**3GPP TSG-RAN WG4 Meeting # 107 R4-23XXXXX**

**Incheon, KR, May 22nd – May 26th , 2023**

**Agenda item:** 8.17.6

**Source:** Moderator (CAICT)

**Title:** Topic summary for [107][333] NR\_MIMO\_OTA\_enh

**Document for:** Information

# Introduction

*This topic summary covers discussions for Rel-18 NR\_MIMO\_OTA\_enh WI (AI 8.17) and Rel-17 MIMO OTA maintenance (R4-2308739, R4-2309250, R4-2309304 in AI 5.2.2).*

# Topic #1: FR1 MIMO OTA

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2307242**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307242.zip) | Huawei, HiSilicon | MU associated with hand phantom  **Proposal: review and endorse the MU table in R4-2307242 for MIMO OTA tests with hand phantoms.** |
| [**R4-2307244**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307244.zip) | Huawei, HiSilicon | On the necessity of testing with hand phantom  **Observation 1: majority of use scenarios involves interaction with hands.**  **Observation 2: the first step towards improving performance during device interaction with hands is to bench mark the performance degradation due to hands.**  **Proposal 1: in view of observation 1 and 2, it is necessary to study MIMO performance with hand phantom.** |
| [**R4-2307506**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307506.zip) | MediaTek (Hefei) Inc. | Channel validation results at low bands  ***Observation1****: Channel validation results are submitted for all listed items as one of Lab volunteers:*   |  |  | | --- | --- | |  | **Case** | | Channel Model Validation | PDP | | Doppler/Temporal Correlation | | Spatial correlation | | Cross-polarization | | Power validation | |
| [**R4-2308742**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308742.zip) | CAICT | On FR1 MIMO OTA test with hand phantom  **Observation 1: At band n78, the rankings of 12 UEs by TRMS, TRS\_hand, and MIMO\_hand are not totally aligned.**  **Observation 2: At band n41, the rankings of 6 UEs by TRMS, TRS\_hand, and MIMO\_hand are almost the same.**  **Observation 3: At band n1, the rankings of 6 UEs by TRMS and MIMO\_hand are the same, but are different from the ranking by TRS\_hand.**  **Observation 4: Based on Observations 1~3, it can be concluded that MIMO OTA performance in browsing mode cannot be reflected by MIMO OTA performance in free space and TRS with hand phantoms.**  **Proposal 1: It is necessary to enhance the FR1 MIMO OTA test methodology for smartphone with hand phantoms.** |
| [**R4-2308743**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308743.zip) | CAICT | On FR1 MIMO OTA lab alignment  **Proposal 1: Adopt the following PAD delivery scheme for FR1 MIMO OTA lab alignment activity. The delivery scheme can be updated/refined during this meeting with formal confirmation of volunteer labs/PADs.**   * **Labs in Beijing -> Labs in Shanghai -> (transfer the PADs at Oct RAN4) -> Labs outside Asia**   + **Note: The PADs can be tested in different labs located in the same country in parallel during the same period.**   **Proposal 2: FR1 Lab Alignment Activity can start with the labs that completed channel model validation at band n28, after RAN4#107 immediately, once PADs are ready.** |
| [**R4-2308979**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308979.zip) | OPPO | On positioning guidelines with hand phantom  **Observation: The maximum length of DUT, which can be totally compassed in the quiet zone together with hand phantom, is 177mm.**  **Proposal: The positioning guideline for FR1 MIMO OTA in DMP mode is that the coordinate of the center of DUT with respect to the coordinate system of test system is (-3, -11, 37.5).** |
| **[R4-2309014](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309014.zip)** | Xiaomi | On the FR1 MIMO OTA  **Observation 1: the MIMO OTA performance in FS couldn’t accurately reflect the MIMO OTA performance with hand phantoms.**  **Observation 2:** **it is necessary to investigate the hand-phantom test for MIMO OTA for handheld UE.**  **Observation 3: the necessity also needs to consider the actual demand from operators.**  **Observation 4:** **changing current QZ range should not be considered at least in R18.** |
| [**R4-2309467**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309467.zip) | Keysight Technologies UK Ltd | On Phantom Testing and QZ Sizes  **Observation 1: Only the 30 cm QZ/test zone has been defined for OTA testing with phantoms for smartphone devices in 3GPP and CTIA.**  **Observation 2: The larger smartphones can typically fit inside the 20 cm QZ regardless of test condition, i.e., FS, DMP, DMSU**  **Observation 3: Using the default DUT positioning approach, the hand phantom cannot be fully contained within the 20 cm QZ but can be fully contained within the 30 cm QZ.**  **Observation 4: The hand phantom and smartphone can be fully contained within the 20 cm QZ in the DMP condition by offsetting the device and phantom and thus not aligning the centre of the coordinate system with the geometric centre of the DUT (default DUT positioning approach).**  **Observation 5: The hand phantom and smartphone cannot be fully contained with the 20 cm QZ in the DMSU condition regardless of offsets.**  **Proposal 1: The hand phantom (excluding adapters and fixtures) and smartphone shall be fully contained within the QZ.**  **Proposal 2: For the DMP condition only, consider offsetting the phone and phantom in z to fully enclose both within the 20 cm QZ.**  **Proposal 2: Adjust the WID to augment the existing 20 cm QZ/test zone with a 30 cm QZ if phantoms are considered for NR FR1 MIMO OTA testing in DMP and DMSU conditions.**  **Proposal 3: In the absence of introducing another QZ/test zone, do not consider phantoms for NR FR1 MIMO OTA testing in DMP and DMSU conditions.** |

## Open issues summary

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

### Sub-topic 1-1 FR1 MIMO OTA test with Hand phantoms

**Issue 1-1-1: Necessity of FR1 MIMO OTA test with hand phantom**

* Proposals
  + Proposal 1: It is necessary to enhance the FR1 MIMO OTA test methodology for smartphone with hand phantoms. (CAICT, Huawei, Xiaomi)
  + Proposal 2: Operators’ actual demands need to be taken into account. (based on Observation 3 in R4-2309014).
* Recommended WF
  + TBA

**Issue 1-1-2: Feasibility of FR1 MIMO OTA test with hand phantom**

* Proposals
  + Proposal 1: The hand phantom (excluding adapters and fixtures) and smartphone shall be fully contained within the QZ. (Keysight)
  + Proposal 2: For the DMP condition only, consider offsetting the phone and phantom to fully enclose both within the 20 cm QZ. The offsets with respect to the centre of test system can be (-3, -11, 37.5). (Keysight, OPPO)
  + Proposal 3: Adjust the WID to augment the existing 20 cm QZ/test zone with a 30 cm QZ if phantoms are considered for NR FR1 MIMO OTA testing in DMP and DMSU conditions. (Keysight)
  + Proposal 4: In the absence of introducing another QZ/test zone, do not consider phantoms for NR FR1 MIMO OTA testing in DMP and DMSU conditions. (Keysight)
  + Proposal 5: Review and endorse the MU table in R4-2307242 for MIMO OTA tests with hand phantoms. (Huawei)
* Recommended WF
  + TBA

### Sub-topic 1-2 FR1 MIMO OTA requirements related work

*Background: It was agreed in the time plan (R4-2305911) to conclude lab volunteers, PADs’ information, and delivery scheme at this for Rel-18 FR1 lab alignment activity.*

**Issue 1-2-1:** **Volunteer labs for FR1 lab alignment activity**

* Proposal
  + Confirm the Volunteer labs for FR1 MIMO OTA lab alignment. The information collection form can be updated during this meeting.

|  |  |  |
| --- | --- | --- |
| **Volunteer lab** | **City** | **Contact** |
| Apple | Cupertino, California, USA | Istvan Szini  Istvan@apple.com |
| CAICT | Beijing, China | Xuan Yi, [yixuan@caict.ac.cn](mailto:yixuan@caict.ac.cn) |
| CMCC&BUPT joint lab | Beijing, China |  |
| MediaTek | Beijing, China |  |
| Xiaomi | Beijing, China |  |
| Huawei | Shanghai, China |  |
|  |  |  |

* Recommended WF
  + Volunteer labs are invited to provide and confirm the information before/during this meeting.
  + Capture confirmed information in WF.

**Issue 1-2-2: PADs for FR1 lab alignment activity**

* Proposal
  + Confirm the PADs for FR1 MIMO OTA lab alignment. The information collection form can be updated during this meeting.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Provider** | **How many PADs** | **Supported FR1 bands** | **PAD current location** | **When will the PAD(s) be ready** | **Note** |
|  |  |  |  |  |  |
|  |  |  |  |  |  |
|  |  |  |  |  |  |

* Recommended WF
  + PAD providers are invited to provide and confirm the information before/during this meeting.
  + Capture confirmed information in WF.

**Issue 1-2-3: Implementation of FR1 MIMO OTA lab alignment**

* Proposals (CAICT)
  + Proposal 1: Adopt the following PAD delivery scheme for FR1 MIMO OTA lab alignment activity. The delivery scheme can be updated/refined during this meeting with formally confirmation of volunteer labs/PADs.
* Labs in Beijing -> Labs in Shanghai -> (transfer the PADs at Oct RAN4) -> Labs outside Asia
  + - * + Note: The PADs can be tested in different labs located in the same country in parallel during the same period.
  + Proposal 2: FR1 Lab Alignment Activity can start with the labs that completed channel model validation at band n28, after RAN4#107 immediately, once PADs are ready.
* Recommended WF
  + Conclude the PAD delivery scheme at this meeting.

**Issue 1-2-4: Channel model validation results submission**

*Note: It was agreed in the time plan (R4-2305911) that the deadline for channel model validation results submission is the starting of RAN4#108 (21 Aug 2023).*

* Observation:
  + MediaTek submitted the channel model validation results in R4-2307506; CAICT submitted part of channel model validation results in R4-2301048 at RAN4#106.

# Topic #2: FR2 MIMO OTA

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2307938**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307938.zip) | Samsung | On applicability decision tree for FR2 MIMO OTA  **Proposal 1: Reuse the same decision tree of FR1 TRP TRS for FR2 MIMO OTA to select EN-DC band combination.**  **Proposal 2:** **Collect PAD’s information on the supported LTE bands corresponding to the NR FR2 tested band in lab alignment campaign, and the tested EN-DC band combination should be recorded in test results.**  **Proposal 3: RAN4 further discuss how to handle the applicability rule for both SA and NSA capable FR2 UEs.** |
| [**R4-2308740**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308740.zip) | CAICT | 3GPP FR2 MIMO OTA Lab Alignment Activity Template |
| [**R4-2308741**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308741.zip) | CAICT | Updated Framework for FR2 MIMO OTA performance requirements development (May 2023)  **Proposal 1: Approve the updated Framework defined in this contribution to guide the FR2 MIMO OTA performance requirements related work. Further refinement is not precluded based on discussion outcomes in future meetings.** |
| [**R4-2309242**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309242.zip) | Qualcomm Incorporated | Views on FR2 MIMO OTA requirements  **Observation 1: With the anonymous manner, it is not feasible to know how many antenna modules are used by the sample devices.**  **Observation 2: It is not technically correct to apply the antenna gain drop between single-panel vs two or more than two panels on top of measurement results since the MACS is the spatial average of MIMO sensitivity under the fading channel that is quite different from legacy EIS simulation.**  **Observation 3: Expecting devices to be getting worse is NOT the right direction in 3GPP when specifying the FR2 MIMO OTA requirements.**  **Proposal 1: RAN4 to derive the FR2 MIMO OTA requirements based on the measurement results of commercial devices and does** **not need to consider any proportion of certain number of antenna panel UE.** |
| [**R4-2309301**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309301.zip) | Huawei,HiSilicon | Discussion on FR2 MIMO OTA test methodology enhancement  **Proposal 1: RAN4 not consider defining the criteria for selecting the LTE anchor band and any LTE anchor band can be used for the measurement activity.** |
| [**R4-2309468**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309468.zip) | Keysight Technologies UK Ltd, Spirent Communications | On FR2 CE MU  **Proposal 1: Re-use the FR1 Channel Emulator definition and MU values for FR2** |

## Open issues summary

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

### Sub-topic 2-1 Framework for FR2 MIMO OTA

*An updated framework is provided in R4-2308741.*

**Issue 2-1-1: Whether to consider a certain number of UE panels**

* Proposals
  + Option 1: Approve the updates proposed in the updated framework (R4-2308741), i.e., not to consider the proportions of any certain number of UE panels in Simulation Platform Validation Activity, Simulation Campaign, and Measurement Campaign; and not to consider the UE panel impact on performance requirements. (CAICT, Qualcomm)
  + Others
* Recommended WF
  + Companies are invited to share views.
  + The framework (R4-2308741) should be revised based on the discussion outcomes. The target is to approve the framework at this meeting.

**Issue 2-1-2: Working procedures for Measurement campaign**

* Proposal:
  + Approve the updated working procedures for Measurement campaign in R4-2308741:

1. Test cases for FR2 MIMO OTA Measurement Campaign:
   1. Test band: n261 (first stage)
   2. Operation mode: NR Non-Standalone (NSA) (first stage)
   3. Powe class: PC3 (first stage)
   4. ~~FFS whether RAN4 shall guarantee the considerable proportion of single panel UE and how to guarantee the proportion of single panel UE~~
2. Commercial Device (Smartphone) selection criteria:
   1. DUT capability: at least support n261
   2. The following selection criteria can also be considered:
      1. Year of production: 2019-2023
      2. Brand variety
      3. Popularity
      4. Number of bands supported
   3. Power Class: PC3
3. Commercial devices preparation:
   1. Test labs can collect commercial devices by themselves based on the above selection criteria
   2. Other companies are also encouraged to provide commercial devices based on the above selection criteria.
4. Measurement results submission:
   1. Use the same worksheet template to submit the measurement results (a template will be submitted to RAN4 meetings for approval)
   2. The measurement results should be submitted to RAN4 by anonymous approach (the UE model should not be disclosed). The following information should be provided:
      1. All FR2 bands supported by each UE
      2. Production year of each UE
      3. Other information that should be disclosed is FFS~~, consider to reuse the discussion outcomes of Rel-17 TRP TRS.~~
   3. The plan and progress of each lab are encouraged to be shared via the RAN4 reflector (e.g., how many devices are planned to be/ have been measured)

* Recommended WF
  + Companies are invited to share views.
  + The framework (R4-2308741) should be revised based on the discussion outcomes. The target is to approve the framework at this meeting.

**Issue 2-1-3: How to process the PAD measurement results to be included into the data pool**

*The agreements of the last meeting in the WF:*

|  |
| --- |
| **Issue 2-1-4: Approaches to increase the measurement data for requirements development**  **<Agreement>**:   * Include the PAD measurement results from aligned labs into the data pool for specifying FR2 MIMO OTA performance requirements, if allowed by PAD providers. FFS how to process the PAD measurement results from aligned labs. |

* Proposals:
  + Proposal 1 (R4-2308741): Directly include the lab alignment reference values of PAD measurement results into the data pool for specifying FR2 MIMO OTA performance requirements. (The generation process of reference values is described in 6b. of cluses 2.2.3 of the framework).
* Recommended WF
  + Companies are invited to share views.
  + The framework (R4-2308741) should be revised based on the discussion outcomes. The target is to approve the framework at this meeting.

### Sub-topic 2-2 FR2 MIMO OTA requirements related work

**Issue 2-2-1: Collect PADs’ information on supported LTE bands**

*This issue is related to Issue 2-3-1.*

* Proposals
  + Proposal 1: Collect PAD’s information on the supported LTE bands corresponding to the NR FR2 tested band in lab alignment campaign, and the tested EN-DC band combination should be recorded in test results. (Samsung)
* Recommended WF
  + Companies are invited to share views.

**Issue 2-2-2: Template for FR2 MIMO OTA lab alignment activity**

*A template is provided in R4-2308740 for PAD measurement results submission during FR2 MIMO OTA lab alignment activity.*

* Recommended WF
  + Companies are invited to review the template.
  + The target is to approve the template at this meeting.

### Sub-topic 2-3 EN-DC band combination selection for FR2 MIMO OTA

**Issue 2-3-1: EN-DC band combination selection for FR2 MIMO OTA**

* Proposals
  + Option 1 (Stick to previous agreements): To make sure a consistent test condition for a particular UE across different labs, an example LTE anchor band along with a decision tree shall be defined. LTE B66 is selected as the example LTE anchor band for n261 FR2 MIMO OTA test. For UEs that don’t support B66, use a decision tree to select the LTE anchor band.
    - Proposal 1: Reuse the same decision tree of FR1 TRP TRS for FR2 MIMO OTA to select EN-DC band combination. (Samsung)
  + Option 2 (Huawei): RAN4 not consider defining the criteria for selecting the LTE anchor band and any LTE anchor band can be used for the measurement activity.
* Recommended WF
  + Companies are invited to share views.

**Issue 2-3-2: Applicability rules for MIMO OTA testing of FR2 SA and NSA UEs**

* Proposal
  + Proposal 1: RAN4 further discuss how to handle the applicability rules for both SA and NSA capable FR2 UEs. (Samsung)
* Recommended WF
  + Companies are invited to share views.

### Sub-topic 2-4 Preliminary MU assessment for FR2 MIMO OTA

**Issue 2-4: FR2 channel emulator MU element**

* Proposals
  + Proposal 1: Re-use the FR1 Channel Emulator definition and MU values for FR2. (Keysight, Spirent)
* Recommended WF
  + Companies are invited to share views.

# Topic #3: Rel-17 MIMO OTA maintenance

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2307241**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2307241.zip)  *(not summarized)* | Huawei, HiSilicon, CAICT, MVG | CR to TS38.151 on FR1 power validation pass fail limit |
| [**R4-2309473**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309473.zip) | Apple, Keysight Technologies | On FR2 MIMO OTA channel model validation  **Proposal 1: Implement on TS 38.151 an alternative time domain test method for the FR2 TCF.**  **Proposal 2: Implement on TS 38.151 a PDP target definition for an additional cluster at 0ns.**  **Proposal 3: Implement on TS 38.151 an option to measure the EPRE Power Validation adopting a test equipment capable to decode the NR signal** |
| [**R4-2309474**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309474.zip)  *(not summarized)* | Apple, Keysight Technologies | Update on PDP Targets for FR2 CDL-C channel model  (CR to TS 38.151) |
| [**R4-2309475**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309475.zip)  *(not summarized)* | Apple, Keysight Technologies | Update on TCF Test Methodology for FR2 CDL-C channel model  (CR to TS 38.151) |
| [**R4-2309476**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309476.zip) | Apple, Keysight Technologies | Update on Test methodology for FR2 Channel Model Power Validation  (CR to TS 38.151) |
| [**R4-2309744**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309744.zip)  *(not summarized)* | Apple | On TS 38.151 Annex C editorial updates  (CR to TS 38.151) |
| [**R4-2308739**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2308739.zip)  *(not summarized)* | CAICT, Spirent, MediaTek, Keysight Technologies | CR to TS 38.151 on FR1 spatial correlation pass/fail limits |
| [**R4-2309250**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309250.zip)  *(not summarized)* | Qualcomm Incorporated | CR on TS 38.151 for clarifications on FR1 channel model parameters |
| [**R4-2309304**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_107/Docs/R4-2309304.zip) | Huawei,HiSilicon | Discussion on FR2 MIMO OTA channel validation  **Proposal 1: Considering unaligned decoding algorithm and the enough accuacy of legacy power validation unaligned decoding algorithm, not recommendation the EPRE power validation.** |

## Open issues summary

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

### Sub-topic 3-1 FR2 channel model validation

**Issue 3-1: FR2 Channel Model Power Validation**

* Proposals
  + Option 1 (Apple): Implement on TS 38.151 an option to measure the EPRE Power Validation adopting a test equipment capable to decode the NR signal, as the CR in R4-2309476.
  + Option 2 (Huawei): Considering unaligned decoding algorithm and the enough accuracy of legacy power validation, not recommendation the EPRE power validation.
* Recommended WF
  + TBA