validation results to 3GPP RAN4 #103-e meeting, SGS TW can be arranged to test the Performance Alignment Devices (PADs) in the last labs. (The shipping order for these PADs will be Beijing **🡪** Shanghai **🡪** Cupertino **🡪** New Taipei City)” |
| MediaTek | **Issue 2-1-1: Reference value for FR1 MIMO OTA lab alignment**  Proposal 1, 2, 3 are okay for us.  **Issue 2-1-2: Pass/fail limit for FR1 MIMO OTA lab alignment**  We prefer Option 2.  **Issue 2-1-3: Arrangement of PAD test**  The proposal is fine for us, more lab volunteers is fine basically. |
| CMCC | **Issue 2-1-2: Pass/fail limit for FR1 MIMO OTA lab alignment**  We support Option2. |
| Apple | **Issue 2-1-1: Reference value for FR1 MIMO OTA lab alignment**  Proposal 2: Supported as long as all volunteer labs have the opportunity to test PADs and provide data before the April 30th deadline  **Issue 2-1-2: Pass/fail limit for FR1 MIMO OTA lab alignment**  Support Option 1  **Issue 2-1-3: Arrangement of PAD test**  Support this proposal, emphasising the agreement that all readily available volunteer labs shall have the opportunity to test PADs and provide results prior to April 30th. |
| vivo | **Issue 2-1-1: Reference value for FR1 MIMO OTA lab alignment**  Basically, the alignment activity is encouraging test labs to improve the system configuration, and get more accurate measurement results. From this perspective, the inverse average approach getting better UE sensitivity performance is preferred. Besides, this is the selected averaging method for TRMS.  We should also note that, for TRS, we use inverse average to get better sensitivity. Linear average is only used for TRP, to get higher power.  For apparent outlier, indeed the criteria should be further discussed.  **Issue 2-1-2: Pass/fail limit for FR1 MIMO OTA lab alignment**  Option 1 is our preference, not only from 3GPP LTE MIMO OTA Pass/fail limit, but also from the value somehow as gentleman's agreements for many informal alignment activities among labs underground. We rarely hear a formal statement from test lab to claim something like that “we are well aligned with lab A due to our only 6dB measurement results offset…”  But we fully understand the worried thoughts from companies, so we are open to further discuss compromised value between option 1 and 2. |
| AT&T | **Issue 2-1-1: Reference value for FR1 MIMO OTA lab alignment**  The proposals are OK with us. For the averaging approach, the same exact method should be used as for TRMS in LTE. If a different method is used, the test metric needs to be renamed to avoid confusion.  **Issue 2-1-2: Pass/fail limit for FR1 MIMO OTA lab alignment**  We are OK with option 1. However, we would prefer an even smaller limit as used for LTE. |

Sub topic 2-2 FR1 MIMO OTA performance test campaign

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| **Company** | **Comments** |
| Huawei, HiSilcon | **Issue 2-2-1: Framework for FR1 MIMO OTA performance test campaign**  We are fine the framework except the [85%] threshold on TRMS CDF because 85% means 15% failure rate, which is too high and could have implication in market access. [95%] threshold or 5% failure rate would be acceptable.  **Issue 2-2-2: How to avoid the same UE model measured in several labs**  We prefer proposal 2.  **Issue 2-2-3: FR1 MIMO OTA TRMS requirements development** |
| OPPO | **Issue 2-2-1: Framework for FR1 MIMO OTA performance test campaign**  Support the proposal.  **Issue 2-2-2: How to avoid the same UE model measured in several labs**  Support the proposals as the proponent.  **Issue 2-2-3: FR1 MIMO OTA TRMS requirements development**  Support the proposal. To make the procedure clearer, we would like to revise the first bullet as follow:  Examine whether there are measurement data in the range of [85%] percentile of CDF +/-1\*MU. |
| Samsung | **Issue 2-2-1: Framework for FR1 MIMO OTA performance test campaign**  Generally support the proposal. Just one tiny comment about the necessity to limit the power class as PC3 only. If such limitation will rule out many PC2 UE in the market, maybe it can be considered to remove the sub-bullet 3e?  We also support Huawei proposed CDF percentile value, i.e. replace [85%] with [95%], detailed analysis has been provided in our previous contribution R4-2112573  **Issue 2-2-2: How to avoid the same UE model measured in several labs**  The proposals are all useful. To avoid repeated test of same model, it seems having to exchange some model information among labs. We are okay to the approach to exchange model name among labs, but we would like to highlight that the mapping between measurement results and model name should not be indicated anywhere, i.e., labs could exchange on planned models, but measurement results in test reports (or any other format document) should not show any model related information.  **Issue 2-2-3: FR1 MIMO OTA TRMS requirements development**  This issue depends on the outcome of issue 2-1-2. This proposal can be further discussed if one MU is adopted for issue 2-1-2. |
| Qualcomm | **Issue 2-2-1: Framework for FR1 MIMO OTA performance test campaign**  Share the same view as Samsung. PC3 should be removed. UEs for n41, n78 and n79 support PC2. |
| Xiaomi | **Issue 2-2-1: Framework for FR1 MIMO OTA performance test campaign**  Support the proposal.  **Issue 2-2-2: How to avoid the same UE model measured in several labs**  Support the proposal 2. |
| CAICT | **Issue 2-2-1: Framework for FR1 MIMO OTA performance test campaign**  We support the proposal as proponent.  Regarding [85%] threshold, we think the value is a key issue to define the performance requirements and we are open to further discuss. But 95% threshold means almost all the Ues can pass the requirements, we have a concern that whether such requirements would be beneficial to the industry.  Regarding PC3, the intention is not to limit the power class to PC3 only, but to encourage labs to concentrate on the same power class such that test resources can be utilized efficiently. Considering it was agreed that PC3 is the 1st priority in 3GPP RAN4 #97-e meeting (WF R4-2017585), the sub-bullet 3e can be refined as below. Further comments are welcome.  3e. Power Class: focus on PC3; test results for other power classes are not precluded, if companies have interests.  **Issue 2-2-2: How to avoid the same UE model measured in several labs**  Support the proposals.  **Issue 2-2-3: FR1 MIMO OTA TRMS requirements development**  Thank OPPO for the proposal, but maybe there are some difficulties to apply the procedure in practice. For example, for PAD\_1, the gaps among the labs are less than 0.5MU, but for PAD\_2, the gaps among the labs are larger than 0.5MU. It will be easier to discuss the proposal when PAD test results from some labs are obtained. |
| MediaTek | **Issue 2-2-1: Framework for FR1 MIMO OTA performance test campaign**  We have no special concern on the proposal.  **Issue 2-2-2: How to avoid the same UE model measured in several labs**  We have no special concern on the proposals.  **Issue 2-2-3: FR1 MIMO OTA TRMS requirements development**  Fine for the proposal |
| CMCC | **Issue 2-2-1: Framework for FR1 MIMO OTA performance test campaign**  Support the proposal. |
| Apple | **Issue 2-2-1: Framework for FR1 MIMO OTA performance test campaign**  Support the proposal  **Issue 2-2-2: How to avoid the same UE model measured in several labs**  We don’t support any attempt to identify devices test on aligned labs.  It seems that any proposal that somehow identify the UE being tested in each lab contradicts the guidance of device being anonymous as proposed n 2-2-1 (5c). Due the limited number of devices available and corresponding banding, cross-referencing a lab provided device list with published data might be possible to estimate a probable device identity and ranking.  In the attempt to provide as much statistically relevant data as possible, it seems natural that labs will test same devices models. Also, is expected that aligned labs will produce equivalent results while testing the same device model, therefore no skewed results should be seeing when analysing the complete pool of data.  **Issue 2-2-3: FR1 MIMO OTA TRMS requirements development**  We agree with Samsung comments: “This issue depends on the outcome of issue 2-1-2. This proposal can be further discussed if one MU is adopted for issue 2-1-2.” |
| vivo | **Issue 2-2-1: Framework for FR1 MIMO OTA performance test campaign**  From my understanding, the CDF percentile value with [85%] in square bracket is just a value as starting point for discussion, further relaxation based on measurement data analysis and other aspects should be considered.  **Issue 2-2-2: How to avoid the same UE model measured in several labs**  For sharing UE model name approach, we share two considerations:   1. if adopted, all the UE model information should be shared to RAN4 reflector finally, we are not ready to accept the information is only shared among small group; 2. if adopted, we prefer that the UE model sharing process can also be anonymous, no mapping between UE model vs test lab. |

Sub topic 2-3 Mechanical mode of FR1 MIMO OTA performance

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| **Company** | **Comments** |
| OPPO | **Issue 2-3: How to treat the mechanical mode in FR1 MIMO OTA performance requirement**  Support the proposal. The primary mechanical mode for foldable phone is FFS. |
| Keysight | **Issue 2-3: How to treat the mechanical mode in FR1 MIMO OTA performance requirement**  Ideally, the requirements should be met in all mechanical modes to avoid very poor performance, especially for modes support voice calls. However, for MIMO OTA, it seems reasonable to focus on just a single mode. It should be captured though that the primary mechanical mode shall be declared by the manufacturer. |
| Samsung | **Issue 2-3: How to treat the mechanical mode in FR1 MIMO OTA performance requirement**  Support the proposal as proponent, also support Keysight proposal that the primary mechanical mode shall be declared by the manufacturer. We are open for further discussion on this issue including foldable phone as OPPO commented. |
| Xiaomi | **Issue 2-3: How to treat the mechanical mode in FR1 MIMO OTA performance requirement**  Support the proposal. |
| MediaTek | **Issue 2-3: How to treat the mechanical mode in FR1 MIMO OTA performance requirement**  Support the proposal. |
| Apple | **Issue 2-3: How to treat the mechanical mode in FR1 MIMO OTA performance requirement**  Support proposal, should add the clarification on the need of manufacturer declaration of primary mechanical mode definition |
| vivo | **Issue 2-3: How to treat the mechanical mode in FR1 MIMO OTA performance requirement**  Support the proposal. Manufacturer declaration is needed. |
| AT&T | **Issue 2-3: How to treat the mechanical mode in FR1 MIMO OTA performance requirement**  We support the proposal and agree with the comments that a manufacturer declaration of primary mechanical mode is required. |

Sub topic 2-4 FR2 MIMO OTA performance requirements

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| **Company** | **Comments** |
| Huawei, HiSilicon | **Issue 2-4-1: How to calculate the sensitivity values by simulation SNR**  We prefer to use EIS.  **Issue 2-4-2: How to evaluate the offset of equivalent SNR due to the non-ideal factors**  The proposal is agreeable.  **Issue 2-4-3: FR2 MIMO OTA simulation results for 36 test directions**  We also propose the simulation results for 36 test direction in R4-2205002*,* whichCCDF/CDF curve mainly depends on the antenna array design. Both simulation results need to be covered. In addition, requirements should be solely be based on simulation results. Measurement results need to be take into account too. |
| OPPO | **Issue 2-4-1: How to calculate the sensitivity values by simulation SNR**  **Issue 2-4-2: How to evaluate the offset of equivalent SNR due to the non-ideal factors**  **Issue 2-4-3: FR2 MIMO OTA simulation results for 36 test directions**  We agree to take the simulation results into account when specifying the FR2 MIMO OTA requirement. Beside, the measurement results should also be considered. |
| Samsung | **Issue 2-4-1: How to calculate the sensitivity values by simulation SNR**  EIS requirements includes peak EIS and EIS spherical coverage. When specifying EIS spherical coverage, it was not purely determined by beam pattern but some implementation margin is considered also. So the equation for MIMO sensitivity at direction X in option 1 based on peak EIS maybe overestimates the MIMO sensitivity at spherical directions.  **Issue 2-4-2: How to evaluate the offset of equivalent SNR due to the non-ideal factors**  **Issue 2-4-3: FR2 MIMO OTA simulation results for 36 test directions**  Thanks for the simulations. It is noticed that there is obvious gap between the simulation results from the two contributions. Maybe it is needed to align the simulation results firstly before next step. |
| Qualcomm | **Issue 2-4-1: How to calculate the sensitivity values by simulation SNR**  Prefer option 1 as the start point.  Response to Samsung, the intention of option 1 is to leverage agreed EIS requirements. For the sensitivities at the direction X, it is based on the simulation all the 36 test directions. If we understand correctly, is Samsung suggesting considering additional margin based on the simulation? Is there any proposal? What was the margin considered for EIS spherical coverage in Rel-15?  **Issue 2-4-2: How to evaluate the offset of equivalent SNR due to the non-ideal factors**  **We support option 1. Our point is the information needed for the simulation is also necessary for channel validation. So it would not disclose the probe weights per our understanding.**  **Issue 2-4-3: FR2 MIMO OTA simulation results for 36 test directions**  A question to Huawei, during the simulator calibration progress, Huawei’s results submitted in R4-2200778 is -147.2dBm/Hz at beam peak direction which almost aligned with QC (-149.2dBm/Hz) and MTK (-150.9dBm/Hz) results. While in R4-2205002 submitted in this meeting, the sensitivity at peak direction is around -137dBm/Hz. Can you clarity why there is 10dB gap between results submitted in previous meeting and this meeting. Was there any change on the simulator? |
| Huawei, HiSilicon | The difference is likely from the way channel normalization is done. Does Qualcomm normalize the 36 points individually or to a common value? Perhaps such details need to be captured in the simulation assumptions. |
| MediaTek | **Issue 2-4-1: How to calculate the sensitivity values by simulation SNR**  In principle, we are fine to assume UE performance just like to meet REFSENS and Spherical EIS.  However, for exact simulation formula/method, about “Option1: *MIMO sensitivity at beam peak direction= REFSENS + SNRBB –(-1) (reference SNR for REFSENS) + 3dB (diversity gain)*”. Does the REFSENS is based on **LOS** condition, and MIMO sensitivity is based on **CDL-C** condition, in this case, why we can directly transfer the two factors. Could **Qualcomm** further clarify it?  Currently, we have more confidence on Option2. Of course, some calculation to make GainANT/GainBF etc can just pass REFSENS & spherical EIS are also need some works to meet the concept.  **Issue 2-4-2: How to evaluate the offset of equivalent SNR due to the non-ideal factors**  fine for the proposal  **Issue 2-4-3: FR2 MIMO OTA simulation results for 36 test directions**  Thanks for Qualcomm and Huawei’s contribution. We are still working on this work. May we clarify some details in parallel?  To Qualcomm: the 100%-tile value of 36 points is about 7~8 dB difference compared to fundamental alignment data, does it only related to equal to antenna in UE performance assumption, to align REFSENS requirement?  Similar question to Huawei, the delta seems about 10 dB. |
| Apple | **Issue 2-4-1: How to calculate the sensitivity values by simulation SNR**  Support option 1 with EIS requirements  **Issue 2-4-2: How to evaluate the offset of equivalent SNR due to the non-ideal factors**  Fine with this proposal as starting point  **Issue 2-4-3: FR2 MIMO OTA simulation results for 36 test directions**  We agreed that simulations and measurements needs to be taken into account. It seems that more work needs to be done to converge the simulation results from both contributions before considering its results. |
| Vivo | **Issue 2-4-3: FR2 MIMO OTA simulation results for 36 test directions**  In general, we agree to consider both simulation results and measurements results, under the premise that simulation results are well aligned, and show acceptable gap with measurement data. Currently, concluding specific value for final requirement consideration would be too early. |
| Huawei | **Issue 2-4-3: FR2 MIMO OTA simulation results for 36 test directions**  Feedback to questions from MediaTek:  The difference is related to antenna parameters, types and positions. |
| Samsung | **Issue 2-4-1: How to calculate the sensitivity values by simulation SNR**  Response to Qualcomm:  we are not suggesting considering additional margin based on the simulation, but suggest that the simulation assumption should be aligned with both peak EIS and EIS spherical coverage requirements if going with Option 1. It will overestimate the performance if only relying on peak EIS.  The implementation margin for PC1 spherical coverage is 4dB compared with peak, there is no recorded data for PC3 but implementation margin is also included. |

Sub topic 2-5 MU budget for FR2 MIMO OTA

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| **Company** | **Comments** |
| Keysight | **Issue 2-5: MU budget for FR2 MIMO OTA 3D-MPAC**  Suggest to use Table in Proposal 1 as baseline as it is more complete. Following comments/corrections:   * The ‘details in’ column should be removed as the references are not defined/incorrect * Distribution for mismatch (UID 1) should be actual instead of U-shaped * The MU for the Channel Emulator (UID 5) should be kept as TBD for now * What is the technical justification for [0.23]dB for output level step resolution (UID 8). For FR1, it was agreed to use 0.25dB. |
| Qualcomm | **Issue 2-5: MU budget for FR2 MIMO OTA 3D-MPAC**  We will update the Table in Proposal 1 per Keysight’s comments. For output level step resolution, we are OK to use 0.25dB which is the agreements for FR1. |
| MVG | **Issue 2-5: MU budget for FR2 MIMO OTA 3D-MPAC**  As opposed to FR1 MPAC, the channel emulator outputs will be connected to Radio Head (RH) before the signal from each output is sent to the DUT via the probes. It means the MU from Channel emulator shall include the MU of RHs. If not a new uncertainty contributor for RH shall be in the FR2 MPAC MU.  Support the comments from Keysight about UID5. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| **CR/TP number** | **Comments collection** |
| [**R4-2204948**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204948.zip)  (on FR1 MPAC MU budget) | Keysight: Clause A.2.5 should be revised to indicate that this is a preliminary MU budget, e.g., A.2.5 **Preliminary** MU budget of FR1 MPAC system This clause defines the **preliminary** Measurement uncertainty (MU) budget for FR1 MPAC system, as shown in Table A.2.5-1.  Table A.2.5-1: **Preliminary** Measurement uncertainty budget for FR1 MPAC system |
| MVG: We have a comment on UID13. For this, we are considering the effect of the Quality of the QZ on range reference calibration. During the calibration stage the ref antenna is aligned with the center of the MPAC system setup so only the phi – ripple contributor for position (0,0,0) should be considered. The distribution of this uncertainty term is Actual. |
| Vivo: Thanks for the comments from Keysight and MVG, we are OK to highlight this is just preliminary MU budget for FR1 MIMO OTA which follows the objective description in the WID. This TP is based on the agreement from R4-2200968, so we prefer to keep the preliminary table as it is. We understand many discussions are on-going in RAN5, we prefer RAN5 to take the responsibility to further finetune the value and contributor description in the future to derive the MTSU. |

## 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** | *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*

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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)

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

# Topic #3: TR38.827 maintance

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| **[R4-2204946](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204946.zip)** | vivo | Draft CR to TR38.827:DL power for FR1 and FR2 test procedure |
| **[R4-2204947](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204947.zip)** | vivo | Draft CR to TR38.827:power validation procedure correction |

## Open issues summary

*No open issues. Please comment to section 3.3.2 directly.*

## Companies views’ collection for 1st round

### Open issues

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

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| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2204946**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204946.zip) | samsung: better to change from “[-80dBm/15kHz (or equivalent 77dBm/30kHz)]” to “[-80dBm/15kHz (or equivalent -77dBm/30kHz)]” to avoid duplicated typo in both TR and TS. |
| Vivo: thanks for the comments from Samsung, this will be updated. |
|  |
| [**R4-2204947**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204947.zip) | 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** | *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*

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
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## 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 … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
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**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-211xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-2203576 | Our Status (SGS TW) for the 3GPP RAN4 5G FR1 SA MIMO OTA Lab Alignment Activity | SGS Wireless |  | discussion |
| R4-2203696 | FR1 MIMO OTA Lab Alignment, Channel Model Validation update | Apple, MVG |  | discussion |
| R4-2204089 | On pass or fail criteria for MIMO OTA lab alignment | Huawei Tech.(UK) Co.. Ltd |  | discussion |
| R4-2204499 | On FR2 MIMO OTA requirements | Qualcomm Incorporated |  | discussion |
| R4-2204500 | Summary results for FR2 MIMO OTA | Qualcomm Incorporated |  | discussion |
| R4-2204501 | On preliminary MU assessment for FR2 MIMO OTA | Qualcomm Incorporated |  | discussion |
| R4-2204570 | PDP validation results for CDL-C Uma and reference values for Umi | CMCC |  | discussion |
| R4-2204571 | Discussion on mechanical mode of FR1 MIMO OTA performance | Samsung |  | discussion |
| R4-2204951 | Further views on framework for FR1 MIMO OTA lab alignment activity | vivo |  | discussion |
| R4-2204985 | PDP pass/fail limit for FR1 | OPPO |  | discussion |
| R4-2204986 | Views on how to avoid the same UE model measured in labs | OPPO |  | discussion |
| R4-2204987 | Views on Pass/Fail limit for lab alignment | OPPO |  | discussion |
| R4-2205002 | Discussion FR2 MIMO OTA performance requirements | Huawei,HiSilicon |  | discussion |
| R4-2205003 | Discussion on preliminary MU assessment for FR2 MIMO OTA | Huawei,HiSilicon |  | discussion |
| R4-2205035 | Framework for FR1 MIMO OTA performance test campaign | CAICT, vivo |  | discussion |
| R4-2205036 | Views on PDP reference and pass/fail limits for FR1 MIMO OTA channel model validation | CAICT, SAICT |  | discussion |
| R4-2205130 | On channel model validation | Xiaomi |  | discussion |
| R4-2205131 | On FR1 lab alignment | Xiaomi |  | discussion |
| R4-2205621 | On FR1 Channel Model Validation | Keysight Technologies UK Ltd |  | discussion |
| R4-2204949 | Further views on Pass/Fail limit for FR1 MIMO OTA lab alignment activity | vivo |  | other |
| R4-2205236 | Channel Emulator BW Impact on PDP validation targets and pass/fail | Spirent Communications |  | other |
| R4-2204945 | 3GPP TS 38.151 v0.8.0 | vivo |  | draft TS |
| R4-2204946 | Draft CR to TR38.827:DL power for FR1 and FR2 test procedure | vivo |  | draftCR |
| R4-2204947 | Draft CR to TR38.827:power validation procedure correction | vivo |  | draftCR |
| R4-2204572 | TP to TS 38.151 on FR1 MIMO OTA test parameter | Samsung |  | pCR |
| R4-2204948 | TP to TS38.151 on FR1 MPAC MU budget | vivo |  | pCR |
| R4-2204950 | TP to TS38.151 on channel model validation limits | vivo, CAICT, Spirent |  | pCR |
| R4-2205181 | TP to TS38.151 on FR1 Temporal Correlation Validation – Time domain technique | MVG Industries |  | pCR |

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

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| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-211xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-211xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-211xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

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   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

Contact information

|  |  |  |
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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)