**3GPP TSG-RAN WG4 Meeting #95-e R4-200xxxx**

**Electronic Meeting, 25 May – 5 June, 2020**

**Agenda item:** 9.1.1

**Source:** Moderator (CAICT)

**Title:** Email discussion summary for [95e][326] FS\_NR\_MIMO\_OTA\_test

**Document for:** Information

# Introduction

Based on the agreed WF [1], FR2 MIMO OTA remaining open issues on PSP validation and QoQZ shall be finalized this meeting:

*Remaining Open issues：*

* + ***FR2 PSP Validation procedures***
    - *CE vendors align on the PSP validation procedure before next RAN4 e-meeting, e.g.,*
      * *consider if Roll/AZ positioner could be used for SP method [R4-2005560]*
      * *consider different virtual array configurations and NF compensation methods for the PAS estimation step for KS method [R4-2004565]*
    - *If misalignment still shows next meeting, then better accuracy vs. measurement time will be the KPI to select one procedure to finalize this topic.*
  + ***FR2 QoQZ procedure*** 
    - *QoQZ procedure based on the agreed 6 probes location shall be finalized next RAN4 e-meeting*

In addition, the maintenance of Rel-15 NR UE Testability TR38.810 (i.e. FR2 test methods for UE RF, RRM and Demod) is also discussed in this email thread.

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

* 1st round: make decision on PSP and QoQZ validation procedure.
* 2nd round: finalize the content of TPs based on the decision of 1st round.

# Topic #1: FR2 test methods

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2006308 | CAICT | **TP to TR 38.827 v1.3.0 on RMC correction** |
| R4-2006431 | Samsung | **Proposal 1: feasible SNR range can be split into two parts: single probe contribution (SNRsingle-probe) and multi-probe contribution (ΔSNRmulti-probe), i.e., SNR3D-MPAC = SNRsingle-probe + ΔSNRmulti-probe**  **Observation 1: the multi-probe SNR contribution (ΔSNRmulti-probe) is affected by two aspects, probe weights at TE side and antenna directivity pattern at UE side.**  **Observation 2: the multi-probe SNR contribution (ΔSNRmulti-probe) is expected in the range of [0, 3.5]dB.**  **Proposal 2: it is encouraged for TE vendors to input an aligned estimated value to ΔSNRmulti-probe among [0, 3.5]dB based on probe weights for CDL-A InO and CDL-C UMi respectively** |
| R4-2006740 | Keysight Technologies | **Observation 1: Suitable omnidirectional loop and dipole reference antennas with insignificant azimuth gain variations currently do not exist.**  **Observation 2: The current FR1 QoQZ procedure cannot be leveraged for the NR FR2 3D MPAC QoQZ validation procedure.**  **Observation 3: For NR MIMO OTA, only the single-directional EIRP/EIS metrics need to be assessed in the QoQZ procedure**  **Observation 3: The existing NR FR2 QoQZ validation approach is suitable for NR FR2 3D MPAC systems**  **Proposal 1: Leverage the NR FR2 UE RF QoQZ procedure for NR FR2 3D MPAC MIMO OTA systems using just a single measurement probe**  **Proposal 2: Include the draft text below as FR2 QoQZ Validation procedure in [6].** |
| R4-2006741 | Keysight Technologies | **Observation 1: The two-step process using the MUSIC algorithm shows PSP of >96% when the OTA PAS is considered the reference.**  **Observation 2: The PSP results using the spatial correlation-based approach are not as good as with the MUSIC based approach.**  **Proposal 1: Adopt the PSP validation approach based on a virtual antenna array configuration with two vertical sectors and one horizontal sector and the MUSIC algorithm.** |
| R4-2006742 | Keysight Technologies, Spirent Communications | **TP to 38.827 to add PSP validation procedure** |
| R4-2006743 | Keysight Technologies | **Observation 1: The current FR2 3D MPAC system definition has ambiguities in terms of UE positioning and the NR MIMO probes**  **Observation 2: The spherical coordinate system lends itself to a common ambiguity which could be avoided by limiting rotation angles to certain ranges.**  **Observation 3: Whether the UE is rotated so that the test direction w.r.t. to the UE is aligned with the channel model coordinate system z axis or whether the UE is rotated so that the z axis of the UE’s coordinate system is aligned with the fixed test point w.r.t. the channel model coordinate system will yield additional ambiguities.**  **Observation 4: Option 1 introduces the least amount of positioner blockage while Options 2 and 3 can obstruct the path between UE and NR MIMO probes.**  **Proposal 1: Select a single positioner, probe layout configuration, and rotation assumption to avoid ambiguities**  **Proposal 2: Select Option 4 of the FR2 NR MIMO system configuration as the baseline for 3D MPAC systems.**  **Proposal 3: Perform the UE rotations based on the assumption that the test direction w.r.t. to the UE is aligned with the channel model coordinate z axis**  **Proposal 4: Limit the turntable rotation to a range of 0 to 180o only.** |
| R4-2007085 | OPPO | **Proposal:** to realize the placement of FR2 uplink communication path in MPAC, two approaches could be considered:   * Add an independent antenna near the 6 downlink probes * Pick up the uplink signals from one or several of the 6 probes   Consequently, in order to guarantee the FR2 3D-MPAC system working effectively, the following aspects is FFS.   * The dynamic range of uplink signal * The isolation between downlink and uplink |
| R4-2007592 | Spirent Communications | **Observation 1**. PSP validation most likely need some phase taper correction technique.  **Observation 2.** If the number of measurement time is limited, number of virtual elements will also become limiter mandating to use some super-resolution technique to estimate DoA.  **Proposal 1.** Apply either of the PSP validations proposed in [1],[2], using super-resolution technique to estimate DoA. |
| R4-20007594 | Spirent Communications | TP on Verification of Channel Model implementation in TR38.827, PSP |
| R4-2007658 | ROHDE & SCHWARZ | **Observation 1**: Current probe layout centered around 90º elevation and close to 0º azimuth will affect the DUT performance.  **Observation 2**: Simulations to evaluate the PSP performance implement a rotation of the DUT so the original absolute impinging angles of each channel model are respected.  **Proposal:** Channel model rotations shall be specified in TR 38.827 and FR2 test points shall be rotated to compensate them on a per channel model basis. |
| R4-2008273 | Keysight Technologies | **TP to TR38.827 to avoid ambiguities for FR2 MIMO OTA Testing** |

## Open issues summary

### Sub-topic 1-1 FR2 PSP validation procedure

* Proposals
  + - **Proposal 1.** Apply either of the PSP validations proposed in [1],[2], using super-resolution technique to estimate DoA.
    - **Proposal 2:** Adopt the PSP validation approach based on a virtual antenna array configuration with two vertical sectors and one horizontal sector and the MUSIC algorithm

Related TPs: R4-20007594 and R4-2006742

* Recommended WF
  + Make decision on PSP validation procedure and text proposal

### Sub-topic 1-2 FR2 QoQZ procedure

* Proposals
  + **Proposal 1:** Leverage the NR FR2 UE RF QoQZ procedure for NR FR2 3D MPAC MIMO OTA systems using just a single measurement probe.
  + **Proposal 2:** Include the draft text below as FR2 QoQZ Validation procedure in [6].
* Recommended WF
  + Make decision on QoQZ procedure and corresponding text proposal.

### Sub-topic 1-3 other FR2 system issues

**Issue 1-3-1: 3D-MPAC SNR analysis**

* Proposals
  + **Proposal 1: feasible SNR range can be split into two parts: single probe contribution (SNRsingle-probe) and multi-probe contribution (ΔSNRmulti-probe), i.e., SNR3D-MPAC = SNRsingle-probe + ΔSNRmulti-probe.**
  + **Proposal 2: it is encouraged for TE vendors to input an aligned estimated value to ΔSNRmulti-probe among [0, 3.5]dB based on probe weights for CDL-A InO and CDL-C UMi respectively**.
* Recommended WF
  + TBA

**Issue 1-3-2: UE orientations in 3D-MPAC system**

* Proposals
  + **Proposal 1: Select a single positioner, probe layout configuration, and rotation assumption to avoid ambiguities**
  + **Proposal 2: Select Option 4 of the FR2 NR MIMO system configuration as the baseline for 3D MPAC systems.**
  + **Proposal 3: Perform the UE rotations based on the assumption that the test direction w.r.t. to the UE is aligned with the channel model coordinate z axis**
  + **Proposal 4: Limit the turntable rotation to a range of 0 to 180o only.**
  + **Proposal 5:** Channel model rotations shall be specified in TR 38.827 and FR2 test points shall be rotated to compensate them on a per channel model basis.
* Recommended WF
  + TBA

**Issue 1-3-3: FR2 Uplink path**

* + **Proposal: to realize the placement of FR2 uplink communication path in MPAC, two approaches could be considered:**
    - Add an independent antenna near the 6 downlink probes
    - Pick up the uplink signals from one or several of the 6 probes
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Sub topic 1-1:   * Clarification questions on R4-2006741:   + The real antenna array might be different from the assumption in the PSP validation procedure, i.e. 4\*4, how the does antenna array impact the real PSP values in the testing?   + Is PSP limit different with frequency carrier? * The PSP validation procedure should make sure the PSP in real test is comparable with the target PSP limit when deciding the probe layout.   Sub topic 1-2:   * Leveraging NR FR2 UE RF QoQZ procedure for NR FR2 3D MPAC MIMO OTA systems makes sense.   Sub topic 1-3:   * Issue 1-3-1: Agree with Samsung’s analysis on proposal 1. For observation 2, considering UE antenna array depends on UE implementation, we prefer to use [0, 7.8]dB as the starting point. Input on SNR gain is encouraged from TE vendors considering typical UE antenna assumptions such as 1\*4, 2\*4. * Issue 1-3-2: Clarification question on proposal 4, with limitation on the turntable rotation from 0 to 180, can it still guarantee 3D test directions are covered? Does it mean there is no need to do the re-positioning with option 1 or option 4?   Issue 1-3-3: |
| Samsung | Sub topic 1-3: other FR2 system issues   * Issue 1-3-1: 3D-MPAC SNR analysis   + Thanks Qualcomm’s comments. Agree that [0, 7.8]dB is the starting point. Input on SNR improvements from multi-probe (**ΔSNRmulti-probe**) is encouraged from TE vendors considering typical UE antenna assumptions such as 1\*4, 2\*4 and considering beam weights for CDL-A InO and CDL-C UMi respectively. * Issue 1-3-2: UE orientations in 3D-MPAC system   + We support Keysight’s proposal 1 and proposal 2. It is beneficial to avoid ambiguity by standardized relative location among positioner, probe and UE. Option 4 helps to minimize the positioner blocking effect. * Issue 1-3-3: FR2 Uplink path   + Thanks OPPO for raising the uplink path issue. It is necessary to make it clear. For the approach of “Add an independent antenna near the 6 downlink probes”, not sure if there will be testability issue especially for UEs with narrow beam like power class 1. |
| CAICT | Sub topic 1-1: In R4-2006742, regarding the Semi-circle measurement array configurations in Figure 7.4.1.6-1, are these two options for selection or both shall be done for validation? If anyone is OK, suggest to align with the discussion paper using “Two alternative semi-circle measurement array configurations with N = 37 elements (at 28 GHz). On the left with two crossed vertical sectors, on the right with two parallel vertical sectors.”  Sub topic 1-2: Agree with the proposals.  Sub topic 1-3:   * Issue 1-3-1: agree with this approach. From the experience of FR1 MIMO OTA measurement, the maximum DL power is the main critical aspect for the whole system. So suggest to calculate the SNR or at least SNR range for FR2 at early stage, which is good for us to continue our work in the next step. * Issue 1-3-2: * Issue 1-3-3: we need to check whether there is an isolation issue, if we reuse the downlink path for uplink. |
| R&S | Sub-topic 1-1 FR2 PSP validation procedure   * Similar to Qualcomm’s comments above, we are concerned about how comparable are the results from the proposed PSP validation procedures with the simulations used to decide the probe layout. More precisely, the proposed radius in R4-2006741 is R = 5cm corresponding to half the test volume size of R = 10cm. As shown in figures and results in R4-2006741, all PSP results are better compared to the ones presented last meeting. * Even though the proposed procedures are very much detailed, there is no clear information about the test antenna to be used, what is an essential element. More details are required.   Sub-topic 1-3 other FR2 system issues  Issue 1-3-2 (UE orientation in 3D-MPAC system)   * Comments on Keysight’s R4-2006743:   + We do not agree with several of the observations along the document where there is a “lack of definition how the UE rotations need to be performed” since theta/phi rotations are clearly defined in TR 38.827, clause A.1.   + Option 1 along the document does not respect the theta/phi rotations defined in the reference coordinate system.   + Regarding Proposal 2, it describes a very concrete implementation of the positioning system, while the same issues can be solved in different ways depending on the positioning system. Therefore we cannot agree to it. Same comment applies to Proposal 4. How this potential issues are solved should be left to test system implementation.   + Proposal 3 refers the alignment of UE with respect to the channel model z-axis (thus in elevation), but does not address the required additional adjustment on the test points due to the change in azimuth. * Since the DUT alignment to the reference coordinate system (including the corresponding rotations in theta/phi), the test points and the probe locations are already defined in the technical report, the only missing parameters are the channel model rotations to fit the probe locations. With those, DUT test points can be adjusted in theta/phi per channel model in the same way the rotations were compensated on the simulations for PSP performance. |
| Qualcomm | Sub topic 1-3:  Issue 1-3-3: We agree with OPPO’ proposal that the position of FR2 UL path should be discussed. We should note that UE BC depends on certain SNR side condition. In other words, to make sure UE can keep the uplink connection with the same direction as DL beam, SNR side condition should be guaranteed. |
| Keysight | Sub topic 1-1:   * **Response to QC:**   + as discussed in earlier meetings, all FR2 PSP simulations presented so far have been based on the 4x4 Bartlett beamformer. Non-symmetric arrays such as 4x1 or 4x2 cannot be used in probe placement optimization simulations with the black box approach; here it necessary to use symmetric arrays.   + Since the 4x4 antenna array was used for PSP simulations deciding the probe placements, the suggestion here is to use the same assumption for PSP validation. * **Response to CAICT:**   + Two configurations were introduced since different positioner/coordinate system definitions will yield either two parallel scans or an X scan, e.g., Options 1, 2, 3 of R4-2006743. If we limit the options, we could focus on just a single vertical scan but we can further revise the TP to align with the discussion paper, no problem. * **Response to R&S:**   + The reasons for the better results are due to various changes when compared to last meeting, e.g., optimized virtual array configuration and near-field compensation method.   + The most suitable approach for the PSP validation is based on an omnidirectional antenna (omni in AZ and wide BW in EL) as the test can be automated easily. Alternatively, a directional antenna could be used but requires frequent re-positioning.   Sub topic 1-3:   * Issue 1-3-1: * Issue 1-3-2:   + **Response to R&S:**     - As outlined in the contribution, different interpretations to theta/phi test directions are possible and we are asking to clearly define those. While in OTA systems with a single, dedicated measurement probe, theta/phi usually corresponds to either UE or probe antenna rotations, we felt that NR FR2 MIMO OTA requires additional clarifications. Can you confirm that you can agree with Proposal 3 then which clearly ties theta/phi to UE rotations?     - It is not clear to us why Option 1 does not respect theta/phi rotations, we feel the example rotations indicate it is a viable option     - If we do not define a specific implementation (P2) and turntable rotations (P4), we are afraid that there will be ambiguities and that different system implementations will yield different results and that different pass/fail verdicts can be reached. We feel option 4 is the best compromise in terms of ambiguities, blocking, and coordinate system familiarity. * Issue 1-3-3:   + We believe UL link antenna placement should be left to system vendors similar to UE RF systems. |
| MVG | Sub topic 1-1:   * In the response from KS to RnS, near field compensation was used in order to derive PSP results. What kind of near field compensation? Is this compensation based on Spherical Wave Expansion (SWE) algo? Does it require to measure the phase in NF at the DUT during the validation process? In FR1, spatial correlation was calculated based on relative power measurement. NF phase was not needed. * R4-2006741 – I think this was a comment from other companies too but we are not sure what type of antenna to be used for PSP validation. Usually, for calibration and system validation reference antenna (from different manufacturers) could be used. Those antennas come with test report and eventually calibration report. It means the characteristics of the antenna could be easily understood. Is there a way the used antenna can be documented? In terms of the radiating properties? |

### CRs/TPs comments collection

*NR MIMO OTA is a close-to-finalize SI, suggest to focus on finalizing the text proposals for TR.*

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| **CR/TP number** | **Comments collection** |
| R4-2006308 | *Samsung: Thanks CAICT, we support this TP.* |
| R4-2006740 |  |
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| R4-2006742 |  |
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| R4-2007594 |  |
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## Summary for 1st round

### Open issues

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

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|  | **Status summary** |
| **Sub-topic 1-1**  **FR2 PSP validation procedure** | *Tentative agreements:*   * Develop PSP validation procedure based on the proposals in R4-2006742 as baseline.   *Recommendations for 2nd round:*   * Refine the wording of PSP validation procedure to address the comments from 1st round. Focus on the TP discussion and finalize the content in 2nd round. |
| **Sub-topic 1-2**  **FR2 QoQZ procedure** | *Agreements:*   * + **Proposal 1:** Leverage the NR FR2 UE RF QoQZ procedure for NR FR2 3D MPAC MIMO OTA systems using just a single measurement probe.   + **Proposal 2:** Include the draft text below as FR2 QoQZ Validation procedure in [6].   *Recommendations for 2nd round:*   * None |
| **Sub-topic 1-3**  **other FR2 system issues** | **Issue 1-3-1: 3D-MPAC SNR analysis**  *Tentative agreements:*   * + **Proposal 1: feasible SNR range can be split into two parts: single probe contribution (SNRsingle-probe) and multi-probe contribution (ΔSNRmulti-probe), i.e., SNR3D-MPAC = SNRsingle-probe + ΔSNRmulti-probe.**   *Recommendations for 2nd round:*   * Further discuss **ΔSNRmulti-probe**, proper range value is encourage to be stabilized in 2nd round.   **Issue 1-3-2: UE orientations in 3D-MPAC system**  *Tentative agreements:*  *Recommendations for 2nd round:*   * Further discuss on this topic.   **Issue 1-3-3: FR2 Uplink path**  *Tentative agreements:*   * + Suitable uplink path of FR2 MIMO OTA system shall be considered   *Recommendations for 2nd round:*   * Further discuss if we need to standardize the UL antenna placement, or leave this open for different system implementation. |

*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on FR2 MIMO OTA | CAICT |

### CRs/TPs

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

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2006308 | *Agreeable* |
| R4-2006740 | *Agreeable* |

## Discussion on 2nd round

### Sub-topic 1-1 FR2 PSP validation procedure

*Tentative agreements:*

* Develop PSP validation procedure based on the proposals in R4-2006742 as baseline.

*Recommendations for 2nd round:*

* Refine the wording of PSP validation procedure to address the comments from 1st round. Focus on the TP discussion and finalize the content in 2nd round.

### Sub-topic 1-3 other FR2 system issues

**Issue 1-3-1: 3D-MPAC SNR analysis**

*Tentative agreements:*

* + **Proposal 1: feasible SNR range can be split into two parts: single probe contribution (SNRsingle-probe) and multi-probe contribution (ΔSNRmulti-probe), i.e., SNR3D-MPAC = SNRsingle-probe + ΔSNRmulti-probe.**

*Recommendations for 2nd round:*

* Further discuss **ΔSNRmulti-probe**, proper range value is encourage to be stabilized in 2nd round.

**Issue 1-3-2: UE orientations in 3D-MPAC system**

*Tentative agreements:*

*Recommendations for 2nd round:*

* Further discuss on this topic.

**Issue 1-3-3: FR2 Uplink path**

*Tentative agreements:*

* + Suitable uplink path of FR2 MIMO OTA system shall be considered

*Recommendations for 2nd round:*

* Further discuss if we need to standardize the UL antenna placement, or leave this open for different system implementation.

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| **Company** | **Comments for 2nd round** |
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## Summary on 2nd round

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
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# Topic #2: Others (including Rel-15 TR38.810 maintenance)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2006310 | CAICT | The latest FR1 MIMO OTA measurement results based on the agreed test system in TR38.827 is presented. Some observations on UE performance are also discussed. This selected approach is able to differentiate 4x4 MIMO OTA performance and more work for higher MCS is expected in the future. |
| R4-2007084 | OPPO | **Proposal 1:** UE movement with certain speed should be a typical dynamic testing scenario to evaluate the period of new beam re-obtaining and refining as one test case of dynamic testing.  Technically, with the help of coordinate system conversion, the scenario of UE movement with certain speed could be re-structured in MPAC with UE rotation on the turn table, accompanied with downlink power change to simulate the BS-UE distance variation. Furthermore, the performance of new beam re-obtaining and refining should be evaluated under different UE movement speed. Obviously, these test scenarios can not be covered by current FR2 MIMO OTA 3D-MPAC static testing.  **Observation 1:** UE movement based scenario can not be covered by current FR2 MIMO OTA 3D-MPAC static testing.  **Proposal 2:** UE movement based scenario should be re-structured in MPAC with rotation and downlink power highly aligned to simulate movement speed. The scenario is recommended to be studied and implemented in a separate new SI. |
| R4-2007285 | Qualcomm Incorporated | **Proposal 1:** For MIMO OTA sensitivity requirements, RAN4 to agree the introduction of MMO-OTA T-put measurement during at least BEAM\_SELECT\_WAIT\_TIME based on agreed test conditions, e.g. Probe-layout, Channel model, etc. and to discuss performance metric to assess UE performances in WI phase. And during BEAM\_SELECT\_WAIT\_TIME, DL transmission power is constant and its level is FFS. |
| R4-2007563 | Qualcomm Incorporated | TP to TR38.827 on FR2 test procedure  **Proposal: Include the following text proposal on FR2 test procedure in TR38.827.** |
| R4-2008014  (TR38.810 CR) | Keysight Technologies | Beam correspondence – SRS configuration corrections in section 5.2.1.3.7  Clarifed the ‘*usage*’ as ‘*beamManagement’* for the up to 8 SRS resources.  Added the creation of an additional SRS resource set of type ‘*semi-persistent*’ and ‘*usage’* set to ‘*codebook’*.  Clarified how the spatial relationship is set during semi-persistent SRS activation. |

## Open issues summary

### Sub-topic 2-1 FR1 MIMO OTA measurement results

* Discussion
  + The latest FR1 MIMO OTA measurement results based on the agreed test system in TR38.827 is presented.
* Recommended WF
  + TBA

### Sub-topic 2-2 FR2 dynamic testing

* Proposals
  + **Proposal 1:** UE movement with certain speed should be a typical dynamic testing scenario to evaluate the period of new beam re-obtaining and refining as one test case of dynamic testing.
  + **Proposal 2:** UE movement based scenario should be re-structured in MPAC with rotation and downlink power highly aligned to simulate movement speed. The scenario is recommended to be studied and implemented in a separate new SI.
  + **Proposal 3:** For MIMO OTA sensitivity requirements, RAN4 to agree the introduction of MMO-OTA T-put measurement during at least BEAM\_SELECT\_WAIT\_TIME based on agreed test conditions, e.g. Probe-layout, Channel model, etc. and to discuss performance metric to assess UE performances in WI phase. And during BEAM\_SELECT\_WAIT\_TIME, DL transmission power is constant and its level is FFS.

Related TP: R4-2007563

* Recommended WF
  + TBA

### Sub-topic 2-3 Rel-15 TR38.810 maintanence in AI 4.13

* CR R4-2008014
  + Beam correspondence – SRS configuration corrections in section 5.2.1.3.7.
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

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| **Company** | **Comments** |
| Qualcomm | Sub topic 2-1:  Sub topic 2-2:  We agree that the dynamic test with the UE continue movement in Proposal 1&2 of R4-2007084 could be further studied in a new SI. Please note that proposal 3 which is from R4-2007285 is to reuse the current static testing setup and mechanism. The only difference is the T-put during the BEAM\_SELECT\_WAIT\_TIME will be measured with non-continue movement which is same as current static testing. Therefore, proposal 3 is clearly not the scenario of dynamic testing mentioned in R4-2007084. With this clarification, we propose the following WF on dynamic testing:   * RAN4 to agree the introduction of MIMO-OTA T-put measurement during at least BEAM\_SELECT\_WAIT\_TIME based on agreed test conditions/setup and to discuss UE performance metric in WI phase * RAN4 to recommend starting a new SI to further study other scenarios e.g. continue UE movement etc.   Sub topic 2-3: |
| Samsung | Sub topic 2-1: FR1 MIMO OTA measurement results   * Thanks a lot for CAICT’s input. Measurement results show that 40MHz BW is doable for FR1 TDD 4x4 * A question on Figure 4 in the paper, are the test results obtained with 40MHz or 100MHz BW? We see both 40MHz and 100MHz in the figure.   Sub topic 2-2: FR2 dynamic testing   * For proposal 3 (test MIMO OTA throughput during BEAM\_SELECT\_WAIT\_TIME), it is true that it can make use of the static MIMO OTA system, but there are still many technical issues, e.g.:   + BEAM\_SELECT\_WAIT\_TIME (T2) is meanwhile the dwell time for UE to be steady from vibration status after test point is changed from one to another. UE vibration during the dwell time may be quite different for different system and are also random. The MIMO OTA throughput test during T2 does not account for beam forming performance but also mechanical performance of test system which is beyond the scope.   + The test result repeatability is one of the most important aspects. The MIMO OTA throughput test during T2 can not guarantee test result repeatability.   + One more consideration is that UE speed is already a parameter for channel model, not sure if there is conflict to apply MIMO OTA channel model for a rotating UE in a dynamic test. * Based on above considerations, we think dynamic test is not mature for Rel-16.   Sub topic 2-3: Rel-15 TR38.810 maintanence in AI 4.13   * Thanks Keysight for identifying the SRS configuration issue for bit-0 UE beam correspondence test. We agree that the usage of SRS should be configured as ‘beamMnagement’. However, further study is needed about if addition SRS resource set should be configured. There may be different approaches for detailed configurations. On the other hand, further discussion with other WG is also expected. Given limited time for companies to look into this issue in RAN4, we hope that this issue could be postponed to Aug meeting. |
| CAICT | Sub topic 2-1:  Response to Samsung: yes, in Fig. 4 we tested 40 MHz and 100MHz. Using MCS 19 with 100MHz is for checking the UE performance under “extreme condition”, to compare sensitivity performance with standardized MCS13 with 40MHz.  Sub topic 2-2:  We understand the intention of checking UE performance under beam switching condition. However, technically, many things are not clear.  Based on the experience of LTE and FR1 MIMO OTA testing. The T2 (BEAM\_SELECT\_WAIT\_TIME) is not a constant window at each position, it could be 3 seconds or even several mins, and sometimes in this period reconnection may happen, for some UEs somehow they can not re-connect automatically, then the test engineer need to try fly-mode or reboot the phone for re-connection to continue the testing. Therefore, this is an unstable time period which is not repeatable. I put a throughput trend figure here for easy discussion.    From another side, as shown in the figure above, it’s clear for everyone that agreed performance metric for “static testing” is similar to FR1, which is Sensitivity under stable connection with specific throughput rate. Even you use the same system with same channel model, when you want to check the UE status under unstable condition during rotation or beam selection/reconnection, this is obviously a NEW performance requirement for UE. Meanwhile, the main concern is that we are not clear which kind of new performance you want to define. Are you going to check one point during T2, or measure continuously during unstable T2 with [xx] ms interval time.  Besides, I am not sure if T-put is a good metric for T2 time period, maybe time-based metric is better. So my suggestion for this topic is to identify the new performance metric of this time period first, and then discuss how to measure.  Regarding the proposals for WF, I am fine to further discuss the wording, but I think if second bullet is agreeable for the group, then we don’t need the first one, because T2 is also main work for second bullet scope. |
| Huawei | Sub topic 2-2: FR2 dynamic testing   1. Generally, demodulation test need to verify whether SNR requirement is satisfied under certain throughput. So during T3, the SNR and DL power need to be adjusted until BLER is reached. We would like to know, during T1 and T2, what is the test metric? What is exact test object recorded and how to judge on the UE with pass or fail. We don’t see any description in the paper. 2. Whether all 36 points should be tested during the dynamic test? How to handle with the points out of Refsens requirement, whether the UE is allowed to be disconnected considering the DL power is provided by the TE with the whole procedure? 3. By the way, we would like to know is there any restriction on the UE rotation velocity during T1 and T2, and how to ensure on this restriction? Is there any specific requirement corresponding to different rotation model?   We don’t see any analysis on the above issues. It is not clear how UE proceed with such test, what metric the UE targets to and how to judge on the test results. Honestly saying, there is not enough time for dynamic test in Rel-16. Propose to exclude this issue in Rel-16. Whether a Rel-17 SI depends on RAN decision. |
| Qualcomm | Response to Samsung’s comments on Sub topic 2-2:  Please find our response below:   * For the first bullet, the issue should be due to the inconsistency of positioner in different test houses, e.g. positioner in two test houses might need different time durations to be stabilized from one test direction to another. Based on our survey, the time duration for positioner from one to another direction should be order of millisecond. Compared with 3sec dwell time, the impact of this millisecond difference can be ignored. In case, the impact can’t not be ignored, then this should be included in MU budget. We encourage TE vendors to provide more input on the positioner performance, e.g, how long does it take to be stabilized etc. * For the second bullet, the repeatability issue should also be due to the inconsistency of positioner. Thereofre, it can be solved as the response in the first bullet. Additionally, there should not be repeatability issue in the same test house. * For the third bullet, there is no any discrepancy with channel model. It follows the same principle as current static testing which means the UE speed is only considered in the channel model and it is emulated by channel emulator. The measurement in T2 keeps the same direction as T3 which means all the measurement would be from a static/fixed test direction. * Please note that the requirements will be discussed in Rel-17 MIMO OTA WI. And the setups, channel modle and test procdure are reused from the current static testing of Rel-16 SI.   Response to CAICT’s comments on Sub topic 2-2:  Please find our response below:   * BEAM\_SELECT\_WAIT\_TIME is defined in RAN5 test spec which is 3sec for UE to refine the beam in RF test cases. We can take [3sec] as the example to illustrate the how to measure the T-put in T2. During the T2 period, DL power is fixed, and then the average MIMO T-put which is defined in 5.1.1 of TR38.827 is measured continuously in each T2. Therefore, after all 36 test directions are tested, we can obtain at least 35 average T-put for T2 period, e.g. 30%, 40%, 45% of maximum T-put etc. With the 35 average T-put measurement results, we can draw the below CDF curve which is similar as current static potential performance metric options. The only difference is the x-axis is T-put but not sensitivity. With this curve, we can define the performance metric for T2. Actually, we are open to other options on performance metric. Companies are welcome to provide input on this in WI phase.      * Regarding the disconnection issues, if we assume the maximum DL power is used for T2 measurement, we believe disconnect should not happen frequently. Moreover, as shown above figure, with a proper X% value when defining performance metric, the average T-put with disconnection in T2 can be skipped. Therefore, we can solve the disconnection issue with a proper X value when defining the performance metric for T2. * We would clarify the proposed requirement in T2 is a separate additional requirement with T3 which is current static testing. And it will have NO impact on the current static performance metric. * Regarding the WF, the first bullet is to reuse the current setup to do the additional measurement and further study the performance metric in WI phase. The average T-put mentioned in above figure can be as starting point for performance metric in T2. The second bullet is to study a new setup and methodology which is different from the current one for more real dynamic scenario, e.g. UE continue movement and beam changing from gNB.   Response to Huawei’s comments on on Sub topic 2-2:   * Regarding 1), the response can refer to the first bullet of response to CAICT. And we would clarify that the average MIMO T-put can be calculated by the equation defined in 5.1.1 of TR38.827. At T2 period, the measurement is the same as static testing with a certain DL power. But in this case, there is no target value e.g. [70%] or [90%] of maximum T-put which is defined in static testing. * Regarding 2), the response can refer to the second bullet of response to CAICT. * Regarding 3), Could Huawei clarify what does “restriction on the UE rotation velocity” mean? We think there is no restriction on UE rotation. Based on our survey, the time duration for positioner from one to another direction should be order of millisecond. Compared with 3sec dwell time, the impact of this millisecond difference can be ignored. TE vendors can provide more views on this. * Please note that the requirements will be discussed in Rel-17 MIMO OTA WI. And the setups, channel modle and test procdure are reused from the current static testing of Rel-16 SI. Therefore, this would not be a Rel-16 requirment. And the only open issue for this is how to define the performance meric. We can use the option shown above figure as the starting point for performance metric discussion in WI phase.   Sub topic 2-3: Rel-15 TR38.810 maintenance in AI 4.13   * In general, we are fine with the Keysight’s CR. We noticed there is a similar CR submitted to RAN5. RAN4 CR should align with RAN5’s conclusion. |

### CRs/TPs comments collection

*NR MIMO OTA is a close-to-finalize SI, suggest to focus on finalizing the text proposals for TR.*

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| **CR/TP number** | **Comments collection** |
| R4-2007563 | Samsung: “Keep downlink signal power from step 2” is not feasible. As to whether changing downlink power to maximum downlink power, it may depends on implementation or algorithm of different test system. Comments from TE vendors are expected. At least it may be not necessary to be captured in the test procedure in TR of SI. |
| CAICT: before simply adding additional test procedure, it’s better to align on the new performance metric for T2 first. |
| R4-2008014 | Samsung: As commented above in 1st round, it is beneficial to collect view in this meeting, but prefer to postpone further discussion in Aug meeting. |

## Summary for 1st round

### Open issues

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

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| --- | --- |
|  | **Status summary** |
| **Sub-topic 2-1**  **FR1 MIMO OTA measurement results** | *Tentative agreements:*  *Recommendations for 2nd round:*   * None |
| **Sub-topic 2-2 FR2 dynamic testing** | *Tentative agreements:*  *Recommendations for 2nd round:*   * Further discuss suitable performance metric for T2 time period. Identify a proper way to proceed on this topic. Further check if GTW meeting session is needed. |
| **Sub-topic 2-3 Rel-15 TR38.810 maintenance in AI 4.13** | *Tentative agreements:*  *Recommendations for 2nd round:*   * Further discuss on this topic. |

*Suggestion on WF/LS assignment*

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| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

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| **CR/TP number** | **CRs/TPs Status update recommendation** |
| R4-2007563 | *to be revised* |
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## Discussion on 2nd round

### Sub-topic 2-2 FR2 dynamic testing

*Tentative agreements:*

*Recommendations for 2nd round:*

* Further discuss suitable performance metric for T2 time period. Identify a proper way to proceed on this topic. Further check if GTW meeting session is needed.

### Sub-topic 2-3 Rel-15 TR38.810 maintanence in AI 4.13

*Tentative agreements:*

*Recommendations for 2nd round:*

* Further discuss on this topic.

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| **Company** | **Comments for 2nd round** |
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## Summary on 2nd round

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |
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## Refrenece

1. R4-2005556, WF on FR2 MIMO OTA, CAICT, Keysight, Spirent, 3GPP TSG-RAN WG4 Meeting #94-e-bis, April 2020