**3GPP TSG-RAN WG4 Meeting # 104-e R4-22XXXXX**

**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.

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
| CAICT | Xuan Yi  Siting Zhu | [yixuan@caict.ac.cn](mailto:yixuan@caict.ac.cn)  zhusiting@caict.ac.cn |
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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. |

Sub topic 1-2 FR2 channel model validation results

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | **Issue 1-2-1: FR2 channel model validation results** |

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 |
|  |  |

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

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

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

## Discussion on 2nd round (if applicable)

# Topic #2: 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]** |  |  |  |



****

**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**

* 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

|  |  |
| --- | --- |
| **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. |

Sub topic 2-2 FR1 MIMO OTA lab alignment

|  |  |
| --- | --- |
| **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. |

Sub topic 2-3 FR1 MIMO OTA performance test campaign

|  |  |
| --- | --- |
| **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. |

Sub topic 2-4 FR1 MIMO OTA performance requirements

|  |  |
| --- | --- |
| **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 |

Sub topic 2-5 Test Tolerance for FR1 MIMO OTA

|  |  |
| --- | --- |
| **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. |

### 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

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

# Topic #3: FR2 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.** |
| [**R4-2213177**](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

|  |  |
| --- | --- |
| **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. |

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

|  |  |
| --- | --- |
| **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** |

Sub topic 3-3 FR2 MIMO OTA performance requirements

|  |  |
| --- | --- |
| **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. |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

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

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |  |
| --- | --- | --- | --- |
| **New Tdoc number** | **Title** | **Source** | **Comments** |
|  | WF on … | YYY |  |
|  | LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
|  |  |  |  |

**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 |  | other |
| R4-2211826 |  | Draft CR to update Number of HARQ Processes | Keysight Technologies UK Ltd, vivo, Samsung, CAICT |  | draftCR |
| R4-2211827 |  | Draft CR to update Number of HARQ Processes | Keysight Technologies UK Ltd, vivo, Samsung, CAICT |  | draftCR |
| R4-2211987 |  | Draft CR to TS 38.151 on editorial correction | Samsung |  | draftCR |
| R4-2211996 |  | FR1 MIMO OTA Test Campaign results from Huawei | Huawei Tech.(UK) Co.. Ltd |  | discussion |
| R4-2212323 |  | Channel model validation results for FR2 | CMCC |  | discussion |
| R4-2212406 |  | MIMO OTA lab alignment results | Apple |  | discussion |
| R4-2212407 |  | MIMO OTA device measurement results and requirement proposal | Apple |  | discussion |
| R4-2212568 |  | LS on NR MIMO OTA | CAICT |  | LS out |
| R4-2212639 |  | Proposals on concluding NR MIMO OTA WI | CAICT,SAICT |  | discussion |
| R4-2212640 |  | Proposals on FR1 MIMO OTA performance requirements | CAICT |  | discussion |
| R4-2212641 |  | draft CR to TS38.151 on minmum requirements | CAICT |  | draftCR |
| R4-2212642 |  | Summary of FR1 MIMO OTA lab alignment results | CAICT |  | discussion |
| R4-2212644 |  | draft CR to TS38.151 on maximum downlink power and additional criterion for FR1 MIMO OTA test | CAICT |  | draftCR |
| R4-2212819 |  | Views on Test Tolerance for FR1 MIMO OTA | vivo |  | discussion |
| R4-2212820 |  | Proposals on FR1 MIMO OTA requirements | vivo |  | discussion |
| R4-2212828 |  | draft CR to TS38.151 on MIMO OTA requirements | vivo |  | draftCR |
| R4-2213177 |  | On FR2 MIMO OTA requirements | Qualcomm Incorporated |  | discussion |
| R4-2213178 |  | Summary results for FR2 MIMO OTA | Qualcomm Incorporated |  | discussion |
| R4-2213187 |  | Discussion on FR2 MIMO OTA performance requirements | Huawei,HiSilicon |  | Discussion |
| R4-2213188 |  | CR to 38.151 on Validation Passfail limit | Huawei,HiSilicon |  | draftCR (Tdoc number mismatched with the contribution) |
| R4-2213189 |  | Discussion on FR2 MIMO OTA channel model validation | Huawei,HiSilicon |  | Discussion (Tdoc number mismatched with the contribution) |
| R4-2213190 |  | CR to 38.151 on Channel model calidation | Huawei,HiSilicon |  | draftCR (Tdoc number mismatched with the contribution) |
| R4-2213197 |  | on the performance requirement for FR1 MIMO OTA | Xiaomi |  | discussion |
| R4-2213204 |  | test result for FR1 performance requirement | Xiaomi |  | discussion |
| R4-2213422 |  | Lab alignment and requirement for FR1 MIMO OTA | OPPO |  | discussion |
| R4-2213427 |  | Views on FR1 MIMO OTA performance requirement | OPPO |  | discussion |
| R4-2213428 |  | Views on FR2 MIMO OTA performance requirement | OPPO |  | 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

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tdoc number** | **Revised to** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-22xxxxx |  | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-22xxxxx |  | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-22xxxxx |  | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |  |

Notes:

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