**3GPP TSG-RAN WG4 Meeting # 109 R4-232xxxx**

**Chicago, USA, November 13 – November 17, 2023**

**Agenda item:** 8.16.6

**Source:** Moderator (CAICT)

**Title:** Ad-hoc minutes for [109][336] NR\_MIMO\_OTA\_enh

**Document for:** Approval

# Introduction

This is the meeting minutes of ad-hoc discussions for Rel-18 NR\_MIMO\_OTA\_enh WI, chaired by Xuan Yi (CAICT).

# Topic #1: FR1 MIMO OTA

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **[R4-2318102](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318102.zip)** | Huawei, HiSilicon | on identification of number receive paths in devices  **Proposal 1: consider using IE srs-TxSwitch, in conjunction with other means, to identify the number of receive chains.** |
| **[R4-2318269](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318269.zip)** | Mediatek India Technology Pvt. | Measurement results of Mediatek lab for 3GPP Rel-18 FR1 MIMO OTA lab alignment activity |
| **[R4-2318896](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318896.zip)** | Xiaomi | Measure results for 3GPP Rel-18 FR1 MIMO OTA Lab Alignment |
| **[R4-2318927](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318927.zip)** | CMCC | PADs measurement results for n28. |
| **[R4-2318977](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318977.zip)** | vivo | Discussions on FR1 MIMO OTA requirement related work  **Proposal 1: RAN4 should check the following information to ensure FR1 MIMO OTA requirements could be successfully defined in Rel-18.**   * **The number of DUTs they expect to be able to measure and submit to RAN4 data pool** * **The 3GPP member providing the DUTs check how many samples they intend to provide (with support of UE pre-configuration for measurements)**   **Proposal 2: RAN4 should consider developing 4Rx requirements for n1 in Rel-18 as an efficient way.** |
| **[R4-2319109](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319109.zip)** | Apple | On FR1 MIMO OTA noise evaluation  **Proposal 1 RAN4 to accept the measurement results presented in this contribution as an evidence of Apple’s FR1 MIMO OTA lab compliance on low frequency noise mitigation evaluation.** |
| **[R4-2319916](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319916.zip)** | OPPO | Study of number of slots for low band FR1 MIMO OTA  ***Observation 1: The deltas of TRMS with measurement slot number of 20k and 10k separately are less than 0.4dB.***  ***Observation 2: It can achieve around 1/3 test time reduction with 10k measurement slots.***  ***Proposal 1: It is proposed to adopt 10k as minimum number of slots per stream for MIMO OTA measurements of bands < 1GHz.*** |
| **[R4-2319919](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319919.zip)** | OPPO | 3GPP Rel-18 FR1 MIMO OTA PAD measurement |
| **[R4-2320065](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320065.zip)** | CAICT | Updated Framework and time plan for FR1 MIMO OTA performance requirements development (Nov 2023)  **Proposal 1: Approve the updated framework and time plan in Section 3 of this contribution for FR1 MIMO OTA performance requirements development.** |
| **[R4-2320067](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320067.zip)** | CAICT | CAICT Rel-18 FR1 MIMO OTA Lab Alignment PAD Results |
| **[R4-2320068](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320068.zip)** | CAICT | Channel model validation results for Bands n1, n5  **Observation 1: CAICT has completed a full set of MIMO OTA channel model validation for CDL-C UMi at band n1 and n5. The following characteristics have been validated: TCF, SCF, PDP, Cross-polarization, and Power validation.** |
| **[R4-2320381](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320381.zip)** | Qualcomm Incorporated | Discussion on FR1 MIMO OTA test method  **Proposal 1: RAN4 to confirm whether it is a case that a UE with 4Rx on band n1 might report 2Rx in the IE of maxNumberMIMO-LayersPDSCH.**  **Proposal 2: If the IE of maxNumberMIMO-LayersPDSCH could not correctly reflect the UE’s capability for 2Rx or 4Rx. RAN4 should consider the approach of collecting information from OEMs by a neutral party and approve the corresponding guideline.** |
| **[R4-2320594](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320594.zip)** | CAICT | On FR1 MIMO OTA test time reduction  **Observation 1: Based on our measurement results, the TRMS difference between 10k and 20k is small, the maximum difference is 0.15 dB.**  **Observation 2: The actual test time could be reduced obviously if Minimum Number of Slots per Stream is decreased from 20k to 10k.**  **Proposal 1: For FR1 MIMO OTA test lab alignments and FR1 MIMO OTA UE performance requirements: the Minimum Number of Slots per Stream can be reduced to 10k for 15kHz SCS.** |
| **[R4-2320595](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320595.zip)** | CAICT | On MIMO OTA performance requirements work  **Proposal 1: RAN4 should define 4x4 MIMO OTA requirements for 4Rx UE, considering 4Rx UEs at band n1 is the majority on the market and mandatory in some countries/regions.**  **Proposal 2: No need to define 2x2 MIMO OTA requirements for 4Rx UE.**  **Proposal 3: Adopting the following methods to identify 2Rx UE and 4Rx UE and collect measurement data for band n1.**   * **Labs can try to identify 2Rx UE and 4Rx UE by themselves, and submit the measurement data to 3GPP together with the information of the number of Rx antenna ports. Including but not limited to the following methods:**   + **Obtain the MIMO layer information from BS simulator, e.g., check the Information Element of max. MIMO layers for PDSCH per CC/band from BS simulator.**   + **Directly collect the information from OEMs.** * **Any 3GPP member can work with the selected test labs to provide 2Rx/4Rx UEs.** * **For the device/data that labs cannot identify by themselves, a neutral party can help collect the information from OEMs.**    + **Step 1: Labs submit measurement data together with real UE models to the neutral party.**   + **Step 2: The neutral party asks OEMs for the information on the number of Rx antenna ports.**   + **Step 3: The neutral party labels the measurement data as 2Rx or 4Rx, then submits them to 3GPP anonymously.** |

## 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 Test time reduction for FR1 MIMO OTA < 1GHz [Core part]

*Background:* *in Rel-16, we adopted small Number of Slots per Stream for throughput as 10k, but only for bands >1GHz. For band<1GHz, the slot number is tentatively defined as [20k], in TS 38.151:*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Table E.1-1: FR1 Common test parameters   |  |  |  |  | | --- | --- | --- | --- | | **Parameter** | | **Unit** | **Value** | | PDSCH transmission scheme | |  | Transmission scheme 1 | | Carrier configuration | Offset between Point A and the lowest usable subcarrier on this carrier (Note 2) | RBs | 0 | | Subcarrier spacing | kHz | 15 or 30 |   *<Skip unnecessary part in the table…>*   |  |  |  | | --- | --- | --- | | Minimum Number of Slots per Stream |  | 20000 for 15kHz SCS  40000 for 30kHz SCS  (Note 3) | | Transmit Power Control | dBm | 13 | | DL power level  (RS EPRE of SSS) | dBm / SCS | Set at gNodeB simulator  with correction from calibration | | EPRE ratio of PDSCH to SSS | dB | 0 | | Note 1: UE assumes that the TCI state for the PDSCH is identical to the TCI state applied for the PDCCH transmission.  Note 2: Point A coincides with minimum guard band as specified in Table 5.3.3-1 from TS 38.101-1 for tested channel bandwidth and subcarrier spacing.  Note 3: For FR1 MIMO OTA test lab alignments and FR1 MIMO OTA UE performance requirements, the following values can be used:  For FR1 bands >1GHz: 20k for 30kHz SCS, 10k for 15kHz SCS;  For FR1 bands <1GHz: [20k] for 15kHz SCS; | | | | |

**Issue 1-1: Reduce Minimum Number of Slots per Stream for bands <1GHz to 10k**

*R4-2315433 (Xiaomi),* *R4-2319916 (OPPO), and R4-2320594 (CAICT) provided some measurement results, based on which we can obtain the following observations:*

* *Observation 1: the TRMS difference between 10k and 20k varies from 0.07 to 0.4 dB.*
* *Observation 2: test time can be reduced by about 1/3.*
* Proposals
  + Proposal 1 (CAICT, OPPO): adopt 10k as minimum number of slots per stream for MIMO OTA measurements of bands < 1GHz. (for FR1 MIMO OTA test lab alignments and FR1 MIMO OTA UE performance requirements, as stated in Table E.1-1 in TS 38.151)
* Recommended WF
  + Agree on Proposal 1, conclude the core part objective.

Discussions:

Agreements:

10k can be adopted to measurement campaign, and conformance test.

### Sub-topic 1-2 Actions required before participating in Rel-18 FR1 Lab Alignment Activity/Measurement Campaign [Perf. part]

**Issue 1-2-1: Exclude the impact of noise on MIMO OTA test results**

*Background: It was agreed at RAN4 #106 that labs should first exclude the impact of noise before performing MIMO OTA measurements, especially for frequency bands <1GHz.*

|  |
| --- |
| **Issue 2-2-1: Noise impact on MIMO OTA performance at low bands**  **<Agreement>:**   * + RAN4 should study low band noise issue.   + Labs should first exclude the impact of noise before performing MIMO OTA measurements, especially for frequency bands <1GHz. |

*Apple (R4-2319109) presents their measurement results of noise impact mitigation evaluation.*

*Up to now, all the volunteer labs for Rel-18 FR1 Lab Alignment Activity have performed such action. CAICT (R4-2301049), MediaTek (R4-2304073), CMCC&BUPT joint lab (R4-2304215), and OPPO (R4-2316227) presented the measurement results and the solution (adding attenuators) to eliminate the noise impact; Xiaomi (R4-2305525) indicated attenuator have been added to minimize the noise impact.*

* Proposals
  + Proposal 1 (Apple): RAN4 to accept the measurement results presented in this contribution (R4-2319109) as an evidence of Apple’s FR1 MIMO OTA lab compliance on low frequency noise mitigation evaluation.
* Recommended WF
  + Proposal 1 is agreeable.

Discussions:

Agreements:

Proposal 1 is agreed

**Issue 1-2-2: Complete channel model validation**

*Background: It was agreed that RAN4 will specify MIMO OTA requirements for bands < 1GHz based on the data from Rel-18 aligned labs, and specify MIMO OTA requirements for bands > 1GHz based on the data from Rel-17 aligned labs. Labs shall complete channel model validation before performing MIMO OTA test.*

|  |
| --- |
| (a) for bands <1GHz (n5/n8/n28) (b) for bands >1GHz (n1/n77)  Fig. 1. Work flow of FR1 MIMO OTA performance requirements development |

*For bands <1GHz, the status of each Rel-18 volunteer lab is summarized as below:*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Lab** | **Band** | **PDP** | **Doppler** | **Spatial correlation** | **V/H** | **Power validation** |
| Apple | n28 | √ | √ | √ | √ | √ |
| n5/n8 | NA | NA | NA | NA | NA |
| CAICT | n28 | √ | √ | √ | √ | √ |
| n5/n8 | √ | √ | √ | √ | n5: √  n8: NA |
| CMCC&BUPT | n28 | √ | √ | √ | √ | NA |
| n5/n8 | √ | √ | √ | √ | NA |
| MediaTek | n28 | √ | √ | √ | √ | √ |
| n5/n8 | √ | √ | √ | √ | √ |
| Xiaomi | n28 | √ | √ | √ | √ | √ |
| n5/n8 | NA | NA | NA | NA | NA |
| OPPO | n28 | √ | √ | √ | √ | √ |
| n5/n8 | NA | NA | NA | NA | NA |

*For bands <1GHz, the status of each Rel-17 aligned lab is summarized as below:*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Lab** | **Band** | **PDP** | **Doppler** | **Spatial correlation** | **V/H** | **Power validation** |
| Apple | n1 | NA | NA | NA | NA | NA |
| CAICT | n1 | √ | √ | √ | √ | √ |
| CMCC&BUPT | n1 | √ | √ | √ | √ | NA |
| Huawei | n1 | NA | NA | NA | NA | NA |
| MediaTek | n1 | √ | √ | √ | √ | √ |
| Xiaomi | n1 | NA | NA | NA | NA | NA |
| Note: Rel-17 aligned labs do not need to perform channel model validation for band n77, because the validation results for band n78 are applicable to band n77 due to the same validation frequency. | | | | | | |

* Observation:
  + Observation 1 (R4-2320068): CAICT has completed a full set of MIMO OTA channel model validation for CDL-C UMi at band n1 and n5. The following characteristics have been validated: TCF, SCF, PDP, Cross-polarization, and Power validation.
* Proposals
  + Proposal 1 (Moderator): Volunteer labs should provide channel model validation results for bands n1/5/8 no later than RAN4 #110 (Feb. 2024), to ensure the Measurement Campaigns will not be delayed.
* Recommended WF
  + Agree on Proposal 1.

Discussions:

Agreements:

Proposal 1 is agreed.

### Sub-topic 1-3 Rel-18 FR1 MIMO OTA lab alignment [Perf part]

**Issue 1-3: Preliminary outcome of Rel-18 FR1 MIMO OTA lab alignment**

*5 volunteer labs submitted the test results of three PADs: CAICT (R4-2320067), CMCC&BUPT (R4-2318927), MediaTek (R4-2318269), Xiaomi (R4-2318896), OPPO (R4-2319919). The PADs will be transferred to the last lab (Apple) at this meeting.*

*At this meeting, Moderator provides a summary and analysis of the measurement results from the 5 labs, targeting to show a preliminary outcome of the lab alignment activity and establish the confidence on progressing the follow-up Measurement Campaign.*

*The summary of the lab alignment results is shown in Table 1 and Figs. 1~2.*

Table 1. Summary of measurement results from 5 labs

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Device** | **Band** | **TRMS measurement result [dBm/15kHz]** | | | | | | **Average approach** | **Average value** | **Max-Min deviation** |
| **Lab 1** | **Lab 2** | **Lab 3** | **Lab 4** | **Lab 5** | **Lab 6** |
| PAD\_1 | n28 | -89.34 | -90.58 | -89.95 | -88.26 | -89.22 |  | Linear average | -89.47 | 2.32 |
| PAD\_2 | n28 | -86.46 | -88.39 | -88.61 | -85.50 | -85.86 |  | -86.96 | 3.12 |
| PAD\_3 | n28 | -86.26 | -89.80 | -88.75 | -86.19 | -86.49 |  | -87.50 | 3.61 |
| **Device** | **Band** | **TRMS offset [dBm/15kHz]** | | | | | | **Pass/fail limit** | | |
| **Lab 1** | **Lab 2** | **Lab 3** | **Lab 4** | **Lab 5** | **Lab 6** |
| PAD\_1 | n28 | 0.13 | -1.11 | -0.48 | 1.21 | 0.25 |  | [+/- 0.75 MU, i.e., +/- 2.25 dB] | | |
| PAD\_2 | n28 | 0.50 | -1.42 | -1.65 | 1.47 | 1.10 |  |
| PAD\_3 | n28 | 1.23 | -2.30 | -1.25 | 1.31 | 1.01 |  |

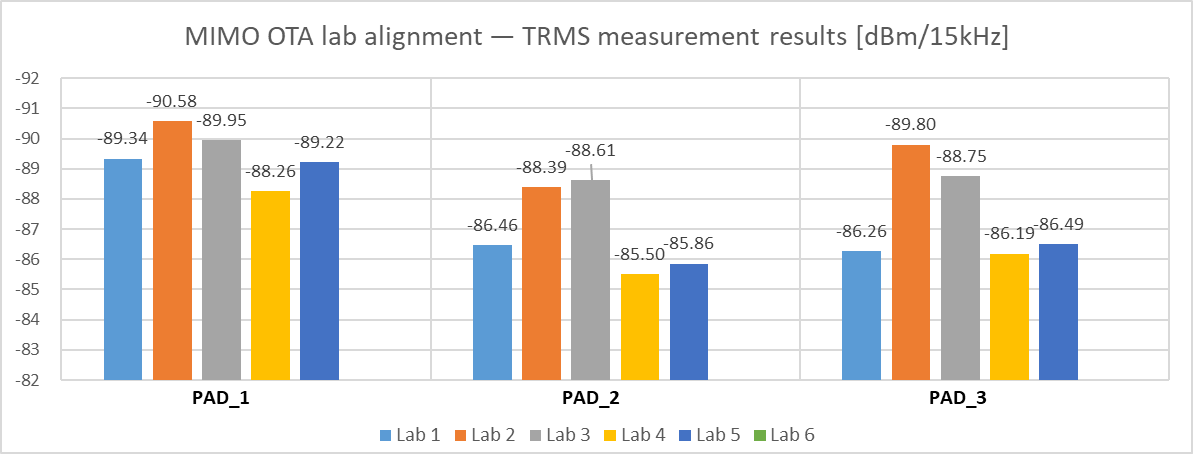


Fig. 1 Measurement results from 5 labs

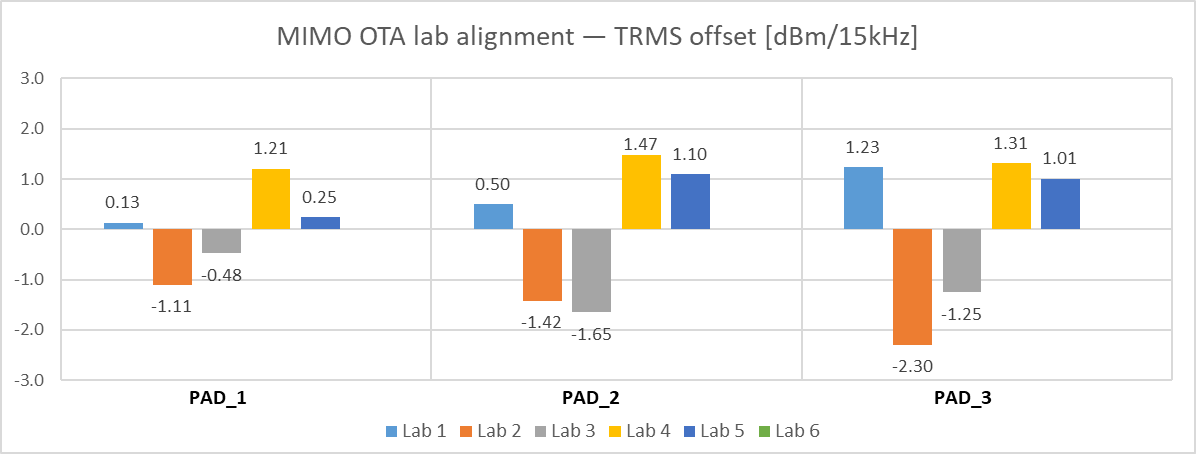


Fig. 2 Deviation between each measurement result and the average value

* Proposals
  + Proposal 1 (Moderator): Reuse the pass/fail limit of Rel-17 FR1 MIMO OTA lab alignment, i.e., +/- 0.75\*preliminary MU (+/- 2.25 dB for bands < 3GHz).
  + Proposal 2 (Moderator): Start the Measurement Campaign after RAN4#109 immediately, based on the preliminary outcome that ≥ 3 labs can be aligned.
* Recommended WF
  + Agree on the proposals, to ensure the progress of the performance requirements work

Discussions:

Agreements:

* + Reuse the pass/fail limit of Rel-17 FR1 MIMO OTA lab alignment, i.e., +/- 0.75\*preliminary MU (+/- 2.25 dB for bands < 3GHz).
  + Start the Measurement Campaign after RAN4#109 immediately, based on the preliminary outcome that ≥ 3 labs can be aligned.
  + The reference values will be derived by averaging the results from all 6 labs submitted in the 1st round. Then determine which labs are aligned; the potential failed labs can have the chance to retest. The reference values will not be changed, and the aligned labs will not be affected.

### Sub-topic 1-4 FR1 MIMO OTA requirements related work [Perf part]

**Issue 1-4-1: Which MIMO OTA requirements should be defined for band n1**

*Background: this issue has been discussed at the last meeting, in the WF:*

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| **Options:**   * Option 1: 2x2 MIMO OTA requirements for 2Rx UE * Option 2: 4x4 MIMO OTA requirements for 4Rx UE * Option 3: 2x2 MIMO OTA requirements for 4Rx UE   **Agreements:**   * Prioritize Option 1. Further study if RAN4 can consider Option 2 or Option 3 if Option 1 has been identified to be infeasible by Feb 2024. * The data pool should consist of UEs with only 2Rx for Option 1. * Companies are encouraged to input on the amount of UE models with only 2Rx available on the market. |

* Proposals
  + Proposal 1 (CAICT, vivo): RAN4 should consider defining 4x4 MIMO OTA requirements for 4Rx UE first in Rel-18, considering 4Rx UEs at band n1 is the majority on the market and mandatory in some countries/regions.
  + Proposal 2 (CAICT): Not to consider defining 2x2 MIMO OTA requirements for 4Rx UE.
* Recommended WF
  + Agree on Proposals 1 and 2 as an efficient way.

Discussions:

*Samsung: Not to perform measurement campaign for 2Rx UE.*

Agreements:

* + RAN4 should define 4x4 MIMO OTA requirements for 4Rx UE first in Rel-18, considering 4Rx UEs at band n1 is the majority on the market and mandatory in some countries/regions.
  + Not to define 2x2 MIMO OTA requirements for 4Rx UE.
  + Not to perform measurement campaign for 2Rx UE.

**Issue 1-4-2: Whether IEs can be used to identify 2Rx UE and 4Rx UE**

*In TS 38.306:*

| ***maxNumberMIMO-LayersPDSCH***  Defines the maximum number of spatial multiplexing layer(s) supported by the UE for DL reception. For single CC standalone NR, it is mandatory with capability signaling to support at least 4 MIMO layers in the bands where 4Rx is specified as mandatory for the given UE and at least 2 MIMO layers in FR2. If absent, the UE does not support MIMO on this carrier. | FSPC | CY | N/A | N/A |
| --- | --- | --- | --- | --- |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***srs-TxSwitch, srs-TxSwitch-v1610***  Defines whether UE supports SRS for DL CSI acquisition as defined in clause 6.2.1.2 of TS 38.214 [12]. The capability signalling comprises of the following parameters:  - *supportedSRS-TxPortSwitch* indicates SRS Tx port switching pattern supported by the UE, which is mandatory with capability signalling. The indicated UE antenna switching capability of ′xTyR′ corresponds to a UE, capable of SRS transmission on ′x′ antenna ports over total of ′y′ antennas, where ′y′ corresponds to all or subset of UE receive antennas, where 2T4R is two pairs of antennas. *supportedSRS-TxPortSwitch-v1610*, which is optional to report, indicates downgrading configuration of SRS Tx port switching pattern. If the UE indicates the support of downgrading configuration of SRS Tx port switching pattern using *supportedSRS-TxPortSwitch-v1610*, the UE shall report the values for this as below, based on what is reported in *supportedSRS-TxPortSwitch*.   |  |  | | --- | --- | | *supportedSRS-TxPortSwitch* | *supportedSRS-TxPortSwitch-v1610* | | *t1r2* | *t1r1-t1r2* | | *t1r4* | *t1r1-t1r2-t1r4* | | *t2r4* | *t1r1-t1r2-t2r2-t2r4* | | *t2r2* | *t1r1-t2r2* | | *t4r4* | *t1r1-t2r2-t4r4* | | *t1r4-t2r4* | *t1r1-t1r2-t2r2-t1r4-t2r4* |   - *txSwitchImpactToRx* indicates the lowest band entry number of the UL group (see *txSwitchWithAnotherBand*) that impacts the DL of this band entry;  - *txSwitchWithAnotherBand* indicates the lowest band entry of the UL group, which is defined as band entries with UL (see NOTE) that impact each other's UL (i.e. SRS TX port switching on any of the cells in the group will impact UL on all the cells in the group). This parameter is absent if an UL group contains only one band entry.  For *txSwitchImpactToRx* and *txSwitchWithAnotherBand*, value 1 means first entry, value 2 means second entry and so on. The UE may include *txSwitchImpactToRx* and *txSwitchWithAnotherBand* for a band entry even if *supportedSRS-TxPortSwitch* is set to 'notSupported' for that band entry. All DL and UL that switch together indicate the same entry number.  The entry number is the band entry number in a band combination. The UE is restricted not to include fallback band combinations for the purpose of indicating different SRS antenna switching capabilities.  NOTE: The band with UL includes a band associated with *FeatureSetUplinkId* set to 0 corresponding to the support of SRS-SwitchingTimeNR. | BC | FD | N/A | N/A |

* Proposals
  + Proposal 1 (Qualcomm): RAN4 to confirm whether it is a case that a UE with 4Rx on band n1 might report 2Rx in the IE of maxNumberMIMO-LayersPDSCH.
  + Proposal 2 (Huawei): consider using IE srs-TxSwitch, in conjunction with other means, to identify the number of receive chains.
* Recommended WF
  + Technical discussions are needed

Discussions:

QC: We have already agreed to define requirement for 4Rx UE. the IE of maxNumberMIMO-LayersPDSCH can be used for identifying 4 Rx UE.

QC: Is it possible that 4Rx UE only report 2r with IE srs-TxSwitch?

Keysight: If the UE can connect to the call box with 4x4 MIMO, not sure if checking with IEs is needed.

Agreements:

The IE of maxNumberMIMO-LayersPDSCH can be used to identify 4Rx UE

Further check if the IE srs-TxSwitch can be used to identify 4Rx UE.

**Issue 1-4-3: How to identify 2Rx UE and 4Rx UE**

*Background: this issue has been discussed at the last meeting, in the WF:*

|  |
| --- |
| **Agreement:**   * UEs will be classified based on the number of Rx antenna ports, regardless of the number of physical antennas.   + Note: The meaning of “antenna port” is the same as that in Clause 7.2 of 3GPP TS 38.101-1. * FFS how to identify the number of Rx antenna ports of UEs. Further discuss the following methods:   + Labs can check the Information Element of max. MIMO layers for PDSCH per CC/band from BS simulator.   + The information can be collected from OEMs by a neutral party. * Other methods are not excluded. |

*The proposals in R4-2320595, R4-2320381, R4-2318102 are merged:*

* Proposals
  + Proposal 1: Labs can try to identify 2Rx UE and 4Rx UE by themselves, and submit the measurement data to 3GPP together with the information of the number of Rx antenna ports. Including but not limited to the following methods:
    - [Obtain the MIMO layer information from BS simulator, e.g., check the IE maxNumberMIMO-LayersPDSCH and/or the IE srs-TxSwitch.]
      * Pending on discussion outcomes of Issue 1-4-2
    - Directly collect the information from OEMs.
  + Proposal 2: Any 3GPP member can work with the selected test labs to provide 2Rx/4Rx UEs.
  + Proposal 3: For the devices/data that labs cannot identify by themselves, a neutral party can help collect the information from OEMs.
    - Step 1: Labs submit measurement data together with real UE models to the neutral party.
    - Step 2: The neutral party asks OEMs for the information on the number of Rx antenna ports.
    - Step 3: The neutral party labels the measurement data as 2Rx or 4Rx, then submits them to 3GPP anonymously.
  + Others
* Recommended WF
  + The proposals are basically agreeable. Further discuss the feasibility and detailed working procedures.

Discussions:

Agreements:

* + Proposal 1: Labs can try to identify 4Rx UE by themselves in any methods listed below:
    - Method 1: If a UE can be connected to call box with 4x4 MIMO, the UE can be confirmed as a 4Rx UE
    - Method 2: Obtain the MIMO layer information from BS simulator, e.g., check the IE maxNumberMIMO-LayersPDSCH
      * FFS IE srs-TxSwitch
    - Method 3: Directly collect the information from OEMs.
    - Other methods are not precluded
  + Proposal 2: Any 3GPP member can work with the selected test labs to provide 4Rx UEs.

**Issue 1-4-4: Updated working procedure for Measurement Campaign**

*Background:*

*At RAN4#108, it was agreed to adopt the same UE information collection approach for both Rel-18 TRP/TRS and Rel-18 MIMO OTA:*

|  |
| --- |
| ***Issue 4-2-7: Adopting the same UE information collection approach for both Rel-18 TRP/TRS and Rel-18 MIMO OTA***   * ***Agreements***   + *The same UE information collection approach from Rel-18 TRP/TRS can be applied for FR1 MIMO OTA*     - *The threshold value can be discussed separately*   + *FFS for FR2 MIMO OTA* |

*At RAN4#108-bis, the working procedures for Rel-18 TRP/TRS measurement campaign were updated accordingly.*

* Proposals (merging R4-2320065 and Proposal 1 in R4-2318977)
  + Approve the following working procedures for FR1 MIMO OTA Measurement Campaign:

**Working procedures for FR1 MIMO OTA Measurement Campaign**

1. …
2. …
3. Commercial device (Smartphone) selection criteria for FR1 MIMO OTA Measurement Campaign:
   1. DUT capability: support for all the bands n1, n5, n8, n28, and n77 listed in the WID is preferred, but devices supporting only a subset of the above bands can equally be used in the measurement campaign for such supported bands
   2. DUT variety: the selection of commercial devices should cover various of devices in the market. The following selection criteria can also be considered:
      1. Year of production: 2020-2023
      2. Brand variety
      3. Price range (to cover different price ranges, including High/Mid/Low-end products)
      4. Popularity
      5. Number of bands supported
4. Commercial devices provision:
   1. Test labs can prepare and collect commercial devices by themselves based on the above selection criteria.
   2. Any 3GPP member can work with the selected test labs to provide devices
      1. A test lab shall measure only one UE model in case different samples are provided
      2. Same UE model supporting different sets of bands can be measured. For this case, the UE model should be marked as different model, e.g., model A-1, model A-2. (guidance on how to manage this case are provided in the spreadsheet in [TBD])
   3. The 3GPP member providing the DUTs should contact one of the selected labs to check their availability to receive the DUTs and define together the related provisioning aspects
      1. Any issue should be reported to the rapporteur in a timely manner to discuss for an alternative solution
      2. To plan properly the measurement campaign, the following actions are requested for the RAN4 Nov meeting:
         1. The rapporteur checks with the volunteer labs the number of DUTs (minimum 3, maximum 15) they expect to be able to measure AND how many DUTs they can accommodate from 3GPP members
         2. The 3GPP members providing the DUTs checks how many samples they intend to provide (with support of UE pre-configuration for measurements)
         3. Planning of the measurement campaign and thresholds of the data pool can be reviewed based on the above points
5. Measurement results submission:
   1. RAN4 Secretary will cover the role of the trusted and neutral third party for the whole procedure
   2. UE information disclosure: labs use the spreadsheet in [TBD] to submit the device information. The UE information should NOT BE CORRELATED with the order in the measurement data submitted by the same lab for the respective list of devices in c, i.e., the UE mode order in the list should be randomly disrupted.
   3. Labs use the worksheet template in [TBD] to submit the measurement results for Rel-18 3GPP FR1 MIMO OTA performance data pool.
   4. The measurement results should be submitted to RAN4 by anonymous approach (the UE model should not be disclosed):
      1. The minimum number of submitted devices from each lab is 3, the maximum number is 15. Meanwhile, labs are encouraged to provide as much data as possible within 15
      2. Volunteer labs provide the device information sheet ONLY to the RAN4 Secretary and the sheet used to submit measurement results to 3GPP RAN4
   5. RAN4 Secretary ONLY publishes to 3GPP RAN4 the following summary of statistical information after anonymizing the sensitive UE information data, i.e., UE model name and vendor name:
      1. Total number of devices
      2. Total number of models
      3. Total number of devices vendors
      4. Percentage of devices per vendor
      5. Percentage of devices per Power Class
      6. Percentage of devices per each supported band
      7. Percentage of devices per year of production
      8. Percentage of the devices that are certified by at least one of certification bodies as following: PTCRB, GCF, NAL/CTA (Chinese network access licensed test)], FCC, CE
         * Once the device gets the above certification, for RAN4 discussion that means the device is commercially available
      9. Percentage of devices that are commercially available
   6. For band n1, the measurement data from 2Rx UE and 4Rx UE should be distinguished.
      1. FFS how to identify the number of Rx antenna ports of UEs and how to submit the measurement results.
   7. The progress in each lab is encouraged to be shared on the RAN4 reflector (for example, how many devices have been measured and on which bands)

* Recommended WF
  + Agreeable
  + Working procedures regarding band n1 can be updated, based on the discussion outcomes of Issues 1-4-1 and 1-4-2.

Discussions:

Agreements:

**Issue 1-4-5: Thresholds of data pool for specifying FR1 MIMO OTA requirements**

* Proposals
  + Proposal 1 (CAICT): Confirm the Minimum number of devices for defining requirements for each band as 15
* Recommended WF
  + Check with the volunteer labs about the number of DUTs they expect to be able to measure this week
  + Make the decision based on volunteer labs’ feedback

Discussions:

Agreements:

# Topic #2: FR2 MIMO OTA

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **[R4-2320066](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320066.zip)** | CAICT | Updated Framework and time plan for FR2 MIMO OTA performance requirements development (Nov 2023)  **Proposal 1: Approve the updated framework and time plan in Section 2 of this contribution for FR2 MIMO OTA performance requirements development.** |
| **[R4-2320595](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320595.zip)** | CAICT | On MIMO OTA performance requirements work  **Proposal 4: The FR2 PAD delivery scheme should be updated based on real progress. In case, Huawei/CMCC/CAICT cannot complete the testing of the three PADs before 10 Nov 2023, still transfer the PADs to Apple/ETS-L at this meeting. Apple and ETS-L should try to complete the test before RAN #102 plenary, then transfer the PADs back to Huawei/CMCC/CAICT at RAN #102 plenary (Dec 2023).** |

## 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 FR2 MIMO OTA lab alignment [Perf. part]

**Issue 2-1: FR2 PAD delivery scheme and time plan**

* Proposals
  + Proposal 1 (CAICT): The FR2 PAD delivery scheme should be updated based on real progress. In case, Huawei/CMCC/CAICT cannot complete the testing of the three PADs before 10 Nov 2023, still transfer the PADs to Apple/ETS-L at this meeting. Apple and ETS-L should try to complete the test before RAN #102 plenary, then transfer the PADs back to Huawei/CMCC/CAICT at RAN #102 plenary (Dec 2023).
* Recommended WF
  + Agreeable

Discussions:

Agreements:

* + Postpone the deadline of FR2 lab alignment activity to Apr. RAN4 110-bis meeting.

### Sub-topic 2-2 FR2 MIMO OTA Measurement Campaign [Perf. part]

**Issue 2-2: Updated working procedures of FR2 MIMO OTA Measurement Campaign for specifying requirements**

* Proposals
  + Proposal 1 (R4-2320066): Approve the following working procedures of FR2 MIMO OTA Measurement Campaign

**2.2.3 Measurement Campaign**

1. The purpose of Measurement Campaign is to collect measurement results of commercial devices from permitted labs after the Lab Alignment Activity for specifying FR2 MIMO OTA performance requirements.
2. 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)
3. Commercial Device (Smartphone) selection criteria:
   1. DUT capability: at least support n261 (for the first stage)
   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
4. Commercial devices provision:
   1. Test labs can collect commercial devices by themselves based on the above selection criteria
   2. Any 3GPP member can work with the selected test labs to provide devices
      1. A test lab shall measure only one UE model in case different samples are provided
      2. Same UE model supporting different sets of bands can be measured. For this case, the UE model should be marked as different model, e.g., model A-1, model A-2. (guidance on how to manage this case are provided in the spreadsheet in [TBD])
   3. The 3GPP member providing the DUTs should contact one of the selected labs to check their availability to receive the DUTs and define together the related provisioning aspects
      1. Any issue should be reported to the rapporteur in a timely manner to discuss for an alternative solution
      2. To plan properly the measurement campaign, the following actions are requested for the RAN4 Nov meeting:
         1. The rapporteur checks with the volunteer labs the number of DUTs (minimum 3) they expect to be able to measure AND how many DUTs they can accommodate from 3GPP members
         2. The 3GPP member providing the DUTs checks how many samples they intend to provide (in terms of maximum number)
         3. Planning of the measurement campaign could be reviewed based on the above points
5. 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
   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)

**2.2.4 Specifying Performance Requirements**

1. Only the results from aligned labs will be considered for specifying requirements
2. Minimum number of commercial devices for defining requirements: [8-15] per band
   * + FFS after receiving some feedback from volunteer labs on the estimated amount of measurement data can be provided. More measurement data is preferred.
     + To increase the number of measurement data, 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.
3. Method: Derive the requirements based on per-band Data driven approach. The value at [85%] percentile of the CDF curve can be selected as the starting point for requirement discussion.
4. Performance part of the work will proceed in a contribution-driven manner.

* Recommended WF
  + Basically agreeable. Further discuss details and collect feedbacks

Discussions:

Agreements:

# Topic #3: Internal TR 38.761

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **[R4-2319164](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319164.zip)** | CAICT | 3GPP TR 38.761 v0.1.0 |
| **[R4-2320060](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320060.zip)** | CAICT | TP to TR 38.761 on General Aspects and Measurement Setup |
| **[R4-2320061](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320061.zip)** | CAICT | TP to TR 38.761 on channel model validation for n28 |
| **[R4-2320062](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320062.zip)** | CAICT | TP to TR 38.761 on FR2 channel model validation |
| **[R4-2320063](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320063.zip)** | CAICT | TP to TR 38.761 on FR1 noise impact |
| **[R4-2320064](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320064.zip)** | CAICT | TP to TR 38.761 on Rel-18 lab alignment framework |
| **[R4-2318430](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318430.zip)** | Apple | TP to TR 38.761 on Lab 6 Power Validation |
| **[R4-2318895](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318895.zip)** | Xiaomi | TP for TR 38.761 on channel model validation for n78 and n41 |
| R4-2320179 | CAICT | 3GPP TR 38.761 v0.2.0  Reserved for email approval |

## Open issues summary

*Moderator: The target completion plenary for TR 38.761 is TSG#102 (Dec. 2023). The target is to approve all TPs at this meeting.*

### Sub-topic 3-1 3GPP TR 38.761 v0.1.0

**Issue 3-1: 3GPP TR 38.761 v0.1.0**

* Recommended WF
  + Approve 3GPP TR 38.761 v0.1.0 in R4-2319164

### Sub-topic 3-2 TPs to TR 38.761

**Issue 3-2-1: TP on General Aspects and Measurement Setup**

* Recommended WF
  + Companies are invited to share views on R4-2320060

**Issue 3-2-2: TPs on channel model validations**

* Recommended WF
  + R4-2320061, R4-2320062, [R4-2318430](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318430.zip), [R4-2318895](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318895.zip) are agreeable. Comments are also welcome.

**Issue 3-2-3: TP on FR1 noise impact**

* Recommended WF
  + R4-2320063 can be revised to capture Apple’s newly results.

**Issue 3-2-4: TP on Rel-18 lab alignment framework**

* Recommended WF
  + R4-2320064 is agreeable.

# Topic #4: Rel-17 MIMO OTA maintenance

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **[R4-2318230](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318230.zip)** | MVG Industries, MVG, Spirent, Keysight, Apple | Updates to FR1 Channel model validation |
| **[R4-2318836](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318836.zip)** | Keysight Technologies UK Ltd | CR to update preliminary FR2 MU |
| **[R4-2318978](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2318978.zip)** | vivo | CR to TS 38.161 on Applicability rules and test configurations |
| **[R4-2319271](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2319271.zip)** | Samsung | CR on introduction of applicability rules for MIMO OTA requirements |
| **[R4-2320596](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320596.zip)** | CAICT | CR to TS 38.151 on FR2 channel model validation pass/fail limits |
| **[R4-2320597](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_109/Docs/R4-2320597.zip)** | CAICT | On MIMO OTA Doppler validation pass fail limits  **Proposal 1: The Doppler pass/fail limits for FR1 and FR2 channel model validation should be tightened appropriately.**  **Proposal 2: The pass/fail limits for temporal correlation are formed as bands of ±10% of correlation capped at 100% from the target. Additionally, when the upper bound reaches 20%, the limit stays at 20% and the lower limit drops to 0%. The pass/fail limits apply for both FR1 and 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 4-1 Channel Model Validation

**Issue 4-1-1: CR (R4-2318230) to update FR1 Channel model validation**

* Recommended WF
  + Technical discussions may be needed before agreeing to the CR

Discussions:

Agreements:

* FFS whether “The power validation result is considered as systematic offset, which needs to be corrected on the UE final sensitivity value to further reduce measurement uncertainty.” can be removed.
* Other changes proposed in the CR are agreeable.

**Issue 4-1-2: Doppler pass/fail limits for FR1 and FR2 channel model validation**

* Proposals (CAICT)
  + Proposal 1: The Doppler pass/fail limits for FR1 and FR2 channel model validation should be tightened appropriately.
  + Proposal 2: The pass/fail limits for temporal correlation are formed as bands of ±10% of correlation capped at 100% from the target. Additionally, when the upper bound reaches 20%, the limit stays at 20% and the lower limit drops to 0%. The pass/fail limits apply for both FR1 and FR2.
* Recommended WF
  + Reasonably tightened pass/fail limits are preferred, to guarantee correct implementation of channel models.

Discussions:

*Huawei: We have not seen validation results at other bands.*

Agreements:

**Issue 4-1-3: CRs (R4-2318978, R4-2320596) to update pass/fail limits for channel model validation**

* Recommended WF
  + R4-2320596 (CAICT) can be merged into R4-2318978 (vivo)
  + Revise the CR to capture agreements of Issue 4-1-2 if reached

### Sub-topic 4-2 Applicability rules for testing of SA and NSA UEs

**Issue 4-2: CRs (R4-2318978, R4-2319271) on Applicability rules for testing of SA and NSA UEs**

* Recommended WF
  + Applicability rules proposed in R4-2318978 (vivo) can be merged into R4-2319271 (Samsung)
  + Suggest adding the Decision tree for EN-DC band combination selection for MIMO OTA testing

*Moderator: Based on offline discussions, the applicability rules have been revised as:*

|  |
| --- |
| Applicability rules for testing of SA and NSA UEs The applicability and test coverage rules for Non-Standalone (NSA) only capable UEs shall include the following:  - For FR1 NSA (EN-DC) only capable UEs, testing is not required.  - For FR2 NSA (EN-DC) only capable UEs, for each FR2 NR band supported by the device, test the UE in EN-DC mode using any one example configuration containing that NR band or configuration declaration decision tree as per recommended MIMO OTA test procedures in this specification.  The applicability and test coverage rules for Standalone (SA) and NSA (EN-DC) capable UEs shall include the following:  - For FR1 UEs, for each NR band in a device, test the UE in Standalone Mode as per the TRMS test procedures in this specification. This shall also fulfil coverage for all EN-DC minimum performance requirements for that NR band and need not be retested in EN-DC mode.  - For FR2 UEs, for each FR2 NR band supported by the device, test the UE in any of SA modes including FR2 only mode, FR1+FR2 NR-DC mode and FR1+FR2 NR-CA mode using any one example configuration containing that NR band. This shall fulfil coverage for FR2 MIMO OTA requiremetnrs for that NR band and need not be retested in EN-DC mode. |

Discussions:

Agreements:

### Sub-topic 4-3 Preliminary MU for FR2 MIMO OTA

**Issue 4-3: CR (R4-2318836) to update preliminary FR2 MU**

* Recommended WF
  + The CR in R4-2318836 is agreeable