**3GPP TSG-RAN WG4 Meeting # 104-e R4-2214320**

**Electronic Meeting, 15– 26 August 2022**

**Agenda item:** 9.1.4

**Source:** Moderator (CAICT)

**Title:** Email discussion summary for [104-e] [331] NR\_MIMO\_OTA

**Document for:** Information

# Introduction

*Contributions submitted to AI 9.1 NR MIMO OTA WI and AI 4.7 MIMO OTA SI maintenance are captured in this email discussion.*

*The Rel-17 NR MIMO OTA Work Item is scheduled to conclude at the RAN #97-e plenary in Sep. 2022. In the latest SR for NR MIMO OTA WI, there are the following open issues:*

*This is the last RAN4 meeting before the target completion date of the WI. The target of this meeting is to finalize all the remaining open issues and conclude the WI.*

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

* 1st round: discuss open issues and draft CRs.
* 2nd round: agree draft CRs, make decision on the open issues.

It is appreciated that the delegates for this topic put their contact information in the table below.

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|  |  |  |
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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)

# Topic #1: General and Testing methodology maintenance

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2212323**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212323.zip) | CMCC | Channel model validation results for FR2  **Observation 1: The PDP measurement results of two FR2 reference channel models match well with the reference PDP values, proving that the pass/fail limits for PDP is reasonable.**  **Observation 2: The TC measurement results of two FR2 reference channel models match well with the reference TC values, proving that the pass/fail limits for TC is reasonable.**  **Observation 3: The PAS measurement results of two FR2 reference channel models match well with the reference PAS values. Considering PSP is the spatial validation parameter only defined in FR2 and the reference value is determined as the theoretical value rather than the simulation ones, we support that the pass/fail limits can be slightly loose such as the tentative agreement limits.**  **Observation 4: The V/H ratio measurement results of two FR2 reference channel models match well with the reference V/H ratio values, proving that the pass/fail limits for V/H ratio is reasonable.** |
| [**R4-2212568**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212568.zip) | CAICT, SAICT, OPPO | LS on NR MIMO OTA  **Proposal 1: Send a LS on NR MIMO OTA progress to RAN5, CTIA MOSG and CCSA TC9 WG1.** |
| [**R4-2212639**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212639.zip) | CAICT,SAICT | Proposals on concluding NR MIMO OTA WI  **Proposal 1: Remove the square brackets and confirm the maximum downlink RS-EPRE as 80dBm/15kHz (or equivalent -77dBm/30kHz) for FR1 MIMO OTA.**  **Proposal 2: Remove the square brackets in additional criterion. The EUT must meet 90% throughput in 10 of total 12 azimuthal orientations.**  **Proposal 3: Define the same criterion on 90%TP for bands ≥3GHz and bands <3GHz.**  **Proposal 4: Lab that submit PAD measurement results meeting the pass/fail limit in this meeting can be confirmed as FR1 MIMO OTA aligned lab. Close FR1 lab alignment activity in RAN4#104-e meeting.**  **Proposal 5: Make decision on FR1 MIMO OTA performance requirements in this meeting.**  **Proposal 6: A recommended TT value for FR1 MIMO OTA should be discussed in RAN4.**  **Proposal 7: Accept TT=0.5\*MU budget as the recommended TT value of FR1 MIMO OTA.**  **Proposal 8: Decision on how to handle FR2 performance requirements development issues is needed.** |
| [**R4-2213188**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213188.zip) | Huawei,HiSilicon | CR to 38.151 on Channel model validation |
| [**R4-2213190**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213190.zip) | Huawei,HiSilicon | Discussion on FR2 MIMO OTA channel model validation  **Proposal 1: RAN4 agrees the square bracket should be removed.**  Table D.4.2-1: PDP pass/fail limits for FR2 CDL-C UMi channel model validation   |  |  |  | | --- | --- | --- | |  | Power Tolerance | Delay Tolerance | | Paths from 0dB to 10dB | ±1dB | ±6ns | | Paths from 10dB to 30dB | ±5dB | ±6ns | | Paths from 30dB to 40dB | ±10dB | ±6ns |   **Proposal 2: Adopt the same wording for Temporal Correlation pass/fail limits as agreed for FR1.**  **Proposal 3: Considering only one target curve for FR2, tighten the pass/fail limit appropriately.**  We provied two tightened pass/fial limits:  **Proposal 4a: The pass/fail limits for temporal correlation are formed as bands of ±10% of correlation capped at 100% from the target defined in clause D.3.3. Additionally, when the upper bound reaches 20%, the limit stays at 20% and the lower limit drops to 0%. The values defined in Table 2 are introduced into the spec.**  Table 2 pass/fail limits for temporal correlation based on Proposal 4a   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Distance [λ] | X2V Corr. | | Distance [λ] | X2V Corr. | | | Lower | Upper | Lower | Upper | | 0 | 0.9000 | 1.0000 | 2.5 | 0.0769 | 0.2769 | | 0.1 | 0.8929 | 1.0000 | 2.6 | 0.0717 | 0.2717 | | 0.2 | 0.8717 | 1.0000 | 2.7 | 0.0649 | 0.2649 | | 0.3 | 0.8379 | 1.0000 | 2.8 | 0.0564 | 0.2564 | | 0.4 | 0.7937 | 0.9937 | 2.9 | 0.0456 | 0.2456 | | 0.5 | 0.7414 | 0.9414 | 3 | 0.0327 | 0.2327 | | 0.6 | 0.6834 | 0.8834 | 3.1 | 0.0177 | 0.2177 | | 0.7 | 0.6223 | 0.8223 | 3.2 | 0.0011 | 0.2011 | | 0.8 | 0.5601 | 0.7601 | 3.3 | 0.0000 | 0.2000 | | 0.9 | 0.4986 | 0.6986 | 3.4 | 0.0000 | 0.2000 | | 1 | 0.4387 | 0.6387 | 3.5 | 0.0000 | 0.2000 | | 1.1 | 0.3817 | 0.5817 | 3.6 | 0.0000 | 0.2000 | | 1.2 | 0.3284 | 0.5284 | 3.7 | 0.0000 | 0.2000 | | 1.3 | 0.2796 | 0.4796 | 3.8 | 0.0000 | 0.2000 | | 1.4 | 0.2362 | 0.4362 | 3.9 | 0.0000 | 0.2000 | | 1.5 | 0.1984 | 0.3984 | 4 | 0.0000 | 0.2000 | | 1.6 | 0.1667 | 0.3667 | 4.1 | 0.0000 | 0.2000 | | 1.7 | 0.1416 | 0.3416 | 4.2 | 0.0000 | 0.2000 | | 1.8 | 0.1221 | 0.3221 | 4.3 | 0.0000 | 0.2000 | | 1.9 | 0.1081 | 0.3081 | 4.4 | 0.0000 | 0.2000 | | 2 | 0.0987 | 0.2987 | 4.5 | 0.0000 | 0.2000 | | 2.1 | 0.0921 | 0.2921 | 4.6 | 0.0000 | 0.2000 | | 2.2 | 0.0879 | 0.2879 | 4.7 | 0.0000 | 0.2000 | | 2.3 | 0.0844 | 0.2844 | 4.8 | 0.0000 | 0.2000 | | 2.4 | 0.0812 | 0.2812 | 4.9 | 0.0000 | 0.2000 | |  |  |  | 5 | 0.0000 | 0.2000 |   **Proposal 4b: The pass/fail limits for temporal correlation are formed as bands of ±10% of correlation capped at 100% from the target defined in clause D.3.3, and the lower limit drops to 0%. The values defined in Table 3 are introduced into the spec.**  Table 3 pass/fail limits for temporal correlation based on Proposal 4a   |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | | Distance [λ] | X2V Corr. | | Distance [λ] | X2V Corr. | | | Lower | Upper | Lower | Upper | | 0 | 0.9000 | 1.0000 | 2.5 | 0.0769 | 0.2769 | | 0.1 | 0.8929 | 1.0000 | 2.6 | 0.0717 | 0.2717 | | 0.2 | 0.8717 | 1.0000 | 2.7 | 0.0649 | 0.2649 | | 0.3 | 0.8379 | 1.0000 | 2.8 | 0.0564 | 0.2564 | | 0.4 | 0.7937 | 0.9937 | 2.9 | 0.0456 | 0.2456 | | 0.5 | 0.7414 | 0.9414 | 3 | 0.0327 | 0.2327 | | 0.6 | 0.6834 | 0.8834 | 3.1 | 0.0177 | 0.2177 | | 0.7 | 0.6223 | 0.8223 | 3.2 | 0.0011 | 0.2011 | | 0.8 | 0.5601 | 0.7601 | 3.3 | 0.0000 | 0.1829 | | 0.9 | 0.4986 | 0.6986 | 3.4 | 0.0000 | 0.1638 | | 1 | 0.4387 | 0.6387 | 3.5 | 0.0000 | 0.1449 | | 1.1 | 0.3817 | 0.5817 | 3.6 | 0.0000 | 0.1272 | | 1.2 | 0.3284 | 0.5284 | 3.7 | 0.0000 | 0.1121 | | 1.3 | 0.2796 | 0.4796 | 3.8 | 0.0000 | 0.1023 | | 1.4 | 0.2362 | 0.4362 | 3.9 | 0.0000 | 0.1079 | | 1.5 | 0.1984 | 0.3984 | 4 | 0.0000 | 0.1104 | | 1.6 | 0.1667 | 0.3667 | 4.1 | 0.0000 | 0.1083 | | 1.7 | 0.1416 | 0.3416 | 4.2 | 0.0000 | 0.1026 | | 1.8 | 0.1221 | 0.3221 | 4.3 | 0.0000 | 0.1095 | | 1.9 | 0.1081 | 0.3081 | 4.4 | 0.0000 | 0.1235 | | 2 | 0.0987 | 0.2987 | 4.5 | 0.0000 | 0.1397 | | 2.1 | 0.0921 | 0.2921 | 4.6 | 0.0000 | 0.1572 | | 2.2 | 0.0879 | 0.2879 | 4.7 | 0.0000 | 0.1738 | | 2.3 | 0.0844 | 0.2844 | 4.8 | 0.0000 | 0.1890 | | 2.4 | 0.0812 | 0.2812 | 4.9 | 0.0018 | 0.2018 | |  |  |  | 5 | 0.0109 | 0.2019 |   **Proposal 5: RAN4 agrees the square bracket should be removed: The cross-polarization ratio pass/fail limit is specified as ±1.5 dB.**  **Proposal 6:** **RAN4 agrees the square bracket should be removed: The PSP pass/fail limit is specified as 84%.**  **Observation 1: Huawei, Hisilicon measurement results for FR2 CDL-C UMi channel model matches with the reference values.** |
| [**R4-2213189**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213189.zip) | Huawei,HiSilicon | CR to 38.151 on Validation Passfail limit |
| [**R4-2211826**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211826.zip) | Keysight Technologies UK Ltd, vivo, Samsung, CAICT | Draft CR to update Number of HARQ Processes |
| [**R4-2211827**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211827.zip) | Keysight Technologies UK Ltd, vivo, Samsung, CAICT | Draft CR to update Number of HARQ Processes |
| **[R4-2211987](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211987.zip)** | Samsung | Draft CR to TS 38.151 on editorial correction |

## 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 LS on NR MIMO OTA progress

*Moderator’s note: An LS is prepared in* *R4-2212568 on NR MIMO OTA progress to RAN5, CTIA MOSG and CCSA TC9 WG1.*

**Issue 1-1: LS on NR MIMO OTA progress**

* Proposal (CAICT, SAICT, OPPO)
  + Send an LS on NR MIMO OTA progress to RAN5, CTIA MOSG and CCSA TC9 WG1.
* Recommended WF
  + Companies are invited to share views, the LS can be updated according to the discussion outcomes. The target is to approve the LS.

### Sub-topic 1-2 FR2 channel model validation results

**Issue 1-2-1: FR2 channel model validation results**

*Moderator’s note: CMCC (R4-2212323) and Huawei, Hisilicon (R4-2213190) submitted their FR2 channel model validation results.*

* Recommended WF
  + Comments are welcome.

**Issue 1-2-2: Draft CR on channel model validation**

*Moderator: Companies are invited to comment directly in the CR comments collection part, i.e., section 1.3.2.*

### Sub-topic 1-3 Pass/fail limits for FR2 channel model validation

**Issue 1-3-1: PDP** **pass/fail limits for FR2 channel model validation**

* Proposal (Huawei, Hisilicon):
  + RAN4 agrees the square bracket should be removed.

Table D.4.2-1: PDP pass/fail limits for FR2 CDL-C UMi channel model validation

|  |  |  |
| --- | --- | --- |
|  | Power Tolerance | Delay Tolerance |
| Paths from 0dB to 10dB | ±1dB | ±6ns |
| Paths from 10dB to 30dB | ±5dB | ±6ns |
| Paths from 30dB to 40dB | ±10dB | ±6ns |

* Recommended WF
  + Companies are invited to share views. Conclude this issue in 1st round.

**Issue 1-3-2: Wording of the Temporal Correlation pass/fail limits for FR2**

* Proposals
  + Option 1 (Huawei, Hisilicon): Adopt the same wording for Temporal Correlation pass/fail limits as agreed for FR1, i.e.,
    - The pass/fail limits for temporal correlation are formed as bands of ±10% of correlation capped at 100% from the target defined in clause D.3.3. Additionally, when the upper bound reaches 30%, the limit stays at 30% and the lower limit drops to 0%.
  + Option 2 (The current wording for FR2 in TS 38.151): The pass/fail limits for theoretical temporal correlation defined in Clause D.3.3 above [0.3] are formed as bands of [±10%] of correlation capped at 100% at the high end. Additionally, when the theoretical temporal correlation drops below [0.3], the limits are formed at bands of [±30%] of correlation capped at 0% at the low end.
* Recommended WF
  + Companies are invited to share views. Conclude this issue in 1st round.

**Issue 1-3-3: Tighten the Temporal Correlation pass/fail limits for FR2**

* Proposal 1 (Huawei, Hisilicon): Considering only one target curve for FR2, tighten the pass/fail limit appropriately. Two candidate tightened pass/fail limits are provided:
  + Proposal 1a: The pass/fail limits for temporal correlation are formed as bands of ±10% of correlation capped at 100% from the target defined in clause D.3.3. Additionally, when the upper bound reaches 20%, the limit stays at 20% and the lower limit drops to 0%. The values defined in Table 2 in R4-2213190 are introduced into the spec.
  + Proposal 1b: The pass/fail limits for temporal correlation are formed as bands of ±10% of correlation capped at 100% from the target defined in clause D.3.3, and the lower limit drops to 0%. The values defined in Table 3 in R4-2213190 are introduced into the spec.
* Proposal 2 (Moderator): Keep the temporal correlation pass/fail limits the same for FR1 and FR2, i.e., not to tighten the temporal correlation pass/fail limits for FR2.
* Recommended WF
  + Companies are invited to share views. Conclude this issue in 1st round.

**Issue 1-3-4: Cross-polarization (V/H) pass/fail limits for FR2 channel model validation**

* Proposal (Huawei, Hisilicon):
  + RAN4 agrees the square bracket should be removed: The cross-polarization ratio pass/fail limit is specified as ±1.5 dB.
* Recommended WF
  + Companies are invited to share views. Conclude this issue in 1st round.

**Issue 1-3-5: PSP pass/fail limits for FR2 channel model validation**

* Proposal (Huawei, Hisilicon):
  + RAN4 agrees the square bracket should be removed: The PSP pass/fail limit is specified as 84%.
* Recommended WF
  + Companies are invited to share views. Conclude this issue in 1st round.

**Issue 1-3-6: Draft CR on channel model validation pass/fail limits**

*Moderator: Companies are invited to comment directly in the CR comments collection part, i.e., section 1.3.2. The draft CR can be updated according to discussion outcomes of Sub-topic 1-3.*

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1 LS on NR MIMO OTA progress

|  |  |
| --- | --- |
| **Company** | **Comments** |
| CAICT | **Issue 1-1: LS on NR MIMO OTA progress**  Support as proponent. The LS can be updated based on discussion outcomes of this meeting. |
| Samsung | **Issue 1-1: LS on NR MIMO OTA progress**  Support the recommended WF from moderator. |
| Apple | **Issue 1-1: LS on NR MIMO OTA progress**  Support the proposal to send LS on NR MIMO OTA progress to RAN5, CTIA MOSG and CCSA TC9 WG1 |
| Xiaomi | **Issue 1-1: LS on NR MIMO OTA progress**  OK to send the LS. |
| OPPO | **Issue 1-1: LS on NR MIMO OTA progress**  Support the proposal, and update the LS based on the discussion outcomes. |

Sub topic 1-2 FR2 channel model validation results

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | **Issue 1-2-1: FR2 channel model validation results**  Many thanks to CMCC and Huawei for sharing the measurement results. The validation data is well aligned with the reference value, which provides a good example for FR2 MIMO OTA. |
| OPPO | **Issue 1-2-1: FR2 channel model validation results**  Thanks for sharing the measurement results. Good alignment is achieved between labs and the reference. To best understand the alignment results, it is appreciated if the following information can be provided by CMCC and Huawei, i.e. which test method is used, DFF or IFF? What is the measurement distance from the center of test zone to the measurement probe? |

Sub topic 1-3 Pass/fail limits for FR2 channel model validation

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei,  Hisilicon | **Issue 1-3-1: PDP pass/fail limits for FR2 channel model validation**  From CMCC and Huawei measurement results, the square bracket can be removed.  **Issue 1-3-2: Wording of the Temporal Correlation pass/fail limits for FR2**  As a proponent on Option 1, we just want to align with the same wording for Temporal Correlation pass/fail limits as agreed for FR1. **Issue 1-3-3: Tighten the Temporal Correlation pass/fail limits for FR2**  Prefer Option1:  FR1 has six target curves including CDL-C UMa beam 1 at ≤ 2.5 GHz, CDL-C UMa beam 2 at ≤ 2.5 GHz, CDL-C UMa beam 2 at ≤ 2.5 GHz, CDL-C UMa beam 2 at > 2.5 GHz, CDL-C UMi beam 1 at ≤ 2.5 GHz and CDL-C UMi beam 1 at > 2.5 GHz to measure, which drives loose restrictions, yet FR2 only has one target curve for CDL-C UMi. It may be necessary to tighten the pass/fail limit appropriately.**Issue 1-3-4: Cross-polarization (V/H) pass/fail limits for FR2 channel model validation**  From CMCC and Huawei measurement results, the square bracket can be removed.  **Issue 1-3-5: PSP pass/fail limits for FR2 channel model validation**  From CMCC and Huawei measurement results, the square bracket can be removed. |
| CAICT | **Issue 1-3-1: PDP pass/fail limits for FR2 channel model validation**  Support the proposal to remove the square brackets.  **Issue 1-3-2: Wording of the Temporal Correlation pass/fail limits for FR2**  Support Option 1. We prefer the same wording with that for FR1.  **Issue 1-3-3: Tighten the Temporal Correlation pass/fail limits for FR2**  Support Proposal 2, not to tighten the TC pass/fail limits for FR2. The TC pass/fail limits for FR1 should not be tighter than those for FR1.  **Issue 1-3-4: Cross-polarization (V/H) pass/fail limits for FR2 channel model validation**  Support the proposal to remove the square brackets.  **Issue 1-3-5: PSP pass/fail limits for FR2 channel model validation**  Support the proposal to remove the square brackets. |
| Spirent | **Issue 1-3-3: Tighten the Temporal Correlation pass/fail limits for FR2**  Support Proposal 2 |
| vivo | **Issue 1-3-2: Wording of the Temporal Correlation pass/fail limits for FR2**  Option 1 is OK for us.  **Issue 1-3-3: Tighten the Temporal Correlation pass/fail limits for FR2**  Support Proposal 2. In general, we do not object tightening the pass/fail limits, but we tend to further collect more validation results before making this decision. |
| Keysight Technologies | **Issue 1-3-1: PDP pass/fail limits for FR2 channel model validation**  KS believes that tighter pass/fail limits could be applied but for the sake of progress we can agree to these limits.  **Issue 1-3-2: Wording of the Temporal Correlation pass/fail limits for FR2**  We prefer replacing all percentages with decimal values, i.e., Option 3:  Option 3 (modify the current wording for FR2 in TS 38.151): The pass/fail limits for theoretical temporal correlation defined in Clause D.3.3 above 0.3 are formed as bands of ±0.1 of correlation capped at 1 at the high end. Additionally, when the theoretical temporal correlation drops below 0.3, the limits are formed at bands of ±0.3 of correlation capped at 0 at the low end.  **Issue 1-3-3: Tighten the Temporal Correlation pass/fail limits for FR2**  We support tightening the limits  **Issue 1-3-4: Cross-polarization (V/H) pass/fail limits for FR2 channel model validation**  We support the proposal |
| OPPO | **Issue 1-3-1: PDP pass/fail limits for FR2 channel model validation**  Support to remove the square brackets.  **Issue 1-3-2: Wording of the Temporal Correlation pass/fail limits for FR2**  We slightly prefer Option 3 provided by Keysight.  **Issue 1-3-3: Tighten the Temporal Correlation pass/fail limits for FR2**  Support Proposal 2.  **Issue 1-3-4: Cross-polarization (V/H) pass/fail limits for FR2 channel model validation**  Support to remove the square brackets.  **Issue 1-3-5: PSP pass/fail limits for FR2 channel model validation**  Support to remove the square brackets. |
| Huawei,  Hisilicon | **Issue 1-3-2: Wording of the Temporal Correlation pass/fail limits for FR2**  We are fine with Keysight’s wording for FR2:  The pass/fail limits for theoretical temporal correlation defined in Clause D.3.3 above 0.3 are formed as bands of ±0.1 of correlation capped at 1 at the high end. Additionally, when the theoretical temporal correlation drops below 0.3, the limits are formed at bands of ±0.3 of correlation capped at 0 at the low end.  And the same wording should also be applied for FR1:  The pass/fail limits for theoretical temporal correlation defined in Clause C.3.3 above 0.3 are formed as bands of ±0.1 of correlation capped at 1 at the high end. Additionally, when the theoretical temporal correlation drops below 0.3, the limits are formed at bands of ±0.3 of correlation capped at 0 at the low end.  The wording for FR1 and FR2 can be merged into our draft CR.  **Issue 1-3-3: Tighten the Temporal Correlation pass/fail limits for FR2**  From CMCC and Huawei measurement results, we can find too much room between the current limit and measurement results. We propose to revise the limit based on Issue 1-3-2 from 0.3 to 0.2. |

### 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** |
| R4-2213188 (on Channel model validation) | Moderator: The Tdoc number mismatched with the draft CR. Please the source company to correct it after 1st round, and update the draft CR based on the 1st round discussion outcomes if applicable. |
| Company B |
|  |
| R4-2213189 (on Validation Passfail limit) | Moderator: The Tdoc number mismatched with the draft CR. Please the source company to revise it after 1st round, and update the draft CR based on the 1st round discussion outcomes if applicable. |
| Company B |
|  |
| R4-2211826, R4-2211827 (to 38.151 and 38.827, update Number of HARQ Processes) | Company A |
| Company B |
|  |
| R4-2211987 (on editorial correction) | CAICT: Thanks for the editorial corrections. We support the draft CR. |
| 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 1-1 LS on NR MIMO OTA progress** | **Issue 1-1: LS on NR MIMO OTA progress**  *5 companies commented this issue and all supported the proposal.*  *Agreement:*   * Send an LS on NR MIMO OTA progress to RAN5, CTIA MOSG and CCSA TC9 WG1.   *Recommendations for 2nd round:*   * Update the LS based on the discussion outcomes of this meeting. * Review and approve the revised LS. |
| **Sub-topic 1-2 FR2 channel model validation results** | **Issue 1-2-1: FR2 channel model validation results**  *Thanks for the measurement results and comments. Given that this is the last meeting of the WI, this issue can be closed.*  *Recommendations for 2nd round:*   * No further discussion   **Issue 1-2-2: Draft CR on channel model validation**  *There’s no comments on the content of the draft CR.* *After correcting the Tdoc number, this draft CR can be agreed.*  *Recommendations for 2nd round:*   * Agree with the revised draft CR. |
| **Sub-topic 1-3 Pass/fail limits for FR2 channel model validation** | **Issue 1-3-1: PDP pass/fail limits for FR2 channel model validation**  *Companies supported the proposal. There’s no objection.*  *Agreement:*   * Remove the square brackets in Table D.4.2-1, as shown below.   Table D.4.2-1: PDP pass/fail limits for FR2 CDL-C UMi channel model validation   |  |  |  | | --- | --- | --- | |  | Power Tolerance | Delay Tolerance | | Paths from 0dB to 10dB | ±1dB | ±6ns | | Paths from 10dB to 30dB | ±5dB | ±6ns | | Paths from 30dB to 40dB | ±10dB | ±6ns |   *Recommendations for 2nd round:*   * Capture the agreement in WF.   **Issue 1-3-2: Wording of the Temporal Correlation pass/fail limits for FR2**  *After the discussion, the following tentative agreements should be agreeable.*  *Tentative Agreements:*   * Adopt the following wording of the Temporal Correlation pass/fail limits for FR1:   + The pass/fail limits for theoretical temporal correlation defined in Clause C.3.3 above 0.3 are formed as bands of ±0.1 of correlation capped at 1 at the high end. Additionally, when the theoretical temporal correlation drops below 0.3, the limits are formed at bands of ±0.3 of correlation capped at 0 at the low end. * Adopt the following wording of the Temporal Correlation pass/fail limits for FR2:   + The pass/fail limits for theoretical temporal correlation defined in Clause D.3.3 above 0.3 are formed as bands of ±0.1 of correlation capped at 1 at the high end. Additionally, when the theoretical temporal correlation drops below 0.3, the limits are formed at bands of ±0.3 of correlation capped at 0 at the low end.   *Recommendations for 2nd round:*   * Further check if the tentative agreements are agreeable. * Capture the agreement in WF.   **Issue 1-3-3: Tighten the Temporal Correlation pass/fail limits for FR2**  *6 companies commented this issue. 4 companies (CAICT, Spirent, vivo, OPPO) prefer not to tighten the Temporal Correlation pass/fail limits, 2 companies (Huawei, Keysight) support to tighten the limits. Considering it is the last meeting for the WI, and few validation results are available, it is recommended to keep the current pass/fail limit as it is, and it is not excluded to further tighten this value (if necessary) when more validation results are obtained.*  *Tentative Agreements:*   * Keep the temporal correlation pass/fail limits the same for FR1 and FR2, i.e., not to tighten the temporal correlation pass/fail limits for FR2. * It is not excluded to further tighten this value (if necessary) when more validation results are obtained.   *Recommendations for 2nd round:*   * Further check if the tentative agreements are agreeable. * Capture the agreement in WF.   **Issue 1-3-4: Cross-polarization (V/H) pass/fail limits for FR2 channel model validation**  *Companies supported the proposal. There’s no objection.*  *Agreement:*   * Remove the square brackets. The cross-polarization ratio pass/fail limit is specified as ±1.5 dB.   *Recommendations for 2nd round:*   * Capture the agreement in WF.   **Issue 1-3-5: PSP pass/fail limits for FR2 channel model validation**  *Companies supported the proposal. There’s no objection.*  *Agreement:*   * Remove the square brackets. The PSP pass/fail limit is specified as 84%.   *Recommendations for 2nd round:*   * Capture the agreement in the WF.   **Issue 1-3-6: Draft CR on channel model validation pass/fail limits**  *Recommendations for 2nd round:*   * Revise the draft CR based on the discussion outcomes of this sub-topic. * Review and agree with the revised draft CR. |

### 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”* |
| R4-2213188 (on Channel model validation) | *to be revised* |
| R4-2213189 (on Validation Passfail limit) | *to be revised* |
| R4-2211826, R4-2211827 (to 38.151 and 38.827, update Number of HARQ Processes) | *agreeable* |
| R4-2211987 (on editorial correction) | *agreeable* |

## Discussion on 2nd round

### Sub-topic 1-1 LS on NR MIMO OTA progress

**Issue 1-1: LS on NR MIMO OTA progress**

*Agreement:*

* Send an LS on NR MIMO OTA progress to RAN5, CTIA MOSG and CCSA TC9 WG1.

*Recommendations for 2nd round:*

* Update the LS based on the discussion outcomes of this meeting.
* Review and approve the revised LS.

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| **Company** | **Comments** |
| OPPO | Support the revised LS. |
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### Sub-topic 1-3 Pass/fail limits for FR2 channel model validation

**Issue 1-3-2: Wording of the Temporal Correlation pass/fail limits for FR2**

*Tentative Agreements:*

* Adopt the following wording of the Temporal Correlation pass/fail limits for FR1:
  + The pass/fail limits for theoretical temporal correlation defined in Clause C.3.3 above 0.3 are formed as bands of ±0.1 of correlation capped at 1 at the high end. Additionally, when the theoretical temporal correlation drops below 0.3, the limits are formed at bands of ±0.3 of correlation capped at 0 at the low end.
* Adopt the following wording of the Temporal Correlation pass/fail limits for FR2:
  + The pass/fail limits for theoretical temporal correlation defined in Clause D.3.3 above 0.3 are formed as bands of ±0.1 of correlation capped at 1 at the high end. Additionally, when the theoretical temporal correlation drops below 0.3, the limits are formed at bands of ±0.3 of correlation capped at 0 at the low end.

*Recommendations for 2nd round:*

* Further check if the tentative agreements are agreeable.
* Capture the agreement in WF.

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| **Company** | **Comments** |
| OPPO | Support the tentative agreements. |
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**Issue 1-3-3: Tighten the Temporal Correlation pass/fail limits for FR2**

*Tentative Agreements:*

* Keep the temporal correlation pass/fail limits the same for FR1 and FR2, i.e., not to tighten the temporal correlation pass/fail limits for FR2.
* It is not excluded to further tighten this value (if necessary) when more validation results are obtained.

*Recommendations for 2nd round:*

* Further check if the tentative agreements are agreeable.
* Capture the agreement in WF.

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| --- | --- |
| **Company** | **Comments** |
| OPPO | Support the tentative agreements. |
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### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| Rev. of R4-2213188 (on Channel model validation) | Moderator: *In 1st round, there’s no comments on the content of the draft CR. After correcting the Tdoc number, this draft CR can be agreed.* |
| Company B |
|  |
| Rev. of R4-2213189 (on Validation Pass/fail limits) | Company A |
| Company B |
|  |

# Topic #2: FR1 Performance requirements

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **[R4-2212639](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212639.zip)** | CAICT,SAICT | Proposals on concluding NR MIMO OTA WI  **Proposal 1: Remove the square brackets and confirm the maximum downlink RS-EPRE as 80dBm/15kHz (or equivalent -77dBm/30kHz) for FR1 MIMO OTA.**  **Proposal 2: Remove the square brackets in additional criterion. The EUT must meet 90% throughput in 10 of total 12 azimuthal orientations.**  **Proposal 3: Define the same criterion on 90%TP for bands ≥3GHz and bands <3GHz.**  **Proposal 4: Lab that submit PAD measurement results meeting the pass/fail limit in this meeting can be confirmed as FR1 MIMO OTA aligned lab. Close FR1 lab alignment activity in RAN4#104-e meeting.**  **Proposal 5:** **Make decision on FR1 MIMO OTA performance requirements in this meeting.**  **Proposal 6: A recommended TT value for FR1 MIMO OTA should be discussed in RAN4.**  **Proposal 7: Accept TT=0.5\*MU budget as the recommended TT value of FR1 MIMO OTA.**  **Proposal 8: Decision on how to handle FR2 performance requirements development issues is needed.** |
| **[R4-2211560](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211560.zip)** | Huawei Tech.(UK) Co.. Ltd | On MIMO OTA FR1 lab alignment criteria  **Proposal 1**: keep the current lab alignment criteria unchanged at 0.75\*MU. |
| **[R4-2211996](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211996.zip)** | Huawei Tech.(UK) Co.. Ltd | FR1 MIMO OTA Test Campaign results from Huawei |
| **[R4-2212406](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212406.zip)** | Apple | MIMO OTA lab alignment results  **Observation 1**  The PAD\_n78\_3 from vivo was delivered on 08/09/22, one day before the contribution submission deadline. Despite our efforts the data-set could not be collect on time for this contribution. It will be provided later as a revision.  **Observation 2**  The PAD\_n41\_3 from OPPO despite several test attempts, had unstable performance during our evaluation and will not be included in this contribution. Apple proactively contacted the 3GPP and OPPO to report this situation and tried a mitigation solution. OPPO hypothesized that the device could had registered in a US local network, therefore changing some of its configurations. We proposed to master reset the device, OPPO didn’t recommend indicating that some function settings would became invalid. |
| **[R4-2212407](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212407.zip)** | Apple | MIMO OTA device measurement results and requirement proposal  **Observation 1**  HW/SW/FW dedicated to FR1 MIMO OTA test systems are still being refined or under final stages of development. 3GPP RAN4 lab alignment initiative is the first coordinated attempt on better understanding how FR1 MIMO devices can have radiated performance requirement evaluated across different test systems.  **Observation 2**  Multi-band devices with complex RF front end, TAS, etc. Can be penalized by additional RF front-end insertion losses.  **Observation 3**  The passing rate computed from the means of each UE type's TRMS distribution overestimates the passing rate computed from the actual population. By defining a manufacturing tolerance, which is used to relax the population pass/fail limit, a similar passing rate as expected from the average TRMS statistics can be obtained.  **Proposal 1**  FR1 MIMO OTA test systems are still being refined or under final stages of development, a performance requirement based on 95% passing rate is proposed.  **Proposal 2**  Define a manufacturing tolerance, which is used to relax the population pass/fail limit, a similar passing rate as expected from the average TRMS statistics can be obtained.  **Proposal 3**  UEs supporting multiple bands must pass the OTA requirements for all applicable bands in order to achieve certification and by introducing the evaluation of a joint band passing rate (JBPR) based on the comparison of the potential requirements against the measured OTA performances over a selected set of bands and evaluating the ratio of the number of passed UEs over the total number of UEs. |
| [**R4-2212640**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212640.zip) | CAICT | Proposals on FR1 MIMO OTA performance requirements  **Proposal 1: Adopt 80% percentile values in CDF curves to specify FR1 MIMO OTA TRMS requirements.**  **Proposal 2: Approve the values in the following table as FR1 MIMO OTA TRMS requirements for n41 and n78 bands.**   |  |  |  | | --- | --- | --- | | **Operating Band** |  | **TRMSaverage,70 [dBm/30kHz]** | | n41 |  | -95 | | n78 |  | -97 | |
| [**R4-2212641**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212641.zip) | CAICT | draft CR to TS38.151 on minimum requirements |
| R4-2212642 (reserved) | CAICT | Summary of FR1 MIMO OTA lab alignment results |
| [**R4-2212819**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212819.zip) | vivo | Views on Test Tolerance for FR1 MIMO OTA  **Proposal 1: RAN4 to provide recommendations to RAN5 on test tolerance values for FR1 MIMO OTA.**  **Proposal 2: Consider the following options to define TT values for FR1 MIMO OTA TRMS:**   * **Option 1:** Define TT=0.5\* MU budget, i.e. 1.5dB for ≤3GHz, and 1.7 dB for >3GHz. * **Option 2:** Define TT values as the same as lab alignment pass/fail limit [0.75\*MU], i.e. 2.3dB for ≤3GHz, and 2.5dB for >3GHz. * **Option 3:** TT values are not directly driven from assessed MU budget. Values between Option 1 and Option 2.   **Proposal 3: Optimization of the MU assessment can be done in the RAN5 but the TT values for FR1 MIMO OTA TRMS shall not be further impacted.** |
| R4-2212820 (reserved) | vivo | Proposals on FR1 MIMO OTA requirements |
| [**R4-2212828**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212828.zip) | vivo | draft CR to TS38.151 on MIMO OTA requirements |
| [**R4-2213197**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213197.zip) | Xiaomi | on the performance requirement for FR1 MIMO OTA  **Observation: For LTE MIMO OTA band 5, the requirement corresponds to the 95% of the CDF.**  **Proposal: To re-use the 95% percentile of the CDF as LTE MIMO OTA requirement for MIMO OTA FR1 requirement.** |
| [**R4-2213204**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213204.zip) | Xiaomi | test result for FR1 performance requirement |
| [**R4-2213422**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213422.zip) | OPPO | Lab alignment and requirement for FR1 MIMO OTA  ***Observation 1: The measurement offsets of 5 aligned labs are much less than the preliminary MU and even 0.75\*MU.***  ***Proposal 1: Define +/- 0.6\*MU as the pass/fail limit for FR1 MIMO OTA lab alignment, i.e. +/- 1.8 dB for band <3GHz and +/- 2.0 dB for band >3GHz.*** |
| [**R4-2213427**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213427.zip) | OPPO | Views on FR1 MIMO OTA performance requirement  ***Proposal 1: Adopt 80% percentile of CDF curve to define FR1 TRMS requirement.***  ***Proposal 2: The adjustments or relaxations with 80% percentile is needed based on the collected measurement data of commercial devices.*** |
| [**R4-2212644**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212644.zip) | CAICT | draft CR to TS38.151 on maximum downlink power and additional criterion for FR1 MIMO OTA test |

## 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 Figure of Merits for FR1 MIMO OTA

**Issue 2-1-1: Maximum downlink power and additional criterion for FR1 MIMO OTA**

* Proposals:
  + Proposal 1: Remove the square brackets and confirm the maximum downlink RS-EPRE as -80dBm/15kHz (or equivalent -77dBm/30kHz) for FR1 MIMO OTA. (CAICT)
  + Proposal 2: Remove the square brackets in additional criterion. The EUT must meet 90% throughput in 10 of total 12 azimuthal orientations. (CAICT, vivo)
  + Proposal 3: Define the same criterion on 90%TP for bands ≥3GHz and bands <3GHz. (CAICT, vivo)
* Recommended WF
  + Companies are invited to share views. Conclude this issue in 1st round.

**Issue 2-1-2: Draft CR on maximum downlink power and additional criterion for FR1 MIMO OTA test**

*Moderator: Companies are invited to comment directly in the CR comments collection part, i.e., section 2.3.2. The draft CRs can be updated according to discussion outcomes of* *Issue 2-1-1.*

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

*Moderator’s note: In the last meeting, 5 labs have been confirmed as aligned labs. Due to the delay caused by COVID lockdown, the last lab (Apple) is allowed to submit PAD measurement results at this meeting.* *The agreements in the WF R4-2210675 are listed as bellow.*

*In this meeting, Apple submitted some PAD measurement results in R4-2212406.*

**Issue 2-1: FR1 MIMO OTA lab alignment results**

**Agreement:**

* 3GPP FR1 MIMO OTA lab alignment among the 5 labs, i.e., CAICT, CMCC&BUPT, Huawei, MediaTek, and Xiaomi, is confirmed.

**Issue 2-2-1: How to treat late submission of PAD measurement results due to COVID?**

Agreement:

* Confirm the reference values for FR1 MIMO OTA lab alignment as linear average (in dBm) of the PAD measurement results submitted before 30 Apr. 2022 as baseline. If the unfinished volunteer lab submits PAD measurement results before RAN4#104 meeting and the results are not identified as apparent outliers, consider to update the reference values as the average of the PAD measurement results from all the labs.
* RAN4 allows the unfinished volunteer lab to submit PAD measurement results after RAN4#103-e meeting, before RAN4#104-e meeting.
* Labs who submitted data to RAN4#103-e are confirmed as the aligned labs according to the currently agreed reference values and pass/fail limits.

*PAD measurement results from the 6 labs are briefly summarized as below:*

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Device** | **Band** | **TRMS measurement result [dBm/30kHz]** | | | | | | **Average approach** | **Reference value** | **Max-Min deviation** |
| **Lab 1** | **Lab 2** | **Lab 3** | **Lab 4** | **Lab 5** | **Lab 6** |
| PAD\_n41\_1 | n41 | -96.43 | -97.61 | -98.20 | -97.45 | -96.88 | -99.10 | Linear average | -97.61 | 2.67 |
| PAD\_n41\_2 | n41 | -99.30 | -97.80 | -100.02 | -99.96 | -99.62 | -101.43 | -99.69 | 3.63 |
| PAD\_n41\_3 | n41 | -96.31 | -97.39 | -97.81 | -96.53 | -96.74 | -98.59 | -97.23 | 2.28 |
| PAD\_n78\_1 | n78 | -96.02 | -96.54 | -96.44 | -96.10 | -96.53 | -98.38 | -96.67 | 2.36 |
| PAD\_n78\_2 | n78 | -95.42 | -95.95 | -96.11 | -96.48 | -96.66 | -98.97 | -96.60 | 3.55 |
| PAD\_n78\_3 | n78 | -99.06 | -97.42 | -99.53 | -99.08 | -99.54 | NA | -98.93 | 2.12 |
| **Device** | **Band** | **TRMS offset [dBm/30kHz]** | | | | | | **Pass/fail limit** | | |
| **Lab 1** | **Lab 2** | **Lab 3** | **Lab 4** | **Lab 5** | **Lab 6** |
| PAD\_n41\_1 | n41 | 1.18 | 0.00 | -0.59 | 0.16 | 0.73 | -1.49 | +/- 0.75 MU, i.e., +/- 2.25 dB | | |
| PAD\_n41\_2 | n41 | 0.39 | 1.89 | -0.33 | -0.27 | 0.07 | -1.74 |
| PAD\_n41\_3 | n41 | 0.92 | -0.16 | -0.58 | 0.70 | 0.49 | -1.36 |
| PAD\_n78\_1 | n78 | 0.65 | 0.13 | 0.22 | 0.57 | 0.14 | -1.71 | +/- 0.75 MU, i.e., +/- 2.55 dB | | |
| PAD\_n78\_2 | n78 | 1.18 | 0.65 | 0.48 | 0.12 | -0.06 | -2.37 |
| PAD\_n78\_3 | n78 | -0.13 | 1.51 | -0.60 | -0.15 | -0.61 | NA |
| **Lab alignment conclusion** | | **Pass** | **Pass** | **Pass** | **Pass** | **Pass** | **[Pass]** |  |  |  |



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

*Moderator’s note: In the last meeting, the agreements were captured in the WF R4-2210675 as bellow.*

**Issue 2-4: Pass/fail limit for FR1 MIMO OTA lab alignment**

**Agreements:**

* RAN4 confirm the pass/fail limit for FR1 MIMO OTA lab alignment as +/- 0.75MU, i.e. +/- 2.25 dB for band <3GHz and +/- 2.55 dB for band >3GHz.
* RAN4 further discuss a more tightened limit at RAN4#104 meeting, to provide a reasonable guidance for MIMO OTA industry.
* Proposals:
  + Proposal 1: keep the current lab alignment criteria unchanged at 0.75\*MU. (Huawei)
  + Proposal 2: Define +/- 0.6\*MU as the pass/fail limit for FR1 MIMO OTA lab alignment, i.e. +/- 1.8 dB for band <3GHz and +/- 2.0 dB for band >3GHz. (OPPO)
* Recommended WF
  + Companies are invited to share views. Conclude this issue in the 1st round.

**Issue 2-2-2: FR1 MIMO OTA lab alignment outcome**

*Moderator’s note: It is the last meeting before the target completion date of the WI. All the open issues and unfinished activities should be finalized.*

* Proposals:
  + Proposal 1: Lab that submit PAD measurement results meeting the pass/fail limit in this meeting can be confirmed as FR1 MIMO OTA aligned lab. Close FR1 lab alignment activity in RAN4#104-e meeting. (CAICT)
  + Proposal 2: Discuss and make decision on whether the 6 labs can be confirmed as aligned labs in RAN4#104-e meeting. (Moderator)
* Recommended WF
  + Companies are invited to share views. Conclude this issue in 1st round.

### Sub-topic 2-3 FR1 MIMO OTA performance test campaign

**Issue 2-3: TRMS measurement data for** **defining FR1 MIMO OTA performance requirements**

*Moderator’s note: In the last meeting, CAICT (R4-2209330), Xiaomi (R4-2209513), and CMCC (R4-2208413) submitted some measurement data for FR1 MIMO OTA performance requirements. In this meeting, Xiaomi (R4-2213204), Huawei(R4-2211996), and Apple (R4-2212407) submitted more TRMS measurement data.*

*The submitted TRMS measurement data and CDF curves are presented as below. Please note that the measurement results submitted by Apple (to be confirmed as aligned) are also collected in the table for your review:*

**Table 1. Submitted UE TRMS measurement data for n41 band**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No.** | **Band** | **TRMSaverage,70** | **TRMSaverage,90** | **Test lab** |
| 1 | n41 | -101.45 | -100.83 | Huawei |
| 2 | n41 | -101.23 | -99.68 | CMCC&BUPT |
| 3 | n41 | -100.54 | -98.70 | CMCC&BUPT |
| 4 | n41 | -99.99 | -98.43 | CMCC&BUPT |
| 5 | n41 | -99.69 | -98.15 | CMCC&BUPT |
| 6 | n41 | -99.31 | -97.16 | CAICT |
| 7 | n41 | -99.04 | -97.07 | Huawei |
| 8 | n41 | -99.00 | -97.51 | CMCC&BUPT |
| 9 | n41 | -98.14 | -95.95 | CAICT |
| 10 | n41 | -97.42 | -95.28 | CAICT |
| 11 | n41 | -97.06 | -94.95 | Apple |
| 12 | n41 | -97.05 | -94.94 | CAICT |
| 13 | n41 | -96.98 | -95.05 | CMCC&BUPT |
| 14 | n41 | -96.90 | NA | Apple |
| 15 | n41 | -96.80 | -94.59 | CAICT |
| 16 | n41 | -96.77 | NA | Apple |
| 17 | n41 | -95.87 | -93.73 | CAICT |
| 18 | n41 | -95.06 | -92.90 | CAICT |
| 19 | n41 | -95.00 | -92.92 | CAICT |
| 20 | n41 | -94.64 | -93.00 | Xiaomi |
| 21 | n41 | -94.37 | -92.79 | Xiaomi |
| 22 | n41 | -93.92 | -92.29 | Xiaomi |
| 23 | n41 | -93.91 | -92.32 | Xiaomi |
| 24 | n41 | -93.85 | -92.17 | Xiaomi |
| 25 | n41 | -93.74 | -92.12 | Xiaomi |
| 26 | n41 | -93.68 | -92.07 | Xiaomi |
| 27 | n41 | -93.27 | -91.64 | Xiaomi |

**Table 2. Submitted UE TRMS measurement data for n78 band**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **No.** | **Band** | **TRMSaverage,70** | **TRMSaverage,90** | **Test lab** |
| 1 | n78 | -101.43 | -99.61 | CMCC&BUPT |
| 2 | n78 | -101.04 | -98.99 | CAICT |
| 3 | n78 | -100.42 | -98.24 | CAICT |
| 4 | n78 | -100.37 | -98.82 | CMCC&BUPT |
| 5 | n78 | -100.13 | -98.31 | CMCC&BUPT |
| 6 | n79 | -99.49 | NA | Apple |
| 7 | n78 | -99.11 | -98.16 | Huawei |
| 8 | n78 | -98.93 | -96.85 | CAICT |
| 9 | n78 | -98.77 | -96.62 | CAICT |
| 10 | n78 | -98.67 | -97.87 | Huawei |
| 11 | n78 | -98.34 | -96.18 | CAICT |
| 12 | n78 | -98.04 | -95.60 | CMCC&BUPT |
| 13 | n78 | -97.05 | -94.88 | CAICT |
| 14 | n78 | -96.86 | -94.79 | CAICT |
| 15 | n78 | -96.79 | -95.14 | CMCC&BUPT |
| 16 | n78 | -96.47 | -94.76 | Xiaomi |
| 17 | n78 | -96.29 | -94.74 | Xiaomi |
| 18 | n78 | -96.26 | -94.69 | Xiaomi |
| 19 | n78 | -96.10 | -94.50 | Xiaomi |
| 20 | n78 | -95.78 | -94.19 | Xiaomi |
| 21 | n78 | -95.67 | -94.06 | Xiaomi |
| 22 | n78 | -95.50 | -93.91 | Xiaomi |
| 23 | n78 | -95.10 | -93.45 | Xiaomi |
| 24 | n78 | -94.79 | -92.70 | CAICT |



**Figure 1. CDF curve of the TRMS measurement data for n41 band from the aligned labs (w/o Apple’s data)**



**Figure 2. CDF curve of the TRMS measurement data for n78 band from the aligned labs (w/o Apple’s data)**

The 80%, 85%, 90%, and 95% percentile values of CDF curves are calculated as in Table 3.

**Table 3. 80%, 85%, 90%, and 95%** **percentile values of CDF curves (Unit: dBm/30kHz)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Band** | **Percentile** | **TRMSaverage,70 (w/o Apple’s data)** | **TRMSaverage,70 (w/ Apple’s data)** |
| n41 | 80% | -93.92 | -94.10 |
| 85% | -93.89 | -93.92 |
| 90% | -93.78 | -93.82 |
| 95% | -93.69 | -93.70 |
| n78 | 80% | -95.97 | -96.04 |
| 85% | -95.72 | -95.74 |
| 90% | -95.55 | -95.57 |
| 95% | -95.16 | -95.18 |

* Recommended WF
  + Companies are welcome to discuss and analysis the TRMS measurement data. Discussions on the next Sub-topic can base on these data.

### Sub-topic 2-4 FR1 MIMO OTA performance requirements

*Moderator’s note: It is the last meeting before the target completion date of the WI. The target is to conclude FR1 MIMO OTA performance requirements in this meeting.*

**Issue 2-4-1: Framework for defining FR1 MIMO OTA performance requirements**

* Proposals:
  + Proposal 1: Discuss and decide the percentile of CDF to derive TRMS requirements. Consider the following options:
    - Option 1: 80% pass rate (CAICT, OPPO)
    - Option 2: 95% pass rate (Apple, Xiaomi)
    - Others
  + Proposal 2: The adjustments or relaxations with 80% percentile is needed based on the collected measurement data of commercial devices. (OPPO)
  + Proposal 3: Define a manufacturing tolerance, which is used to relax the population pass/fail limit, a similar passing rate as expected from the average TRMS statistics can be obtained. (Apple)
  + Proposal 4: UEs supporting multiple bands must pass the OTA requirements for all applicable bands in order to achieve certification and by introducing the evaluation of a joint band passing rate (JBPR) based on the comparison of the potential requirements against the measured OTA performances over a selected set of bands and evaluating the ratio of the number of passed UEs over the total number of UEs. (Apple)
* Recommended WF
  + Companies are invited to share views. If company supports Proposal 2/3, please also provides corresponding detailed technical reasons, and analysed relaxation values [dB]
  + Conclude this issue in the 1st round.

**Issue 2-4-2: Final values of TRMS requirements**

* Proposals:
  + Proposal 1: Make decision on FR1 MIMO OTA performance requirements in this meeting. (CAICT)
  + Proposal 2: Approve the values in the following table as FR1 MIMO OTA TRMS requirements for n41 and n78 bands. (CAICT)

|  |  |  |
| --- | --- | --- |
| **Operating Band** |  | **TRMSaverage,70 [dBm/30kHz]** |
| n41 |  | -95 |
| n78 |  | -97 |

* + Proposa1 3: Adopt 80% percentile values in the CDF curves of the lasted TRMS data pool as presented under Issue 2-3. (Moderator)

|  |  |  |
| --- | --- | --- |
| **Operating Band** |  | **TRMSaverage,70 [dBm/30kHz]** |
| n41 |  | -94 |
| n78 |  | -96 |

* + Others
* Recommended WF
  + Companies are invited to discuss the final values. The target is to reach agreements on TRMS requirements and conclude this issue in this meeting.

**Issue 2-4-3: Draft CRs on MIMO OTA requirements**

*Moderator: Companies are invited to comment directly in the CR comments collection part, i.e., section 2.3.2. The draft CRs can be updated according to discussion outcomes of Issue 2-4-2.*

### Sub-topic 2-5 Test Tolerance for FR1 MIMO OTA

**Issue 2-5-1: Test Tolerance (TT) and MU assessment work in RAN4 and RAN5**

* Proposals:
  + Proposal 1: RAN4 should discuss recommended TT values for FR1 MIMO OTA, and provide the recommended TT values to RAN5. (CAICT, vivo)
  + Proposal 2: Optimization of the MU assessment can be done in the RAN5 but the TT values for FR1 MIMO OTA TRMS shall not be further impacted. (vivo)
* Recommended WF
  + Companies are invited to share views.

**Issue 2-5-2: TT values for FR1 MIMO OTA**

*Moderator: For LTE MIMO OTA, TT was defined as 1dB, while MU is 2.65dB.*

* Options:
  + Option 1: Define TT=0.5\* MU budget, i.e. 1.5dB for ≤3GHz, and 1.7 dB for >3GHz. (CAICT, vivo)
  + Option 2: Define TT values as the same as lab alignment pass/fail limit [0.75\*MU], i.e. 2.3dB for ≤3GHz, and 2.5dB for >3GHz. (vivo)
  + Option 3: TT values are not directly driven from assessed MU budget. Values between Option 1 and Option 2. (vivo)
* Recommended WF
  + Companies are invited to share views.

## Companies views’ collection for 1st round

### Open issues

Sub topic 2-1 Figure of Merits for FR1 MIMO OTA

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| --- | --- |
| **Company** | **Comments** |
| CAICT | **Issue 2-1-1: Maximum downlink power and additional criterion for FR1 MIMO OTA**  Support P1, P2, and P3 as proponent.  P1: During the FR1 lab alignment activity and test campaign, there is no feedback from TE vendors and labs on the infeasibility of the maximum DL power, which confirms that -80dBm/15kHz (or equivalent -77dBm/30kHz) is a reasonable value and the square brackets can be removed.  P2&P3: After reviewing all the 51 measurement results of n41 (bands <3GHz) and n78 (bands ≥3GHz) of commercial devices submitted by labs, we find that all devices can achieve 70% and 90% TP in all 12 UE orientations. Therefore, we suggest to remove the square brackets and it is not necessary to define different criterion on 90%TP for bands ≥3GHz and bands <3GHz. |
| Samsung | **Issue 2-1-1: Maximum downlink power and additional criterion for FR1 MIMO OTA**  Current practical test covers n41 and n78 up to 3.8GHz, there is few practical test up to higher FR1 band (FR1 upper limit 7.125GHz). However, considering all devices in the n41 and n78 test campaign can achieve 90%TP in all test orientations, it is acceptable to remove the bracket in proposal 1 and 2, and to define same criterion in proposal 3. |
| vivo | **Issue 2-1-1: Maximum downlink power and additional criterion for FR1 MIMO OTA**  Support the proposals |
| Xiaomi | **Issue 2-1-1: Maximum downlink power and additional criterion for FR1 MIMO OTA**  We support the proposals |
| OPPO | **Issue 2-1-1: Maximum downlink power and additional criterion for FR1 MIMO OTA**  Support all the proposals. |

Sub topic 2-2 FR1 MIMO OTA lab alignment

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| --- | --- |
| **Company** | **Comments** |
| Huawei | **Issue 2-2-1: Pass/fail limit for FR1 MIMO OTA lab alignment**  Support proposal 1. There is no technical justification for 0.6\*MU because lab alignment should be at 1.0\*MU in principle.  **Issue 2-2-2: FR1 MIMO OTA lab alignment outcome** |
| CAICT | **Issue 2-2-1: Pass/fail limit for FR1 MIMO OTA lab alignment**  Support Proposal 1, keep the current lab alignment criteria unchanged as 0.75\*MU.  **Issue 2-2-2: FR1 MIMO OTA lab alignment outcome**  Support the proposals.  This is the last meeting before the target completion date of the WI, the FR1 lab alignment activity should be concluded in this meeting.  Based on the current pass/fail criterion, it can be confirmed that Apple is aligned with other 5 labs. Although one data is absent, we believe it is acceptable because the last PAD arrived at Apple’s lab on 9 Aug. due to uncontrollable reasons.  With that, we propose to confirm the alignment among the 6 labs, and close the lab alignment activity in this meeting. |
| Samsung | **Issue 2-2-1: Pass/fail limit for FR1 MIMO OTA lab alignment**  We think RAN4 need a trade-off on this issue, a larger pass/fail limit may lead to larger Test Tolerance value. If going with proposal 1, we would like to define a relative larger TT given the large deviation among labs.  **Issue 2-2-2: FR1 MIMO OTA lab alignment outcome**  Considering the schedule of this WI, we are okay with the proposals but we would like to make sure the large deviation issue is addressed with relative large TT as indicated in issue 2-2-1. |
| vivo | **Issue 2-2-1: Pass/fail limit for FR1 MIMO OTA lab alignment**  Proposal 1 is OK for us.  **Issue 2-2-2: FR1 MIMO OTA lab alignment outcome**  We support concluding the alignment of the 6 labs. |
| Apple | **Issue 2-2-1: Pass/fail limit for FR1 MIMO OTA lab alignment**  Follow CAICT**,** Support Proposal 1, keep the current lab alignment criteria unchanged as 0.75\*MU.  **Issue 2-2-2: FR1 MIMO OTA lab alignment outcome**  Support the proposals.  Agreed with CAICT comments. |
| Xiaomi | **Issue 2-2-1: Pass/fail limit for FR1 MIMO OTA lab alignment**  Support the proposals.  **Issue 2-2-2: FR1 MIMO OTA lab alignment outcome**  Support the proposals. |
| OPPO | **Issue 2-2-1: Pass/fail limit for FR1 MIMO OTA lab alignment**  As the proponent, we support to define tighter pass/fail limit to guarantee good measurement consistence between labs. And we echo with Samsung’s view that proposal 1 requires a relative larger TT to reflect lab deviation.  **Issue 2-2-2: FR1 MIMO OTA lab alignment outcome**  Support the proposals and CAICT’s comment that confirm 6 labs are FR1 MIMO OTA aligned labs. |

Sub topic 2-3 FR1 MIMO OTA performance test campaign

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| **Company** | **Comments** |
| Huawei | **Issue 2-3: TRMS measurement data for defining FR1 MIMO OTA performance requirements**  Apple’s data should be included when deciding the final values. |
| CAICT | **Issue 2-3: TRMS measurement data for defining FR1 MIMO OTA performance requirements**  Apple can be confirmed as an aligned lab, the measurement results from Apple should be included. The CDF curves with Apple’s data are as below:      **Table 3. 80%, 85%, 90%, and 95% percentile values of CDF curves (Unit: dBm/30kHz)**   |  |  |  | | --- | --- | --- | | **Band** | **Percentile** | **TRMSaverage,70 (with Apple’s data)** | | n41 | 80% | -94.10 | | 85% | -93.92 | | 90% | -93.82 | | 95% | -93.70 | | n78 | 80% | -96.04 | | 85% | -95.74 | | 90% | -95.57 | | 95% | -95.18 | |
| Samsung | **Issue 2-3: TRMS measurement data for defining FR1 MIMO OTA performance requirements**  Thanks for the efforts during the test campaign. Generally speaking the number of test devices are not so big in statistic point of view. If possible, it is suggested to check the market distribution of the test devices, usually the antenna performance is optimized for the bands of the targeted market, while performance of other roaming bands is relatively worse. |
| Apple | **Issue 2-3: TRMS measurement data for defining FR1 MIMO OTA performance requirements**  Agree with Huawei and CAICT comments.  Thank you for recognizing Apple’s efforts on aligning PADs results, and considering our contribution for TRMS CDF data analysis |
| Xiaomi | **Issue 2-3: TRMS measurement data for defining FR1 MIMO OTA performance requirements**  Thanks CAICT for the analysis. We also agree to include apple’s data in the CDF analysis. |

Sub topic 2-4 FR1 MIMO OTA performance requirements

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| **Company** | **Comments** |
| Huawei | **Issue 2-4-1: Framework for defining FR1 MIMO OTA performance requirements**  95%-ile values should be selected as it means 5% failure, which is reasonable. (Question to OPPO) What would be the criteria to decide the relaxation with 80%-ile in proposal 2? (Question to Apple) Does JBPR only consider FR1 bands in this WI or from measured bands currently available?  **Issue 2-4-2: Final values of TRMS requirements**  We should examine the available results before deciding on the final values. |
| CAICT | **Issue 2-4-1: Framework for defining FR1 MIMO OTA performance requirements**  P1: Support 80%. For E-UTRA MIMO OTA TRMS requirements, 3GPP adopted 85%-ile, CCSA adopted 80%-ile. It is reasonable to follow the successful history to specifying MIMO OTA TRMS requirements for NR.  Besides, compared with LTE, NR FR1 has **removed** the TRMS performance metric at 95% TP and **relaxed** the additional criterion of azimuthal orientations from 10 of 12 azimuthal orientation at 95%TP to [10] of 12 at 90%TP, it is more crucial for the group to define reasonable requirements at 70%TP in order to ensure good implementation of NR devices.  Considering it is the early stage of NR commercialization, the performance of NR UEs is expected to be further improved, we recommend to select 80% percentile values in the CDF curves to specify NR MIMO OTA TRMS requirements to provide a better guidance to the industry.  **Issue 2-4-2: Final values of TRMS requirements**  Support P1 and P3.  This is the lasting meeting before the target completion date of the R-17 WI, it is encouraged to reach consensus on TRMS requirements in this meeting. |
| CAICT | **Issue 2-4-1: Framework for defining FR1 MIMO OTA performance requirements**  P2: A question is how to define the manufacturing tolerance? This issue has been discussed in FR1 TRP TRS WI for several rounds of meetings, the conclusion was the manufacturing tolerance should not be considered. There’s no need to re-discuss the same issue in NR MIMO OTA WI. It’s more reasonable to adopt the discussion outcome form FR1 TRP TRS WI that not to consider manufacturing tolerance.  P3: We do not support to introduce JBPR approach at this stage. There are only two bands being discussed.  JBPR is also not considered in FR1 TRP TRS WI from the beginning. In RAN4 #102-e, JBPR approach was discussed and opposed by several operators and OEMs. |
| Samsung | **Issue 2-4-1: Framework for defining FR1 MIMO OTA performance requirements**  For proposal 1: support option 2 i.e. 95% pass rate.  For proposal 3: in TRP TRS WI, manufacture tolerance is not considered given at least 50ea devices required. For MIMO OTA, the device number is rather small, so it is reasonable to consider the manufacture tolerance.  For proposal 4: The JBPR approach is technical reasonable, i.e. multi-band impact. The issue is the difficulty to implement JBPR. We suggest to consider some relaxation for this factor (e.g. 1~1.5dB) to address the multi-band impact.  **Issue 2-4-2: Final values of TRMS requirements**  Support to start with the 95% pass rate value, plus additional relaxation as indicated in Issue 2-4-1 |
| vivo | **Issue 2-4-1: Framework for defining FR1 MIMO OTA performance requirements**  Given this is last meeting for MIMO OTA WI, instead of discussion framework on how to define requirements, we suggest to focus group efforts on requirements discussion directly.  **Issue 2-4-2: Final values of TRMS requirements**  For n41, we prefer to select 90%-tile value -93.82 dBm/30kHz. However, considering the requirements are usually defined as 0.5 accuracy, it is suggested to use CEILING(-93.82, 0.5), i.e. -93.5dBm/30kHz as the requirement value.  For n78, the performance is much higher than n41, we suggest to consider values at 95%-tile. |
| Apple | **Issue 2-4-1: Framework for defining FR1 MIMO OTA performance requirements**  As a proponent, we support P1 (option 2), P3 and P4  (Answer to Huawei) We are proposing an evaluation of a joint band passing rate (JBPR) based on the comparison of the potential requirements against the measured OTA performances over a selected set of bands (initially considering the FR1 data pool) and evaluating the ratio of the number of passed UEs over the total number of UEs  **Issue 2-4-2: Final values of TRMS requirements**  If the initially proposed 95% pass rate can’t be agreed. We would like to consider a compromised Proposal 4, adopting 90% values in the CDF based on complete TRMS pool of data available in this meeting:   |  |  |  | | --- | --- | --- | | **Operating Band** |  | **TRMSaverage,70 [dBm/30kHz]** | | n41 |  | -93.8 | | n78 |  | -95.5 | |
| Xiaomi | **Issue 2-4-1: Framework for defining FR1 MIMO OTA performance requirements**  We agree with VIVO that to consider the requirement it-self can be more efficient. We also propose that the requirement itself should be discussed with the TT together to ensure an reasonable result.  **Issue 2-4-2: Final values of TRMS requirements**  As stated in previous issue 2-4-1 that to define the requirement and TT together. With the TT as 0.75MU we can compromise to -93.5 at band n41 and -95.5 at band n78. |
| OPPO | **Issue 2-4-1: Framework for defining FR1 MIMO OTA performance requirements**  We echo vivo’s comments to focus on requirement discussion directly.  Answer to Huawei: the criteria to decide the relaxation finally depends on RAN4 technical discussion. Some aspects which may affect OTA performance should be considered, such as multi-band impact, popularity of the devices in data pool, mass production distribution.  **Issue 2-4-2: Final values of TRMS requirements**  Proposal 4 from Apple can be discussed as the startpoint, additional relaxations should be considered. |
| CAICT | **Issue 2-4-1: Framework for defining FR1 MIMO OTA performance requirements**  The TRMS requirements should at least be better than the worst data in the data pool. |

Sub topic 2-5 Test Tolerance for FR1 MIMO OTA

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| **Company** | **Comments** |
| CAICT | **Issue 2-5-1: Test Tolerance (TT) and MU assessment work in RAN4 and RAN5**  Support Proposals 1, 2. Discuss and conclude the recommended TT values in this meeting.  **Issue 2-5-2: TT values for FR1 MIMO OTA**  Option 1. The traditional method for LTE MIMO OTA to specify TT value is to define TT=0.5\*MU budget. It is reasonable to use a similar method to define the test tolerance of NR MIMO OTA. |
| Samsung | **Issue 2-5-1: Test Tolerance (TT) and MU assessment work in RAN4 and RAN5**  Support the proposals  **Issue 2-5-2: TT values for FR1 MIMO OTA**  Given the large deviation observed in test campaign, it is suggested not to consider option 1. Between option 2 and 3, option 2 is slightly preferred. |
| vivo | **Issue 2-5-1: Test Tolerance (TT) and MU assessment work in RAN4 and RAN5**  We support the proposals. And the proposals are also aligned with the traditional way for LTE MIMO OTA.  **Issue 2-5-2: TT values for FR1 MIMO OTA**  It is expected that the TT would not be impacted by further optimized MU in RAN5, thus option 3 is preferred (i.e. TT values are not directly driven from assessed MU budget). TT values as 1.6dB for ≤3GHz, and 1.8 dB for >3GHz can be considered. |
| Apple | **Issue 2-5-1: Test Tolerance (TT) and MU assessment work in RAN4 and RAN5**  Support the proposals  **Issue 2-5-2: TT values for FR1 MIMO OTA**  We agree with Samsung. Do not to consider option 1. Between option 2 and 3, option 2 is slightly preferred. |
| Xiaomi | **Issue 2-5-1: Test Tolerance (TT) and MU assessment work in RAN4 and RAN5**  Support the proposals  **Issue 2-5-2: TT values for FR1 MIMO OTA**  As we stated in issue 2-4 that the TRMS requirement needs to be considered together with TT. With that we would prefer option 3 for TT. |
| CAICT | **Issue 2-5-2: TT values for FR1 MIMO OTA**  Although we believe Option 1 is reasonable, to conclude the WI in this meeting, we can compromise to Option 3 and support 1.8dB for n41 and 2dB for n78. Note that for LTE, TT is defined as 1dB while MU is 2.65dB, i.e., TT is smaller than 0.4MU. |
| OPPO | **Issue 2-5-1: Test Tolerance (TT) and MU assessment work in RAN4 and RAN5**  Support the proposals  **Issue 2-5-2: TT values for FR1 MIMO OTA**  Support option 2 or option 3. Considering lab deviation during lab alignment, 0.5MU is not suitable for TT. |
| Keysight | **Issue 2-5-1: Test Tolerance (TT) and MU assessment work in RAN4 and RAN5**  Proposal 1 is aligned with the WID but Proposal 2 is not as the WID clearly states: “The final MU and test tolerances (TT) will be decided by RAN5.” RAN4 can recommend TT but requirements should be defined without considering/finalizing TT.  **Issue 2-5-2: TT values for FR1 MIMO OTA**  The TT/MU factor for LTE is <0.4! It is not clear at all why factors larger than 0.5 are discussed for NR FR1. What is the technical justification? The largest recommended TT should be Option 1. It is proposed to replace ‘TT’ with ‘suggested TT’ in each option since TT will be finalized in RAN5. |
| CAICT | **Issue 2-5-2: TT values for FR1 MIMO OTA**  If the performance requirements are relaxed, tighter TT values are more reasonable. |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2212644 (on maximum downlink power and additional criterion for FR1 MIMO OTA test) | Company A |
| Company B |
|  |
| R4-2212641 (on minimum requirements, CAICT) | Moderator: R4-2212641 and R4-2212828 can be merged. |
| Company B |
|  |
| R4-2212828 (on FR1 MIMO OTA requirements, vivo) | 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 2-1 Figure of Merits for FR1 MIMO OTA** | **Issue 2-1-1: Maximum downlink power and additional criterion for FR1 MIMO OTA**  *5 companies commented on this issue and all of them agree with the proposals.*  *Agreements:*   * Remove the square brackets and confirm the maximum downlink RS-EPRE as -80dBm/15kHz (or equivalent -77dBm/30kHz) for FR1 MIMO OTA. * Proposal 2: Remove the square brackets in additional criterion. The EUT must meet 90% throughput in 10 of total 12 azimuthal orientations. * Define the same criterion on 90%TP for bands ≥3GHz and bands <3GHz.   *Recommendations for 2nd round:*   * Capture the agreements in WF.   **Issue 2-1-2:** **Draft CR on maximum downlink power and additional criterion for FR1 MIMO OTA test**  *Agreement:*   * Draft CR on maximum downlink power and additional criterion for FR1 MIMO OTA test in R4-2212644 is agreed. |
| **Sub-topic 2-2 FR1 MIMO OTA lab alignment** | **Issue 2-2-1: Pass/fail limit for FR1 MIMO OTA lab alignment**  *GTW agreement:*   * Keep the current FR1 lab alignment pass/fail limits unchanged as 0.75\*MU.   *Recommendations for 2nd round:*   * Capture the agreement in WF.   **Issue 2-2-2: FR1 MIMO OTA lab alignment outcome**  *GTW agreements:*   * 3GPP FR1 MIMO OTA lab alignment among the 6 labs, i.e., CAICT, CMCC&BUPT, Huawei, MediaTek, Xiaomi, and Apple is confirmed. * 3GPP FR1 MIMO OTA lab alignment activity is closed in RAN4#104-e meeting.   *Recommendations for 2nd round:*   * Capture the agreements in WF. |
| **Sub-topic 2-3 FR1 MIMO OTA performance test campaign** | **Issue 2-3: TRMS measurement data for defining FR1 MIMO OTA performance requirements**  *Agreement:*   * The TRMS measurement results in R4-2209330 (CAICT), R4-2209513 (Xiaomi), R4-2208413 (CMCC&BUPT), R4-2213204 (Xiaomi), R4-2211996 (Huawei), and R4-2212407 (Apple) are included in FR1 MIMO OTA data pool for defining performance requirements.   *Recommendations for 2nd round:*   * Capture the agreement in WF. |
| **Sub-topic 2-4 FR1 MIMO OTA performance requirements** | **Issue 2-4-1: Framework for defining FR1 MIMO OTA performance requirements**  *Companies have not reached consensus on this issue. Based on GTW discussions, it is recommended to focus on Issue 2-4-2 directly.*  *Recommendations for 2nd round:*   * Focus on the requirements discussion (Issue 2-4-2) directly.   **Issue 2-4-2: Final values of TRMS requirements**  *GTW agreements:*   * Further discuss TRMS requirements in Rel-17 MIMO OTA for n78 within below range:   + n78: [-94.5 ~-95.5] dBm/30kHz * Further discuss TRMS requirements in Rel-17 MIMO OTA for n41 with below range:   + n41: [-93.0 ~ -93.5] dBm/30kHz   *Considering this is the last meeting of the WI, final values of the requirement shall be concluded.* *It is highly recommended to reach consensus on the TRMS requirements in 2nd round.*  *Recommendations for 2nd round:*   * The following options are suggested for down-selection:   + Option 1 (compromised values based on the GTW agreements):     - n41: -93.3 dBm/30kHz     - n78: -95.2 dBm/30kHz   + Option 2 (To guarantee good 5G end-user experience):     - n41: -93.5 dBm/30kHz     - n78: -95.5 dBm/30kHz * It is highly recommended to reach consensus on the final values. Capture agreements in WF.   **Issue 2-4-3: Draft CRs on MIMO OTA requirements**  *Recommendations for 2nd round:*   * Merge the draft CRs in R4-2212641 and R4-2212828. Update the draft CR based on the discussion outcomes of Issue 2-4-2. * Review and agree with the revised draft CR. |
| **Sub-topic 2-5 Test Tolerance for FR1 MIMO OTA** | **Issue 2-5-1: Test Tolerance (TT) and MU assessment work in RAN4 and RAN5**  *Agreement:*   * RAN4 should discuss recommended TT values for FR1 MIMO OTA, and provide the recommended TT values to RAN5.   *Tentative agreement:*   * Optimization of the MU assessment can be done in RAN5, but RAN4 suggests not to change the TT values for FR1 MIMO OTA TRMS.   *Recommendations for 2nd round:*   * Further check if the tentative agreements are agreeable. * Capture agreements in WF.   **Issue 2-5-2: TT values for FR1 MIMO OTA**  *GTW agreement:*   * RAN4 recommended TT values as:   + Option 3b: Define TT values as 1.8dB for n41 and 2dB for n78.   *However, after GTW session, Keysight expressed in the 1st round email discussion that the largest recommended TT should be 0.5MU. CAICT also commented that if the performance requirements are relaxed, tighter TT values are more reasonable.*  *Recommendations for 2nd round:*   * Further discuss the recommended TT values. The following options are suggested for down-selection:   + Option 1: Define recommended TT values as 0.5\*MU, i.e. 1.5dB for ≤3GHz, and 1.7 dB for >3GHz.   + Option 2: Define recommended TT values as 1.8dB for n41 and 2dB for n78.   + Option 3: Values between Option 1 and Option 2. E.g., 1.6dB for n41 and 1.8dB for n78. * Conclude this issue and capture agreements in WF. |

### CRs/TPs

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

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
| R4-2212644 (on maximum downlink power and additional criterion for FR1 MIMO OTA test) | *agreeable* |
| R4-2212641 (on minimum requirements, CAICT) | *to be revised* |
| R4-2212828 (on FR1 MIMO OTA requirements, vivo) | *to be merged* |

## Discussion on 2nd round

### Sub-topic 2-4 FR1 MIMO OTA performance requirements

**Issue 2-4-2: Final values of TRMS requirements**

*GTW agreements:*

* Further discuss TRMS requirements in Rel-17 MIMO OTA for n78 within below range:
  + n78: [-94.5 ~-95.5] dBm/30kHz
* Further discuss TRMS requirements in Rel-17 MIMO OTA for n41 with below range:
  + n41: [-93.0 ~ -93.5] dBm/30kHz

*Recommendations for 2nd round:*

* Further discuss and decide the TRMS requirements. The following options are suggested for down-selection:
  + Option 1 (compromised values based on the GTW agreements):
    - n41: -93.3 dBm/30kHz
    - n78: -95.2 dBm/30kHz
  + Option 2 (To guarantee good 5G end-user experience):
    - n41: -93.5 dBm/30kHz
    - n78: -95.5 dBm/30kHz
* It is highly recommended to reach consensus on the final values of TRMS requirements. Capture the agreements in WF.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei | Support option 1 |
| Samsung | Both option 1 and option 2 has 2dB gap between n41 and n78. However, in both lab alignment campaign test and own test, there is no such trend found for all UEs. E.g. in lab alignment test results, there is PAD tested for both bands, and n78 performance shows no advantage. We think that is the disadvantage of per-band approach without considering the all bands performance of the same UE. It is encouraged for volunteered labs to check the performance gap between n41 and n78 for the same DUT in the data pool. We believe the gap should not be as large as 2dB. |
| Xiaomi | To Samsung’s comment, as certified lab, the analysis of our result of band n41 and n78 difference varies from 0.4dB to 2.7dB. Indeed we cannot find a quite solid relationship between these two values but we agree that the cross band design should have impact on the value of performance requirement. From this perspective, we would also like to see further analysis of other test lab results and to see if any further conclusion we can make. |
| Apple | Support option 1 starting point to move forward, as a proponent of this concepts, multi band and JBPR should be investigated as well. |
| Samsung2 | We have analyzed the performance gap between n41 and n78 for the same DUT with the data in data pool from performance test campaign (DUTs with TRMS results of both bands are taken into account):    Above analysis results show that the average gap between n41 TRMS and n78 TRMS for a same UE is about 1dB. That is the average of results from all labs. For most labs, the gap is even further smaller than 1dB. |
| Huawei | The average represents 50%-ile, while both option 1 and 2 are above 80%-ile. The behavior at different percentiles can be dissimilar. Modification of measured data at higher percentiles using general trend such as average difference should be avoided in principle and especially so at this late stage of discussion. |
| CAICT | Although we believe the TRMS requirements should at least be better than Option 2, we can compromise to Option 1 to conclude the WI.  To Samsung: Thanks for the analysis. We share similar views with Huawei. The average represents 50%-ile, but it is actually the last 20% data determines the performance requirements.  To Apple: We understand your point, but the framework for performance requirements development was discussed one year ago, multi-band and JBPR concepts were not introduced. It seems too late to start to investigate these concepts at this stage. |
| OPPO | We can support Option 1. However, we also support that the abnormal gap between n41 and n78 should be carefully considered and treated, in case of misleading the UE antenna performance design. |

### Sub-topic 2-5 Test Tolerance for FR1 MIMO OTA

**Issue 2-5-1:** **Test Tolerance (TT) and MU assessment work in RAN4 and RAN5**

*Agreement:*

* RAN4 should discuss recommended TT values for FR1 MIMO OTA, and provide the recommended TT values to RAN5.

*Tentative agreement:*

* Optimization of the MU assessment can be done in RAN5, but RAN4 suggests not to change the TT values for FR1 MIMO OTA TRMS.

*Recommendations for 2nd round:*

* Further check if the tentative agreement is agreeable.
* Capture agreements in WF.

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| **Company** | **Comments** |
| Keysight Technologies | Is the revised tentative agreement even necessary as it seems to contradict the agreement in green? |
| Samsung | Support both the agreement and tentative agreement |
| Xiaomi | We can compromise to the TT value. |
| Apple | Based on previous agreement in R4-2115756 WF on NR MIMO OTA  “RAN4 should discuss the preliminary MU assessment for FR1 MIMOM OTA including example expanded uncertainty, **final MU and TT will be decided by RAN5**”  For clarity the text on tentative WF should be duplicated here:  “The final MU and TT will be decided by RAN5, but it is suggested not to change the TT values for FR1 MIMO OTA TRMS in RAN5.” |
| OPPO | Support the agreement. And also support Apple’s revised version of tentative WF. |

**Issue 2-5-2: TT values for FR1 MIMO OTA**

*GTW agreement:*

* RAN4 recommended TT values as:
  + Option 3b: Define TT values as 1.8dB for n41 and 2dB for n78.

*However, after GTW session, Keysight expressed in the 1st round email discussion that the largest recommended TT should be 0.5MU. CAICT also commented that if the performance requirements are relaxed, tighter TT values are more reasonable.*

*Recommendations for 2nd round:*

* Further discuss the recommended TT values. The following options are suggested for down-selection:
  + Option 1: Define recommended TT values as 0.5\*MU, i.e. 1.5dB for ≤3GHz, and 1.7 dB for >3GHz.
  + Option 2: Define recommended TT values as 1.8dB for n41 and 2dB for n78.
  + Option 3: Values between Option 1 and Option 2. E.g., 1.6dB for n41 and 1.8dB for n78.
* Conclude this issue and capture agreements in WF.

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| **Company** | **Comments** |
| Keysight Technologies | It is not clear what justifies the significant increase in TT for NR FR1 compared to LTE (TT: 1dB, TT/MU: 0.38) since for all practical purposes the same systems are used? A max recommended TT/MU ratio of 0.5 seems reasonable, everything beyond that seems excessive. |
| Samsung | We would like to maintain previous agreement. The agreement is made coupling with Pass/fail limit for FR1 MIMO OTA lab alignment. The agpreement was not made coupling with TRMS requirements. If reopening this issue, lab alignment pass/fail limit should be discussed in a package. |
| OPPO | We share similar view with Samsung. Considering the pass/fail limits for lab alignment are set as 0.75MU, which means allowed lab offset is 2.25dB for bands<3GHz and 2.55dB for bands>3GHz, a relative large TT is reasonable and required. |
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### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| Rev. of R4-2212641 (on minimum requirements) | Company A |
| Company B |
|  |

# Topic #3: FR2 Performance requirements

*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** |
| [**R4-2212639**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212639.zip) | CAICT,SAICT | Proposals on concluding NR MIMO OTA WI  **Proposal 1: Remove the square brackets and confirm the maximum downlink RS-EPRE as 80dBm/15kHz (or equivalent -77dBm/30kHz) for FR1 MIMO OTA.**  **Proposal 2: Remove the square brackets in additional criterion. The EUT must meet 90% throughput in 10 of total 12 azimuthal orientations.**  **Proposal 3: Define the same criterion on 90%TP for bands ≥3GHz and bands <3GHz.**  **Proposal 4: Lab that submit PAD measurement results meeting the pass/fail limit in this meeting can be confirmed as FR1 MIMO OTA aligned lab. Close FR1 lab alignment activity in RAN4#104-e meeting.**  **Proposal 5: Make decision on FR1 MIMO OTA performance requirements in this meeting.**  **Proposal 6: A recommended TT value for FR1 MIMO OTA should be discussed in RAN4.**  **Proposal 7: Accept TT=0.5\*MU budget as the recommended TT value of FR1 MIMO OTA.**  **Proposal 8: Decision on how to handle FR2 performance requirements development issues is needed.** |
| [**R4-2213177**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213177.zip) | Qualcomm Incorporated | On FR2 MIMO OTA requirements  **Proposal 1: RAN4 to use simulation approach as the baseline to specify the FR2 MIMO OTA requirements. The margin due to the misalignment between simulation and measurement can be further added.**  **Observation 1: The impact on MIMO sensitivity due to the non-ideal factors for the beam peak direction is marginal.**  **Observation 2: The main influence on the simulation is coming from the assumptions for antenna module which are depending on the UE implementation.**  **Proposal 2: To consider upto [0.1dB] as the margin to compensate for the offset due to the non-ideal factors in the simulation.**  **Proposal 3: To use the simulation results collected in [3] (R4-2213178) as the data pool to derive the FR2 MIMO OTA requirements by means of dB averaging. The margin of [0.1dB] due to the non-ideal factors will be added on top of average value.** |
| R4-2213178 (reserved) | Qualcomm Incorporated | Summary results for FR2 MIMO OTA |
| [**R4-2213187**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213187.zip) | Huawei,HiSilicon | Discussion on 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 -136.2dBm/Hz.** |
| [**R4-2213428**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213428.zip) | OPPO | Views on FR2 MIMO OTA performance requirement  ***Proposal 1: For simulation approach to defining FR2 MIMO OTA requirements, it is proposed to, at least, complete the following steps, i.e. 1.simulation assumption alignment, 2.simulation result alignment on peak direction, 3.simulation result alignment on 36 test directions (i.e. MASC alignment), 4.device performance simulation results collection for FR2 MIMO OTA data pool.***  ***Proposal 2: For FR2 device performance simulation, it is proposed to consider the following variables to emulate the varieties of FR2 device performances, i.e. 1.non-ideal factors in channel model implementations, 2.antenna panel placement in the UE, 3.potential unavoidable obstruction on antenna panel from internal components or the cover of the UE.***  ***Proposal 3: How to derive the requirements from FR2 MIMO OTA simulation data pool need further discussion.*** |

## 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 3-1 General views on FR2 MIMO OTA requirements development

**Issue 3-1: General views on FR2 MIMO OTA requirements development**

* Proposal (CAICT)
  + Decision on how to handle FR2 performance requirements development issues is needed.
* Recommended WF
  + Companies are invited to share views.

### Sub-topic 3-2 Simulation approach to specify FR2 MIMO OTA requirements

**Issue 3-2-1: Views on the simulation approach**

* Proposals
  + Proposal 1 (Qualcomm): RAN4 to use simulation approach as the baseline to specify the FR2 MIMO OTA requirements. The margin due to the misalignment between simulation and measurement can be further added.
  + Proposal 2 (OPPO): For simulation approach to defining FR2 MIMO OTA requirements, it is proposed to, at least, complete the following steps:
    - 1. simulation assumption alignment,
    - 2. simulation result alignment on peak direction,
    - 3. simulation result alignment on 36 test directions (i.e. MASC alignment),
    - 4. device performance simulation results collection for FR2 MIMO OTA data pool.
  + Proposal 3 (CAICT): The following concerns need to be solved first before the pure simulation approach is used to define FR2 requirements.
    - How to demonstrate the good correlation of simulation model with reality needs to be handled. The gap between simulation and measurement needs to be demonstrated.
    - Before adopting any specific simulation results into FR2 data pool, alignment among companies should be achieved.
    - The metric of simulation results alignment needs to be defined.
    - Framework of FR2 requirement development needs to be agreed, e.g., how many quantities of simulation results are needed, how to process the simulation results to derive the performance requirements, etc.
* Recommended WF
  + Companies are invited to share views.

**Issue 3-2-2: How to handle the misalignment between simulation and measurement**

* Proposals
  + Proposal 1 (Qualcomm): To consider upto [0.1dB] as the margin to compensate for the offset due to the non-ideal factors in the simulation.
  + Proposal 2 (OPPO): For FR2 device performance simulation, it is proposed to consider the following variables to emulate the varieties of FR2 device performances:
    - 1. non-ideal factors in channel model implementations,
    - 2. antenna panel placement in the UE,
    - 3. potential unavoidable obstruction on antenna panel from internal components or the cover of the UE.
* Recommended WF
  + Companies are invited to share views.

### Sub-topic 3-3 FR2 MIMO OTA performance requirements

**Issue 3-3-1: FR2 MIMO OTA simulation results for 36 test directions**

*Moderator’s note: In the last meeting, Qualcomm (R4-2208671) and Huawei (R4-2209144) provided their simulation results for 36 test points, based on which the MASC of meeting 70% maximum throughput is calculated as -141.2dBm/Hz and* *-136.2dBm/Hz, respectively. In this meeting, Huawei (R4-2213187) submitted the result as -136.2dBm/Hz again.*

* Recommended WF
  + Comments are welcome.

**Issue 3-3-2: How to derive FR2 MIMO OTA requirements from the simulation results**

* Proposals
  + Proposal 1 (Qualcomm): To use the simulation results collected in R4-2213178 as the data pool to derive the FR2 MIMO OTA requirements by means of dB averaging. The margin of [0.1dB] due to the non-ideal factors will be added on top of average value.
  + Proposal 2 (OPPO): How to derive the requirements from FR2 MIMO OTA simulation data pool need further discussion.
* Recommended WF
  + Companies are invited to share views.

## Companies views’ collection for 1st round

### Open issues

Sub topic 3-1 General views on FR2 MIMO OTA requirements development

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| **Company** | **Comments** |
| Huawei,  Hisilicon | **Issue 3-1: General views on FR2 MIMO OTA requirements development**  Considering that the measurement results for FR1 have been discussed in many meetings and have not been finalized, majority companies may not be convinced by the simulation results alone. Maybe we can prioritize FR1 performance part and continue to consider FR2 in the future. |
| Keysight Technologies | **Issue 3-1: General views on FR2 MIMO OTA requirements development**  As discussed and endorsed earlier, we believe that simulations should be sufficient to define FR2 OTA requirements just as we did for FR2 UE RF, demod, and RRM. |
| Apple | **Issue 3-1: General views on FR2 MIMO OTA requirements development**  We agree and support Hisilicon comments |
| Xiaomi | **Issue 3-1: General views on FR2 MIMO OTA requirements development**  We also support Huawei’s comment. |
| Qualcomm | **Issue 3-1:**  **We have the same view as Keysight. We already use simulation approach to define the FR2 OTA requirements from Rel-15. Measurement results are encouraged but not necessary when specifying the FR2 MIMO OTA requirements. The simulation approach has been discussed for a long time in this WI. Companies have already provided the simulation results. We don’t see the issue to define the requirements with simulation approach.** |
| CAICT | **Issue 3-1: General views on FR2 MIMO OTA requirements development**  We echo Huawei’s comments. |
| OPPO | **Issue 3-1: General views on FR2 MIMO OTA requirements development**  We echo Huawei’s comments. |

Sub topic 3-2 Simulation approach to specify FR2 MIMO OTA requirements

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| **Company** | **Comments** |
| CAICT | **Issue 3-2-1: Views on the simulation approach**  Support Proposals 2,3. There are several issues have to be solved before pure simulation approach is adopted.  **Issue 3-2-2: How to handle the misalignment between simulation and measurement** |
| Keysight Technologies | **Issue 3-2-1: Views on the simulation approach**  We support Proposal 1 |
| Apple | **Issue 3-2-1: Views on the simulation approach**  Support P2, simulation models from different sources shall correlate based on pre-determined requirements  Support P3, baseline correlation between simulation and measurements is fundamental to proceed simulation analysis results |
| Qualcomm | **Issue 3-2-1:**  **We support P1 but we are open to discuss the specific value for the gap. Based on the our latest simulation results, we see only 0.1dB offset with taking into the offset between ideal channel modelling and real channel in the measurement setup.**  **For P2, we have already done with the alignment for the assumption, peak direction. For 36 test points, two companies submitted the simulation results. The 36 test directions are highly depending on the antenna location. Now the gap is less than 6dB. We think it is reasonable level for the FR2 MIMO simulation. We always encouraged other companies to provide more simulation results.**  **For P3, similar comments as P2. We already did a lot of efforts for the simulation approach. Based on the experience of other topics, we would say we already done with the simulation alignment. We have been encouraging companies to provide the simulation results.** |
| OPPO | **Issue 3-2-1: Views on the simulation approach**  We support Proposal 2 and 3. Appreciate for Qualcomm and Huawei’s efforts on simulation alignment. However, we can not agree that the simulation alignment is done.  **Issue 3-2-2: How to handle the misalignment between simulation and measurement**  We support Proposal 2 as the proponent. |

Sub topic 3-3 FR2 MIMO OTA performance requirements

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| **Company** | **Comments** |
| Huawei,  Hisilicon | **Issue 3-3-1: FR2 MIMO OTA simulation results for 36 test directions**  **Issue 3-3-2: How to derive FR2 MIMO OTA requirements from the simulation results**  So far, we do not think the average method is appropriate enough due to few simulation results and the big gap. |
| CAICT | **Issue 3-3-2: How to derive FR2 MIMO OTA requirements from the simulation results**  Support Proposal 2. Share similar views with Huawei. There are only two simulation results in the data pool with a large gap of 5dBm/Hz. Proposal 1 is not convincing. |
| Keysight Technologies | **Issue 3-3-2: How to derive FR2 MIMO OTA requirements from the simulation results**  It was commented that the simulation gap is based on different UE antenna assumptions, i.e., the requirements should be based on a compromise proposal between the presented results (as it was done for FR2 UE RF). |
| Apple | **Issue 3-3-2: How to derive FR2 MIMO OTA requirements from the simulation results**  Understanding that there always will be misalignment between simulation and measurements, to correlate the simulation with reality a baseline needs to be established. A reference design need to be determined and controllable test conditions that can be emulated by a simulation model. Fulfilling these initial conditions then a simulation/measurement correlation uncertainty can be determined, and the simulation model reliability assessed. |
| Xiaomi | **Issue 3-3-2: How to derive FR2 MIMO OTA requirements from the simulation results**  For the result the gap is large. For the simulation itself, we agree with Apple that a baseline simulation assumption might be needed to create convincing simulation results. |
| Qualcomm | **Issue 3-3-1/2:**  **The gap is mainly due to the different assumptions for antenna. RAN4 already has the similar experience. We can do the average based on the submitted simulation results and add the [] for the tentative limits. We can further revise the values once there are measurement and/or simulation results submitted by other companies.** |
| OPPO | **Issue 3-3-2: How to derive FR2 MIMO OTA requirements from the simulation results**  Support Proposal 2. We don’t think it’s reliable to derive the requirement with only two simulation results. |

### 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** |
| XXX | Company A |
| Company B |
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| YYY | Company A |
| Company B |
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## 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 3-1 General views on FR2 MIMO OTA requirements development** | **Issue 3-1: General views on FR2** **MIMO OTA requirements development**  *Companies hold different views on this issue and have not reached consensus on the approach to define FR2 MIMO OTA requirements.* *Companies (Huawei, Apple, Xiaomi, CAICT, OPPO) also suggest to prioritize FR1 performance part work and continue to consider FR2 in the future.*  *It would be good if the efforts on FR2 MIMO OTA requirements can be continued in Rel-18 scope, based on future RAN-P conclusions.*  *Recommendations for 2nd round:*   * Considering it is the last meeting of the WI, companies are encouraged to reach high-level consensus. * Future actions depend on RAN decision on Rel-18. |
| **Sub-topic 3-2 Simulation approach to specify FR2 MIMO OTA requirements** | **Issue 3-2-1: Views on the simulation approach**  *Companies have not reached consensus on the simulation approach. Although* *Qualcomm and Keysight believe the simulation approach is sufficient, several companies show concerns on reliability of the current simulation approach.*  *We really appreciate companies’ great efforts on FR2 simulation work, especially Qualcomm, Huawei, and MediaTek. It would be good to continue this work in Rel-18, if approved by RAN, to improve the confidence level of the simulation approach.*  *Recommendations for 2nd round:*   * Future actions depend on RAN decision on Rel-18.   **Issue 3-2-2: How to handle the misalignment between simulation and measurement**  *Companies have not reached consensus on how to handle the misalignment between simulation and measurement. It would be good if this issue can be addressed in Rel-18, if approved by RAN.*  *Recommendations for 2nd round:*   * Future actions depend on RAN decision on Rel-18. |
| **Sub-topic 3-3 FR2 MIMO OTA performance requirements** | **Issue 3-3-1: FR2 MIMO OTA simulation results for 36 test directions**  *Thanks for the simulation results.*  *Recommendations for 2nd round:*   * No further discussion in 2nd round.   **Issue 3-3-2: How to derive FR2 MIMO OTA requirements from the simulation results**  *Thank Qualcomm and Huawei for the efforts and contributions on providing the simulation results. Unfortunately, some companies still have little confidence in* *deriving FR2 MIMO OTA requirements based on the current data pool. Keysight and* *Qualcomm explained the cause of the gap and are supportive to derive the FR2 requirements based on the simulation results. But agreement has not been reached on this issue.*  *It would be helpful if more simulation results and measurement results can be obtained in Rel-18, if approved by RAN.*  *Recommendations for 2nd round:*   * Future actions depend on RAN decision on Rel-18. |

### 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

### Sub-topic 3-1 General views on FR2 MIMO OTA requirements development

**Issue 3-1: General views on** **FR2** **MIMO OTA requirements development**

*In the 1st round, companies held different views on this issue and have not reached consensus on the approach to define FR2 MIMO OTA requirements.*

*Proposals from the 1st round can be summarized as:*

* Proposal 1 (Qualcomm, Keysight): Define FR2 MIMO OTA requirements based on simulation approach.
* Proposal 2 (Huawei, Apple, Xiaomi, CAICT, OPPO): Suggest to prioritize FR1 performance part work in Rel-17 timeline, and continue FR2 MIMO OTA requirements development in the future.

*Recommendations for 2nd round:*

* Considering it is the last meeting of the WI, companies are encouraged to reach high-level consensus on how to handle FR2 performance requirements development issues.
* Future actions depend on RAN decision on Rel-18.

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| **Company** | **Comments** |
| Qualcomm | Thanks for Moderator’s efforts. Considering simulation approach was agreed as the alternative approach at the beginning of this WI, and companies have done the alignment for simulation results Based on the summary of results in R4-2213178, less than 3dB gap for peak direction, less than 6dB gap for 36 directions which is not a big offset compared with the traditional RAN4 simulation calibration campaign. To conclude this WI, we would like to propose the draft WF on FR2 MIMO OTA requirements:   * To calculate the FR2 MIMO OTA requirements based on the average of submitted simulation results, i.e., [-138.7]dBm/Hz. * To further consider [0.1]dB margin due to the non-ideal factor * To specify the MASC requirements for 70% maximum throughput for n258 as [-138.6]dBm/Hz. Meanwhile we can capture the following statement in the chairman notes: “The FR2 MIMO OTA requirements can be further revised if simulation results and/or measurement results are submitted by companies” |
| Keysight Technologies | Same comments as in 1st round. As agreed for FR2 in this WI before, the “simulation approach to define performance requirement is not precluded” |
| Samsung | We understand that simulation approach is not precluded. However, as agreed before, simulation alignment should be confirmed before performance simulation for deriving requirements. Considering both simulation status and the WI timeline, it seems option 2 is more practical. |
| OPPO | Thanks again for the contributions to FR2 MIMO simulation campaign from companies. As we commented in 1st round, we can not agree that the simulation alignment is finished with current gap. We even do not discuss the pass/fail criteria of simulation alignment so far. Therefore, we are not at the stage of deriving performance requirements. We support to include the unfinished work into R18 new MIMO OTA WI scope for RAN-P approval. |
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### Sub-topic 3-2 Simulation approach to specify FR2 MIMO OTA requirements

**Issue 3-2-1: Views on the simulation approach**

*Companies have not reached consensus on the simulation approach in 1st round. Although Qualcomm and Keysight believe the simulation approach is sufficient, several companies show concerns on reliability of the current simulation approach.*

*Recommendations for 2nd round:*

* Companies can further discuss this issue. This issue is partly overlapped with Issue 3-1. To facilitate the discussion towards reaching high-level consensus, suggest to focus on the discussions on Issue 3-1.
* Future actions depend on RAN decision on Rel-18.

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| **Company** | **Comments** |
| Qualcomm | Thanks for Moderator’s efforts. Considering simulation approach was agreed as the alternative approach at the beginning of this WI, and companies have done the alignment for simulation results Based on the summary of results in R4-2213178, less than 3dB gap for peak direction, less than 6dB gap for 36 directions which is not a big offset compared with the traditional RAN4 simulation calibration campaign. To conclude this WI, we would like to propose the draft WF on FR2 MIMO OTA requirements:   * To calculate the FR2 MIMO OTA requirements based on the average of submitted simulation results, i.e., [-138.7]dBm/Hz. * To further consider [0.1]dB margin due to the non-ideal factor   To specify the MASC requirements for 70% maximum throughput for n258 as [-138.6]dBm/Hz. Meanwhile we can capture the following statement in the chairman notes: “The FR2 MIMO OTA requirements can be further revised if simulation results and/or measurement results are submitted by companies” |
| Keysight Technologies | Same comments as in 1st round. The simulation gap is due to UE antenna assumption differences which was common for FR2 SISO/Demod requirements definitions and those requirements were defined based on a compromise proposal. |
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**Issue 3-2-2: How to handle the misalignment between simulation and measurement**

*Companies have not reached consensus on how to handle the misalignment between simulation and measurement in 1st round.*

*Recommendations for 2nd round:*

* Companies can further discuss this issue.
* Future actions depend on RAN decision on Rel-18.

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| **Company** | **Comments** |
| Qualcomm | Thanks for Moderator’s efforts. Considering simulation approach was agreed as the alternative approach at the beginning of this WI, and companies have done the alignment for simulation results Based on the summary of results in R4-2213178, less than 3dB gap for peak direction, less than 6dB gap for 36 directions which is not a big offset compared with the traditional RAN4 simulation calibration campaign. To conclude this WI, we would like to propose the draft WF on FR2 MIMO OTA requirements:   * To calculate the FR2 MIMO OTA requirements based on the average of submitted simulation results, i.e., [-138.7]dBm/Hz. * To further consider [0.1]dB margin due to the non-ideal factor   To specify the MASC requirements for 70% maximum throughput for n258 as [-138.6]dBm/Hz. Meanwhile we can capture the following statement in the chairman notes: “The FR2 MIMO OTA requirements can be further revised if simulation results and/or measurement results are submitted by companies” |
| Keysight Technologies | Same comments as above, i.e., it was agreed previously that requirements can be defined based on simulations. |
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### Sub-topic 3-3 FR2 MIMO OTA performance requirements

**Issue 3-3-2: How to derive** **FR2 MIMO OTA requirements from the simulation results**

*In 1st round, companies have not reached agreement on how to derive FR2 MIMO OTA requirements based on the current data pool.*

*Recommendations for 2nd round:*

* Companies can further discuss this issue.
* Future actions depend on RAN decision on Rel-18.

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| **Company** | **Comments** |
| Qualcomm | Thanks for Moderator’s efforts. Considering simulation approach was agreed as the alternative approach at the beginning of this WI, and companies have done the alignment for simulation results Based on the summary of results in R4-2213178, less than 3dB gap for peak direction, less than 6dB gap for 36 directions which is not a big offset compared with the traditional RAN4 simulation calibration campaign. To conclude this WI, we would like to propose the draft WF on FR2 MIMO OTA requirements:   * To calculate the FR2 MIMO OTA requirements based on the average of submitted simulation results, i.e., [-138.7]dBm/Hz. * To further consider [0.1]dB margin due to the non-ideal factor   To specify the MASC requirements for 70% maximum throughput for n258 as [-138.6]dBm/Hz. Meanwhile we can capture the following statement in the chairman notes: “The FR2 MIMO OTA requirements can be further revised if simulation results and/or measurement results are submitted by companies” |
| Keysight Technologies | Same comments as in 1st round. The simulation gap is due to UE antenna assumption differences which was common for FR2 SISO/Demod requirements definitions and those requirements were defined based on a compromise proposal. |
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# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |  |
| --- | --- | --- | --- |
| **New Tdoc number** | **Title** | **Source** | **Comments** |
|  | WF on NR MIMO OTA | CAICT, vivo |  |
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**Existing tdocs**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tdoc number** | **Revised to** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-22xxxxx |  | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-2211560 |  | On MIMO OTA FR1 lab alignment criteria | Huawei Tech.(UK) Co.. Ltd | Noted | other |
| R4-2211826 |  | Draft CR to update Number of HARQ Processes | Keysight Technologies UK Ltd, vivo, Samsung, CAICT | Agreeable | draftCR |
| R4-2211827 |  | Draft CR to update Number of HARQ Processes | Keysight Technologies UK Ltd, vivo, Samsung, CAICT | Agreeable | draftCR |
| R4-2211987 |  | Draft CR to TS 38.151 on editorial correction | Samsung | Agreeable | draftCR |
| R4-2211996 |  | FR1 MIMO OTA Test Campaign results from Huawei | Huawei Tech.(UK) Co.. Ltd | Noted | discussion |
| R4-2212323 |  | Channel model validation results for FR2 | CMCC | Noted | discussion |
| R4-2212406 | *R4-2215135* | MIMO OTA lab alignment results | Apple | Revised | discussion |
| R4-2212407 |  | MIMO OTA device measurement results and requirement proposal | Apple | Noted | discussion |
| R4-2212568 | *R4-2215136* | LS on NR MIMO OTA | CAICT, OPPO | Revised | LS out |
| R4-2212639 |  | Proposals on concluding NR MIMO OTA WI | CAICT,SAICT | Noted | discussion |
| R4-2212640 | *R4-2215137* | Proposals on FR1 MIMO OTA performance requirements | CAICT | Revised | discussion |
| R4-2212641 | *R4-2214794* | draft CR to TS38.151 on minmum requirements | CAICT | Revised | draftCR |
| R4-2212642 |  | Summary of FR1 MIMO OTA lab alignment results | CAICT | Return to | discussion |
| R4-2212644 |  | draft CR to TS38.151 on maximum downlink power and additional criterion for FR1 MIMO OTA test | CAICT | Agreeable | draftCR |
| R4-2212819 |  | Views on Test Tolerance for FR1 MIMO OTA | vivo | Noted | discussion |
| R4-2212820 |  | Proposals on FR1 MIMO OTA requirements | vivo | Withdrawn | discussion |
| R4-2212828 |  | draft CR to TS38.151 on MIMO OTA requirements | vivo | Merged | draftCR |
| R4-2213177 |  | On FR2 MIMO OTA requirements | Qualcomm Incorporated | Noted | discussion |
| R4-2213178 |  | Summary results for FR2 MIMO OTA | Qualcomm Incorporated | Return to | discussion |
| R4-2213187 |  | Discussion on FR2 MIMO OTA performance requirements | Huawei,HiSilicon | Noted | Discussion |
| R4-2213188 | *R4-2214816* | CR to 38.151 on Validation Passfail limit | Huawei,HiSilicon | Revised | draftCR (Tdoc number mismatched with the contribution) |
| R4-2213189 | *R4-2214817* | Discussion on FR2 MIMO OTA channel model validation | Huawei,HiSilicon | Revised | Discussion (Tdoc number mismatched with the contribution) |
| R4-2213190 | *R4-2214818* | CR to 38.151 on Channel model calidation | Huawei,HiSilicon | Revised | draftCR (Tdoc number mismatched with the contribution) |
| R4-2213197 |  | on the performance requirement for FR1 MIMO OTA | Xiaomi | Noted | discussion |
| R4-2213204 |  | test result for FR1 performance requirement | Xiaomi | Noted | discussion |
| R4-2213422 |  | Lab alignment and requirement for FR1 MIMO OTA | OPPO | Noted | discussion |
| R4-2213427 |  | Views on FR1 MIMO OTA performance requirement | OPPO | Noted | discussion |
| R4-2213428 |  | Views on FR2 MIMO OTA performance requirement | OPPO | Noted | discussion |

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** | **Revised to** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2214360 |  | WF on NR MIMO OTA | CAICT, vivo | To be discussed in GTW |  |
| R4-2215135 |  | MIMO OTA lab alignment results | Apple | Noted |  |
| R4-2215136 |  | LS on NR MIMO OTA | CAICT, OPPO | To be updated based on GTW agreements |  |
| R4-2215137 |  | Proposals on FR1 MIMO OTA performance requirements | CAICT | Noted |  |
| R4-2214794 |  | draft CR to TS38.151 on minimum requirements | CAICT | To be updated based on GTW agreements |  |
| R4-2212642 |  | Summary of FR1 MIMO OTA lab alignment results | CAICT | Noted |  |
| R4-2213178 |  | Summary results for FR2 MIMO OTA | Qualcomm Incorporated | to be withdrawn |  |
| R4-2214816 |  | CR to 38.151 on Validation Passfail limit | Huawei,HiSilicon | Agreeable |  |
| R4-2214817 |  | Discussion on FR2 MIMO OTA channel model validation | Huawei,HiSilicon | Noted |  |
| R4-2214818 |  | CR to 38.151 on Channel model calidation | Huawei,HiSilicon | Agreeable |  |

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3. Do not include hyper-links in the documents