**3GPP TSG-RAN WG4 Meeting # 104-e Rev\_R4-2214194**

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

**Agenda item:** 11.5.1, 11.5.2, 11.5.3

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for [104-e][334] FS\_NR\_FR2\_OTA\_enh

**Document for:** Information

# Introduction

The summary is to discuss Rel-18 SI on NR FR2 OTA testing enhancements and it covers the contributions submitted under the following agendas:

* 11.5.1 General and work plan
* 11.5.2 Test methods for RF/RRM/Demodulation requirements
* 11.5.3 Test uncertainty assessments
* Maximum DL testable SNR for band n263 (R4-2213179, R4-2213180)

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

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|  |  |  |
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Note:

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

# Topic #1: Geneal and work plan

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2213181 | Qualcomm Incorporated | Proposal 1: To adopt the work plan, as shown in Table 1, for Rel-18 FR2 OTA testing enhancements study item |
| R4-2212824 | vivo | Observation 1: Both multi-Rx and multi-Tx core requirement might be defined within the same timeline in Rel-18, the corresponding test system capability should consider both these two UE features to reduce the FR2 test system update burden.  Observation 2: Multi-Rx test cases related test methods development can be prioritized in Rel-18.  Observation 3: Multi-Tx test cases may need more complicated test system (depends on requirement definition), it’s valuable to consider a forward compatibility to support multi-Tx UE feature verification to ensure that the test system would not need significant updates in a short term.  Proposal 1: Extend the FR2 OTA SI working scope and also take multi-Tx UE feature into account. |
| R4-2213182 | Qualcomm Incorporated | Skeleton for TR 38.871 |
| R4-2213183 | Qualcomm Incorporated | Proposal 3: RAN4 to specify the test methodology for RF requirements enabling the testing for both multi-panel UL transmission and multi-panel DL reception. |

## Open issues summary

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

### Sub-topic 1-1

*Sub-topic description: Work plan*

*Open issues and candidate options before e-meeting:*

**Issue 1-1: Work plan**

* Proposals
  + Option 1 (Qualcomm): To adopt the work plan, as shown in below Table, for Rel-18 FR2 OTA testing enhancements study item

|  |  |  |  |
| --- | --- | --- | --- |
| **Timeline** | **UE RF objectives** | **UE RRM objectives** | **UE Demod objectives** |
| **RAN4 #104-e, Aug '22** | Approve the work plan | | |
| 1) Discuss the initial contributions on candidate measurement setups, e.g., IFF or DFF, for UE RF testing  2) Discuss whether or not to include transmitting simultaneously | 1) Discuss the initial contributions for UE RRM testing  2) Discuss whether or not to include other number of AoAs | 1) Discuss the initial contributions for UE Demod testing |
| **RAN #97e, Sept '22** |  |  |  |
| **RAN4 #104-bis-e, Oct '22** | 1) Discuss baseline measurement setup for UE RF testing  2) Discuss initial measurement uncertainty (MU) element descriptions | 1) Discuss baseline measurement setup for UE RRM testing  2) Discuss initial measurement MU element descriptions | 1) Discuss baseline measurement setup for UE demodulation testing |
| **RAN4 #105, Nov '22** | 1) Make progress on baseline measurement setup for UE RF testing  2) Make progress on MU element descriptions and MU budget values  2) Discuss mapping between MU elements and UE RF requirement definitions in the multi-Rx WI  3) Define work plan for alternate test methodologies (if applicable) | 1) Make progress on baseline measurement setup for UE RRM testing  2) Make progress on MU element descriptions and MU budget values  2) Discuss mapping between MU elements and UE RRM requirement definitions in the multi-Rx WI  3) Define work plan for alternate test methodologies (if applicable) | 1) Make progress on baseline measurement setup for UE Demod testing  2) Make progress on MU element descriptions and MU budget values  3) Discuss the propagation conditions if any |
| **RAN #98e, Dec '22** |  |  |  |
| **RAN4 #106, Feb '23** | 1) Make progress on the baseline measurement setup for UE RF testing  2) Make progress on MU element descriptions and MU budget values  3) Make progress on mapping between MU elements and UE RF requirement definitions in the multi-Rx WI  4) Discuss the alternate test methodologies (if applicable) | 1) Make progress on the baseline measurement setup for UE RRM testing  2) Make progress on MU element descriptions and MU budget values  3) Make progress on mapping between MU elements and UE RRM requirement definitions in the multi-Rx WI  4) Discuss the alternate test methodologies (if applicable) | 1) Make progress on baseline measurement setup for UE Demod testing  2) Make progress on MU element descriptions and MU budget values  3) Make progress the propagation conditions if any |
| **RAN #99, Mar '23** |  |  |  |
| **RAN4 #106-bis, April '23** | 1) Make progress the baseline measurement setup for UE RF testing  2) Make progress on MU element descriptions and MU budget values  3) Make progress on mapping between MU elements and UE RF requirement definitions in the multi-Rx WI  4) Make progress on the alternate test methodologies (if applicable) | 1) Make progress the baseline measurement setup for UE RRM testing  2) Make progress on MU element descriptions and MU budget values  3) Make progress on mapping between MU elements and UE RRM requirement definitions in the multi-Rx WI  4) Make progress on the alternate test methodologies (if applicable) | 1) Make progress on baseline measurement setup for UE Demod testing  2) Make progress on MU element descriptions and MU budget values  3) Make progress the propagation conditions if any |
| **RAN4 #107, May '23** | 1) Make progress the baseline measurement setup for UE RF testing  2) Make progress on MU element descriptions and MU budget values  3) Make progress on mapping between MU elements and UE RF requirement definitions in the multi-Rx WI  4) Make progress on the alternate test methodologies (if applicable) | 1) Make progress on baseline measurement setup for UE RRM testing  2) Discuss MU element descriptions and MU budget values  3) Discuss mapping between MU elements and UE RRM requirement definitions in the multi-Rx WI  4) Discuss alternate test methodologies (if applicable) | 1) Make progress on baseline measurement setup for UE demodulation testing  2) Make progress MU element descriptions and MU budget values  3) Discuss mapping between MU elements and UE demodulation requirement definitions in the multi-Rx WI  4) Discuss alternate test methodologies (if applicable) |
| **RAN #100, June '23** |  | | |  |  |
| **RAN4 #108, Aug '23** | 1) Make progress the baseline measurement setup for UE RF testing  2) Make progress MU element descriptions and MU budget values  3) Make progress mapping between MU elements and UE RF requirement definitions in the multi-Rx WI  4) Make progress on the alternate test methodologies (if applicable) | 1) Make progress on baseline measurement setup for UE RRM testing  2) Make progress MU element descriptions and MU budget values  3) Make progress mapping between MU elements and UE RRM requirement definitions in the multi-Rx WI  4) Make progress alternate test methodologies (if applicable) | 1) Make progress on baseline measurement setup for UE demodulation testing  2) Make progress MU element descriptions and MU budget values  3) Make progress mapping between MU elements and UE demodulation requirement definitions in the multi-Rx WI  4) Make progress alternate test methodologies (if applicable) |
| **RAN #101, Sept '23** | Provide the TR for information at RAN plenary | | |  |  |
| **RAN4 #108-bis, Oct '23** | Finalize baseline and alternate test methodologies | Finalize baseline and alternate test methodologies | 1) Make progress on baseline measurement setup for UE demodulation testing  2) Make progress MU element descriptions and MU budget values  3) Make progress mapping between MU elements and UE demodulation requirement definitions in the multi-Rx WI  4) Make progress alternate test methodologies (if applicable) |
| **RAN4 #109, Nov '23** | Finalize outcome from baseline and alternate test methodologies | Finalize outcome from baseline and alternate test methodologies | Finalize outcome from baseline and alternate test methodologies |
| **RAN #79,  Dec '23** | Conclude the study item and present the TR for approval at RAN plenary | | |

* + Option 2: TBA
* Recommended WF
  + TBA

### Sub-topic 1-2

*Sub-topic description: Extend the scoping*

*Open issues and candidate options before e-meeting:*

**Issue 1-2: Extend the scoping to also consider multi-panel transmission**

* Proposals
  + Option 1 (vivo, Qualcomm): Extend the FR2 OTA SI working scope and also take multi-Tx UE feature into account.
  + Option 2: Specify other option if any
* Recommended WF
  + If Option 1 is agreed, the workplan will be updated correspondingly.

### Sub-topic 1-3

**Issue 1-3: Dependence between core requirements and test method**

* Proposals
  + Option 1 (vivo): Study on detailed test methods enhancement to support 2AoA spherical coverage can be started after there is a clear framework on the new core requirements.
  + Option 2 (Xiaomi): Study the test method considering both the test system capability as well as the core requirement definition
  + Option 3 (R&S): Consider test system limitations in the requirement discussion
* Recommended WF
  + TBA

### Sub-topic 1-4

**Issue 1-3: Skeleton for TR 38.871**

* Proposals
  + Option 1: Agree on TR skeleton in R4-2213182
  + Option 2: Provide the comments if any
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

*One of the two formats, i.e. either example 1 or 2 can be used by moderators.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Keysight Technologies | Sub topic 1-1 (Work plan): generally agree with workplan. As commented by various companies in their contribution, many system aspects are dependent on the core requirement definition which needs to be considered.  Sub topic 1-2 (Extend the scoping to also consider multi-panel transmission): generally agree with Option 1 but maybe it should be considered a secondary priority?  Sub topic 1-3 (Dependence between core requirements and test method): Options 1 and 2 are very similar in that they are suggesting the requirement definition to progress first. Option 2 seems to be more agreeable as it is more generic, e.g., Anritsu suggests a test mode (Method 3) that would allow sequential 1 AoA testing. While we generally support testability issues to be recognized early, it is not clear that core requirements should take testability issues into account?! |
| Apple | Sub topic 1-1 (Work plan): We should elevate the decision on how many AoAs are needed for the RF setup and whether these AoAs need independent and full degrees of freedom to the work plan. We anticipate that this decision will drive the majority of the complexity in the new method.  Sub topic 1-2 (Extend the scoping to also consider multi-panel transmission): Multi-panel transmission is not in the scope of the core work item on multi-panel Rx requirements, and we should not introduce this discussion into the study item.  Sub topic 1-3 (Dependence between core requirements and test method): Option 2; in this study item the group should be able to highlight key test methodology aspects for which complexity trade-offs can be itemized. This information can help in the core requirement discussions: especially in the context of side conditions. |
| Qualcomm | Sub topic 1-1 (Work plan): Thanks KS and Apple. Your comments are reasonable. We will update the workplan in the 2nd round discussion.  Sub topic 1-2 (Extend the scoping to also consider multi-panel transmission): As the proponent, we support option 1 considering the forward compatibility. We just consider the multiple-panel transmission from testability and will not discuss the requirements.  Sub topic 1-3 (Dependence between core requirements and test method): Option 2 is preferred. Test method and core requirements should be discussed in parallel. The discussion on the test system capability would be useful for core requirements definition. |
| Huawei,  HiSilicon | Issue 1-2(Extend the scoping to also consider multi-panel transmission):  From our perspective, it is not the RAN4 level discussion. Considering Rx and Tx in parallel can be challenging and require more time, and it depends on the RAN plenary decision.  Issue 1-3(Dependence between core requirements and test method):  Prefer Option2. |
| CAICT | Sub topic 1-2 (Extend the scoping to also consider multi-panel transmission):  Generally, we are ok to take multi-Tx into consideration, but we are slightly inclined to focus on multi-Rx at this stage, or at least give priority to multi-Rx. |
| vivo | Sub topic 1-2 (Extend the scoping to also consider multi-panel transmission): we also support to consider multi-Tx, acceptable to be listed as 2nd priority. RAN level guidance is needed.  Sub topic 1-3 (Dependence between core requirements and test method): We support O1 and O2. In general, we support to study both, but the intention of O1 is that detailed decision on test methodology (setup) and procedure should be based on core requirement outcome. |
| R&S | Sub topic 1-2 (Extend the scoping to also consider multi-panel transmission): This is a matter on whether it’s part of the core requirement definition. Eventually, it could be considered as a second priority in this SI to ensure the defined methodology is future proof.  Sub topic 1-3 (Dependence between core requirements and test method): All three options are fine.  As a clarification on our proposal in Option 3: the intention is to ensure a close connection between progress in requirements and methodologies, in the sense that all requirements are testable.  Sub-topic 1-4 (Skeleton for TR 38.871): overall structure looks fine. Please note there is a typo on Annex A subclauses. They are identified as B.1, B.2, etc. |
| Xiaomi | Sub topic 1-2 (Extend the scoping to also consider multi-panel transmission):  The multi-panel TX is quite different from current multi-RX with 2AoA requirement and test method definition. We suggest not to consider adding new scope at the beginning of the WID before making great progress on the original objectives. |
| Anritsu | Sub topic 1-1: Generally fine with the workplan. For the sake of the future compatibility of the test system, we should clarify the planned test cases not only within the Rel-18 but also the possible number of simultaneous Tx/Rx AoAs in the future if possible. For example, though it seems to be out of the scope of RRM for now, we are wondering if the handover test has a possibility to be introduced in the future requirement since the HO test will increase the necessary number of active antennas.  Sub topic 1-2: Agree with option 1.  Sub topic 1-3: Agreeable with option 1 and 2. For option 3, though we would like to support as a TE vendor, at least RAN4 requirement may generally need to be developed rather from the network perspective. Of course we support the idea that we provide our views from the testability viewpoint during the discussion of core requirement. |
| Samsung | Issue 1-2(Extend the scoping to also consider multi-panel transmission):  Agree with Huawei that this is RAN level issue. On one hand there is proposal to consider core requirements, on the other hand we are trying to scope in TX which will not have core requirement in near future, it is contradicted.  Issue 1-3(Dependence between core requirements and test method):  Both option 1 and option 2 are reasonable. However, core requirement make take a little long time, in that case, the test method study would better to include the most flexible freedom in test system.  For option 3, if it is not limited to existing capability, it is also considerable anyhow new method and new configuration are not precluded. |
| OPPO | Sub topic 1-2 (Extend the scoping to also consider multi-panel transmission):  It is acceptable to take multi-Tx into consideration as 2nd priority. An multi-Rx OTA test methodology, which has the capability to perform multi-Tx OTA test, is cost-effective solutions. |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic #1-1** | **Issue 1-1: Work plan**  *Summary of round 1 discussion: three companies added the comment. In general, the workplan is OK. Need to make the update in the 2nd round discussion.*  *Tentative agreements: To revise the workplan based on the comments in the first round.*  *Candidate options: To revise option 1.*  *Recommendations for 2nd round: Continue to discuss the updated workplan* |
| **Sub-topic #1-2** | **Issue 1-2: Extend the scoping to also consider multi-panel transmission**  *Summary of round 1 discussion:*  *Support to extend scope to multi-panel Tx: Keysight, Qualcomm, CAICT, vivo, R&S, Anritsu, OPPO*  *Non support to extend scope to multi-panel Tx: Apple, Huawei, Xiaomi, Samsung*  *It is also pointed out that this is a RAN-P issue and should not be decided by RAN4.*  *Tentative agreements: N/A*  *Candidate options:*  *Option 1: RAN4 to recommend extending the scope to include the multi-Tx from testability point of view considering the forward compatibility. The study on the multi-Tx is with 2nd priority. The final decision will be made in RAN level.*  *Option 2: RAN4 not to recommend extending the scope to include the multi-Tx from testability point. The final decision will be made in RAN level.*  *Recommendations for 2nd round: Continue to discuss candidate options.* |
| **Sub-topic #1-3** | **Issue 1-3: Dependence between core requirements and test method**  *Summary of round 1 discussion:* *Most of companies are OK with option 1 and option 2.*  *Tentative agreements:* *Study the test method considering both the test system capability as well as the core requirement definition. The test method and core requirements will be discussing in parallel.* *Study on detailed test methods enhancement ensuring a close connection between progress in requirements.*  *Candidate options: Combined option 1/2/3*  *Recommendations for 2nd round: Continue to discuss the tentative agreements* |
| **Sub-topic #1-3** | **Skeleton for TR 38.871**  *Tentative agreements: To revise the skeleton of TR 38.871 based on the comments in 1st round.*  *Candidate options: N/A*  *Recommendations for 2nd round: Continue to discuss updated skeleton.* |

### CRs/TPs

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

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

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

## Discussion on 2nd round (if applicable)

### Sub-topic 1-1

*Sub-topic description: Work plan*

*Open issues and candidate options before e-meeting:*

**Issue 1-1: Work plan**

* Proposals
  + Option 1: To adopt the workplan Rel-18 FR2 OTA testing enhancements study item in the revision of R4-2213181 (https://www.3gpp.org/ftp/tsg\_ran/WG4\_Radio/TSGR4\_104-e/Inbox/Drafts/%5B104-e%5D%5B334%5D%20FS\_NR\_FR2\_OTA\_enh/Revisions/Rev\_R4-2213181%20Work%20plan%20for%20Rel-18%20FR2%20OTA%20testing%20enhancements.docx)
  + Option 2: TBA
* Recommended WF
  + Option 1

### Sub-topic 1-2

*Sub-topic description: Extend the scoping*

*Open issues and candidate options before e-meeting:*

**Issue 1-2: Extend the scoping to also consider multi-panel transmission**

* Proposals
  + Option 1: RAN4 to recommend extending the scope to include the multi-Tx from testability point of view considering the forward compatibility. The study on the multi-Tx is with 2nd priority. The final decision will be made in RAN level.
  + Option 2: RAN4 not to recommend extending the scope to include the multi-Tx from testability point. The final decision will be made in RAN level.
* Recommended WF
  + TBA

### Sub-topic 1-3

**Issue 1-3: Dependence between core requirements and test method**

* Proposals
  + Option 1: Study the test method considering both the test system capability as well as the core requirement definition. The test method and core requirements will be discussing in parallel. Study on detailed test methods enhancement ensuring a close connection between progress in requirements.
  + Option 2: specify other option if any
* Recommended WF
  + Option 1

### Sub-topic 1-4

**Issue 1-3: Skeleton for TR 38.871**

* Proposals
  + Option 1: Agree on TR skeleton in revision of R4-2213182 (https://www.3gpp.org/ftp/tsg\_ran/WG4\_Radio/TSGR4\_104-e/Inbox/Drafts/%5B104-e%5D%5B334%5D%20FS\_NR\_FR2\_OTA\_enh/Revisions/Rev\_R4-2213182%20TR38.871%20v0.0.1%20FR2%20OTA%20testing%20enh%20skeleton.docx)
  + Option 2: Provide the comments if any
* Recommended WF
  + Option 1

## Companies views’ collection for 2nd round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| xx | Sub topic x-x: |
| Keysight Technologies | Sub-Topic 1-1 (Work plan)  We have some slight concerns with the revised work-plan and the added scope of “Evaluate the feasibility of supporting 2AoAs with full degrees of freedom” in the two upcoming RAN4 meetings. Given the feedback from TE vendors and various UE vendors, this approach was considered undesirable given the introduction of brand-new test system with large footprints and high complexity, i.e., no re-use of existing test systems at all. If the industry is supportive of new test systems and accepting delays in availability of such test systems, this change in work plan task is acceptable.  Additionally, the evaluation of testability issues should be added to the UE RF objectives (considering it was added to the UE RRM and Demod objectives).  Sub-Topic 1-2 (Extend the scoping to also consider multi-panel transmission)  Support Option 1  Sub-Topic 1-3: Dependence between core requirements and test method  The proposed WF could be simplified by focusing on the last sentence, e.g., “Study of detailed test methods enhancement must ensure a close connection to the core requirements work discussed in parallel.” |
| Samsung | Sub-Topic 1-1 (Work plan)  We support the revised work plan. The objective of core WID explicitly indicates that new spherical coverage will be defined. For the new 2AoA spherical coverage, we think it is necessary to evaluate the feasibility of supporting 2AoAs with full degrees of freedom  Sub-Topic 1-2 (Extend the scoping to also consider multi-panel transmission)  Support Option 2  Sub-Topic 1-3: Dependence between core requirements and test method  The sentence “The test method and core requirements will be discussing in parallel” seems a little confusing, maybe remove this sentence since other two sentences already clearly show the intention  Sub-Topic 1-4: Skeleton for TR 38.871  In core requirement discussion it was just tentatively agreed that “**The concept of panel should not be explicitly used in core requirements and test configurations**”. So it is suggested to change the wording of “multi-panel reception” to “multi-RX chain DL” or else. |
| Qualcomm | Sub-Topic 1-1 (Work plan)  We support the revised workplan as the proponent.  Response to KS’s comments.  Test setup supporting 2AoAs with full degrees of freedom is one of alternative test methodologies. Indeed, this will be a brand-new test system compared with the legacy test system and will have high complexity. Note that in SID, it was saying “FR2 test methods defined in TR 38.810 and TR 38.884 should be used as the baseline”. Our understanding is it does not mean we will have to reuse all the legacy test system, so we think it is worth to investigating the feasibility in RAN4. We would not close the door for alternatives at the first meeting.  For comment of “Additionally, the evaluation of testability issues should be added to the UE RF objectives (considering it was added to the UE RRM and Demod objectives).” We thought evaluation of testability issues for RF/RRM/Demod have already been within the objectives of this SI. But we can clarify in the RAN-P if it is not clear for other companies.  Sub-Topic 1-2 (Extend the scoping to also consider multi-panel transmission)  Support Option 1.  Sub-Topic 1-3: Dependence between core requirements and test method  We are OK with proposal from Samsung.  Sub-Topic 1-4: Skeleton for TR 38.871  In the SID, it is using multi-panel reception. But we are OK to change the wording of “multi-panel reception” to “multi-RX chain DL” if other companies are think Rx channel DL is more accurate. |

# Topic #2: Test methods for RF/RRM/Demodulation requirements

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2211549 | Anritsu Corporation | Observation 1: Current FR2 OTA measurements for TRx RF is testable only by the IFF for the sake of the black box test.  Observation 2: The number of additional antennae from the second AoA depends on the test cases to support with the 2AoA condition. (e.g. an additional antenna for blocker may also be necessary)  Observation 3: It is questionable that another test system for FR2 RF 2AoA with 2 reflectors with a slider is achievable or acceptable in the market.  Proposal 1: Consider the dedicated test system for FR2 Rx 2AoA with a simplified configuration.  Observation 4: Test system with the IFF and the DFF antenna can reduce the second reflector. But it still has a complexity compared to the existing 1 AoA RF test setup since it requires the second positioner.  Observation 5: A setup with multiple DFF antennae may have a chance to reduce the system complexity and to reuse 2 AoA RRM test setup.  Observation 6: There is a need to consider test procedures further to ensure that we measure the RF characteristics of each antenna in the DUT by the IFF antenna.  Observation 7: An existing 1 AoA IFF test system can be used by introducing the dedicated test command to fix the active antenna panel in the DUT.  Observation 8: Method 3 can maintain the black box approach.  Proposal 2: RAN4 aim the method 2-2 or method 3 for the 2AoA RF tests.  Observation 9: Current FR2 TRx RF test system is designed to align polarization planes of the test antenna with the reference coordinate system.  Observation 10: Reference coordinate system may need to be cared also for the 2 AoA RF test setup.  Observation 11: Center of rotation axes have to be in the same direction to keep alignment of both polarization planes from AoA1 and AoA2. FFS if this has to be applied in a case that either of the DL signal is just an anchor. |
| R4-2211991 | Samsung | Observation 1: for 1AoA based OTA test, the rotation system is usually designed with rotating UE instead of rotating probe  Observation 2: the relative position among {probe1, probe2, UE} is more complicated than the relative position between {probe, UE}, so traditional UE rotation could not cover all measurement conditions in the new 2AoA based OTA test  Proposal 1: it is proposed to study new multi-probe test system targeted to enable the condition that the simultaneous reception/transmission paths to and from UE can be configured as any directions by proper rotation system design.  Proposal 2: the rotation system and chamber for 2AoA OTA test should accommodate the scenario that probe1 and probe2 could show up in different hemisphere of UE.  Proposal 3: in 2AoA OTA test system, the two probes are divided into test probe and anchor probe. It is suggested to study the feasibility of rotating both UE and anchor probe as a whole. |
| R4-2212377 | Apple | Observation 1: In order to facilitate the related core work item discussions on side conditions, it can be helpful to collect test equipment vendors’ views on whether full rotational degrees of freedom for AoA1 and AoA2 can be supported in the FR2 RF test setup.  Observation 2: Further discussion of the quiet zone MU definition and validation procedure is needed.  Observation 3: It would be helpful to get feedback from test vendors on the feasibility of the IFF test setup for multi-AoA testing in general.  Observation 4: Further discussion on the potential applicability of the legacy FR2 RRM test setup to the multi-panel reception RRM requirements is needed onces the core work item achieves agreements on the corresponding side conditions.  Observation 5: It would be helpful to get feedback from the test equipment vendors on the feasibility of enabling full rotational degrees of freedom for AoA1 and AoA2 in the demodulation test setup.  Proposal 1: For the FR2 multi-panel reception RF test methodology, the assumption that the test system needs to support 2 simultaneously active AoAs can be taken as a starting point. |
| R4-2212823 | vivo | Observation 1: How to define the enhanced test method is highly dependent on the new criteria for 2AoA spherical coverage which is determined in the main session.  Observation 2: RAN4 still needs more meetings to discuss which RRM requirement should be specified for Multi-Rx RRM, potentially, some down scoping might happen.  Proposal 1: Study on detailed test methods enhancement to support 2AoA spherical coverage can be started after there is a clear framework on the new core requirements.  Proposal 2: RAN4 should reuse legacy IFF/DFF system as much as possible and further study how to introduce additional DL antenna to support the 2AoA spherical coverage measurement.  Proposal 3: For multi-Rx RRM test methods study, it would be good to wait for the clear feedback from RRM session on which requirement will be specified and how the capability of test system should be (e.g., maximum number of DL antenna, required minimum angular separation of antenna pairs…).  Proposal 4: The Rel-15 measurement setup for UE demodulation and CSI characteristics testing in TR 38.810 should be baseline for further enhancement to support 4-layer MIMO.  Proposal 5: On top of the legacy demodulation test system, RAN4 to discuss how to introduce additional DL antenna with reasonable angular separation. |
| R4-2213183 | Qualcomm Incorporated | Observation 1: To enable the UE RF requirements testing, two measurements antennas are needed, and the positioning system such that the angle between each dual-polarized measurement antenna and the DUT might need to have at least two axes of freedom independently.  Proposal 1: The feasibility of supporting two measurement antennas with two axes of freedom independently needs to be checked test equipment vendors.  Proposal 2: The measurement setup should reuse the legacy measurement step, i.e., DFF and IFF as much as possible. For each AoA, the test procedure for EIS1/2 should be reused from legacy EIS test procedure defined in TR 38.810.  Proposal 3: RAN4 to specify the test methodology for RF requirements enabling the testing for both multi-panel UL transmission and multi-panel DL reception.  Observation 2: The definition of angular offset for multi-panel UE RRM testing would be based on the beam pairs which is different from legacy RRM test setup. The legacy measurement setup with 30°, 60°, 90°, 120°, 150° and 180° angular would lead to improper beam pair selection.  Proposal 4: RAN4 to consider more flexibility on the angular offset for multiple panels for UE RRM requirements testing.  Proposal 5: The virtual cable approach should be the baseline for multiple panels UE demodulation testing saying only pure baseband performance shall be tested for UE with multiple panel reception.  Proposal 6: RAN4 to further study how to select the beam pair for UE demodulation requirements testing. |
| R4-2213196 | Xiaomi | Proposal 1: It is proposed to limit the scope of the SID only covers FR2-1 in Rel-18.  Observation 1: The two AOA should test setup should represent two different QCL TypeD RSs and for each angle 2DL layers with dual polarization should be guaranteed by the new test methodology.  Proposal 2: Current study on inter-band CA of FR2+FR2 with offset antenna can be the starting point of the new test methodology.  Proposal 3: How to define the two AOA needs to consider both the test system capability as well as the core requirement definition. |
| R4-2213421 | OPPO | Observation 1: The simulation assumption of DUT antenna panels in Clause 5.1.2 of TR 38.884 can be reused when study multi-panel simultaneously transmission test method.  Proposal 1: The test zone requirement of test method should be studied in RAN4. |
| R4-2213418 | OPPO | Proposal 1: The test method setup for FR2 MIMO OTA in TR 38.827 can also be included as the baseline together with those in TR 38.810 and TR 38.884.  Proposal 2: The two AoAs used for multi-panel simultaneous reception need to be further studied. |
| R4-2213627 | Rohde & Schwarz | Observation 1: TR 38.810 only defines one possible implementation of 2 AoA OTA test environment, based on DFF.  Observation 2: NF based methods defined in TR 38.884 (i.e. CFFNF, CFFDNF and CFFdeltaNF) cannot be adapted to multiple AoA testing.  Observation 3: Enhanced IFF has been proven feasible and presents clear advantages with respect to other methodologies.  Proposal 1: Angular relationships between simultaneously active AoAs shall be reused from TR 38.810 (i.e. 30°, 60°, 90°, 120° and 150°). Whether the list can be further reduced for specific applications is FFS.  Proposal 2: Enhanced IFF is selected as the baseline methodology for further study and definition of multi AoA methodology for multi-panel reception UEs.  Proposal 3: RAN4 to define the applicable QZ sizes per form factor and/or Power Class.  Proposal 4: RAN4 to define the scope of test cases per application (RF, RRM and Demod).  Proposal 5: RAN4 to consider test system limitations in the requirement discussion per application (RF, RRM and Demod). |

## Open issues summary

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

### Sub-topic 2-1

*Sub-topic description: Test methods for RF requirements*

*Open issues and candidate options before e-meeting:*

**Issue 2-1-1: Quiet zone size and validation procedure**

* Proposals
  + Option 1 (Apple, OPPO, R&S): Study the quiet zone size, MU definition, and validation procedure etc., due to the larger radiating parts of the DUT.
  + Option 2: specify other option if any
* Recommended WF
  + TBA

**Issue 2-1-2: Baseline measurement setup for RF testing**

* Proposals
  + Option 1 (vivo): Reuse legacy IFF/DFF system as much as possible and further study how to introduce additional DL antenna to support the 2AoA spherical coverage measurement.
  + Option 2 (Apple): Support 2 simultaneously active AoAs can be taken as a starting point, e.g., the IFF test setup for multi-AoA testing
  + Option 3 (R&S): Enhanced IFF is selected as the baseline methodology for further study and definition of multi AoA methodology for multi-panel reception UEs. Reuse legacy RRM test setup, i.e., angular relationships between simultaneously active AoAs is 30°, 60°, 90°, 120° and 150°. Whether the list can be further reduced is FFS.
  + Option 4 (Samsung): Study new multi-probe test system targeted to enable the condition that the simultaneous reception/transmission paths to and from UE can be configured as any directions permutations by proper rotation system design
  + Option 5 (OPPO): The test method setup for FR2 MIMO OTA in TR 38.827 can also be included as the baseline together with those in TR 38.810 and TR 38.884.
  + Option 6 (Xiaomi): Current study on inter-band CA of FR2+FR2 with offset antenna can be the starting point of the new test methodology.
* Recommended WF
  + TBA

**Issue 2-1-3: The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing**

* Proposals
  + Option 1: Yes
  + Option 2: No. Please specify the issues if Option 2 is selected.
* Recommended WF
  + TBA

**Issue 2-1-4: Potential test methods for RF testing**

* Proposals
  + Option 1(R4-2211549): IFF+IFF with moving reflectors, Test 2 AoAs simultaneously with 2 IFF (see example illustration below)

ダイアグラム

自動的に生成された説明

* + Option 2 (R4-2211549): IFF+DFF, DFF antennae as the second AoA NR anchor (see example illustration below)

ダイアグラム

自動的に生成された説明

* + Option 3 (R4-2211549): IFF+DFF, fixed DFF antennae as NR anchor (see example illustration below)

ダイアグラム

自動的に生成された説明

* + Option 4 (R4-2211549): Sequential tests by introducing a new test command to fix an active antenna in the DUT (see example illustration below)



* + Option 5 (R4-2211991): IFF+ rotating UE and anchor probe as a whole, the probes are divided into test probe and anchor probe (see example illustration below)



rotate UE and anchor probe as a whole

anchor probe

test probe

* + Option 6 (R4-2213627): Enhanced IFF method utilizing multiple compact antenna test ranges as per TS 38.508-1, i.e., reuse the legacy RRM test setup (see example illustration below)

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* Recommended WF
  + TBA

### Sub-topic 2-2

*Sub-topic description: Test methods for RRM requirements*

*Open issues and candidate options before e-meeting:*

**Issue 2-2: Baseline measurement setup for RRM testing**

* Proposals
  + Option 1 (Apple): Further discuss applicability of the legacy FR2 RRM test setup to the multi-panel reception RRM requirements
  + Option 2 (Qualcomm): Legacy RRM test setup could be baseline and to further consider more flexibility on the angular offset for multiple panels for UE RRM requirements testing.
  + Option 3 (R&S): Enhanced IFF is selected as the baseline methodology for further study and definition of multi AoA methodology for multi-panel reception UEs. Reuse legacy RRM test setup, i.e., angular relationships between simultaneously active AoAs is 30°, 60°, 90°, 120° and 150°. Whether the list can be further reduced is FFS.
  + Option 4 (vivo): Wait for the clear feedback from RRM session on which requirement will be specified and how the capability of test system should be.
* Recommended WF
  + TBA

### Sub-topic 2-3

*Sub-topic description: Test methods for demodulation requirements*

*Open issues and candidate options before e-meeting:*

**Issue 2-3-1: Approach for multi-panel reception demodulation testing**

* Proposals
  + Option 1 (Qualcomm): The virtual cable approach should be the baseline for multiple panels UE demodulation testing and only pure baseband performance shall be tested.
  + Option 2: Specify other option if any
* Recommended WF
  + TBA

**Issue 2-3-2: Baseline measurement setup for demodulation testing**

* Proposals
  + Option 1 (vivo): The Rel-15 measurement setup for UE demodulation should be baseline for further enhancement to support 4-layer MIMO. To discuss how to introduce additional DL antenna with reasonable angular separation.
  + Option 2 (Qualcomm): RAN4 to further study how to support the selection of beam pair (two AoAs) for UE demodulation requirements testing.
  + Option 3 (R&S): Enhanced IFF is selected as the baseline methodology for further study and definition of multi AoA methodology for multi-panel reception UEs. Reuse legacy RRM test setup, i.e., angular relationships between simultaneously active AoAs is 30°, 60°, 90°, 120° and 150°. Whether the list can be further reduced is FFS.
* Recommended WF
  + TBA

**Issue 2-3-3: The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing**

* Proposals
  + Option 1: Yes
  + Option 2: No. Please specify the issues if Option 2 is selected.
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Keysight Technologies | Sub topic 2-1:  Issue 2-1-1 (Quiet zone size and validation procedure): Generally agree with Option 1 in that MU definition and validation procedures need to be taking multiple AoAs/new system aspects into account. It would be desirable if the QZ sizes remain the same, i.e., 20cm, 30cm, 40cm, and 55cm while taking into account that the dynamic range of the system is dependent on QZ size.  Issue 2-1-2 (Baseline measurement setup for RF testing):  On Option 1: agree provided the core requirements indeed require simultaneous 2 AoAs and Anritsu’s Method 3 (sequential 1 AoA tests) is not further considered  On Option 2: agree if Anritsu’s Method 3 (sequential 1 AoA tests) is not further considered  On Option 3: RRM 2 AoA test setup including Enhanced IFF is likely not suitable for multi-panel TX/RX UE RF testing given the lack of absolute probe position definition (TR 38.810 states: ‘absolute position of the probes is left up to implementation’). Potentially, an RRM 2 AoA test setup with the same absolute position of at least 2 probes could be considered as a baseline; however, it would require a deviation in the test system definition from the existing 2 AoA RRM system.  On Option 4: For two probes to have arbitrary degrees of freedom has significant impact on test system size, complexity, and cost (as highlighted by Anritsu in their Method 1 illustrations). The upgradeability of existing FR2 OTA test systems would no longer be possible.  On Option 5: Since the absolute probe positions for the FR2 MIMO OTA system (TR 38.827) are defined (unlike the probe positions of the 2 AoA RF2 RRM system), this system could indeed be considered a baseline.  On Option 6: the offset antenna approach was studied in TR38.884 as an optional approach for test systems with probe antennas that cannot support the required frequency range to support the FR2&FR2 Inter-Band CA bands. We do not believe that this approach is suitable for multi-panel FR2 testing.  Issue 2-1-3 (The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing)  Support Option 2 as the full degrees of freedom require brand-new systems and a level of complexity that seems undesirable.  Issue 2-1-4 (Potential test methods for RF testing):  Option 1 & Option 2: concerned with system complexity and the need to have brand-new systems  Option 3: Conceptually, this could be one approach where absolute probe positions are defined but whether the probes are implemented IFF vs DFF should be further discussed, i.e., it is too early to require one probe to be IFF and the other probes DFF.  Option 4: should be more closely considered as it would allow existing systems to be leveraged.  Option 5: this seems to be a subset of what is proposed in Option 3. Generally, we believe that the absolute positions of probes have to be defined (instead of defining just the relative orientation between AoAs).  Option 6: since the probe placement of FR2 RRM systems is left up to system vendors, it does not seem suitable for RF testing to guarantee the same tests (absolute AoAs) are performed among different system vendors. Potentially, an RRM 2 AoA test setup with the same absolute position of at least 2 probes e.g., see Option 5 or 3, could be considered as a baseline; however, it would require a deviation in the test system definition from the existing 2 AoA RRM system.  Sub topic 2-2 (RRM testing):  Support Option 4, we are concerned with Option 3 as this is a very specific implementation of the legacy RRM FR2 system. As stated in the objectives “the target should be to allow testing of 4 AoAs with 2 simultaneously active AoAs,” given the lack of absolute probe position definition, the legacy FR2 RRM system might not be able to test the same 4 AoAs among different system vendors.  Sub topic 2-3 (demodulation testing):  Topic 2-3-1 (Approach for multi-panel reception demodulation testing):  Support Option 1  Topic 2-3-2 (Baseline measurement setup for demodulation testing):  Support Option 1 and Option 2. We are concerned with Option 3 as demodulation testing does not require IFF probes for the “wireless cable mode” approach and since 2 probes should be sufficient instead of the min. of 4 probes for ‘Enhanced IFF.’ We would furthermore suggest the closer consideration of the NF methodology for demodulation testing for Rel-18 (including multi-panel) to address some of the dynamic range/testability concerns.  Topic 2-3-3 (The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing):  Support Option 2: the complexity of test systems to support full degrees of freedom for each AoA would be tremendous. If the “wireless cable mode” is endorsed as baseline, complete degrees of freedom for each probe seems overkill. |
| Apple | Sub topic 2-1:  Issue 2-1-1 (Quiet zone size and validation procedure): Option 1  Issue 2-1-2 (Baseline measurement setup for RF testing):  As the proponent, with Option 2, our intention is to reach an agreement on the number of simultaneously active AoAs. From this perspective, Option 2 is not mutually exclusive with the other options listed.  Option 3 seems to be a reasonable starting point, if full rotational degrees of freedom are not necessary (see Issue 2-1-3).  Issue 2-1-3 (The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing): we would like to gather test equipment vendors’ views  Sub topic 2-2 (RRM testing):  We are fine with Options 1 and 2.  Sub topic 2-3 (demodulation testing):  Issue 2-3-1 (Approach for multi-panel reception demodulation testing): Option 1 is OK  Issue 2-3-2 (Baseline measurement setup for demodulation testing): Option 1 is preferred  Issue 2-3-3 (The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing):  We think further discussion is needed here; if we adopt the cable replacement approach for the 4-layer test, then we also need to ensure that different UE panels are illuminated in the test. However, this probably does not imply that full rotational degrees of freedom are necessary. Thus, we are trending toward Option 2 and would welcome other views. |
| Qualcomm | Sub topic 2-1:  Issue 2-1-1 (Quiet zone size and validation procedure): We support option 1. Regarding the question from KS on the QZ sizes, remaining the same as legacy QZ sizes would be the starting point.  Issue 2-1-2 (Baseline measurement setup for RF testing):  For Option 1/2: we support the proposal of reusing IFF/DFF as much as possible. Simultaneously active 2AoA with full rotation freedom would be preferred as the starting point.  For Option 3: We agree with KS that RRM 2 AoA test setup not suitable for multi-panel TX/RX UE RF testing since there are only serval angular relations which is not enough to cover the multiple-panel UE RF testing. If the current RRM 2 AoA test setup can be extended to support full rotation of freedom for 2 AoAs, it should be fine to use it as the baseline. Otherwise, we need to consider a new test setup. Input from TE vendors on the possibility of extending the legacy RRM test setup is needed.  Option 4: Multiple probes might be needed to support full rotation for 2AoAs. Clarifications to Samsung: would multiple probes are all based on the far-field criterion?  Option 5: Multiple probes defined in TR38.827 is to emulate the fading channel. In multi-panel RF testing, we will just consider AWGN channel. So the probe layout would be different from 3D-MPAC defined in TR38.827.  Option 6: The antenna isolation for FR2 Inter-band CA testing is limited in a small range. It should not be feasible to support multi-panel testing.  Issue 2-1-3 (The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing)  Full rotational degrees of freedom for simultaneously two active AoA is preferred. But we would like to hear the view from TE vendors.  Issue 2-1-4 (Potential test methods for RF testing):  Option 1 & Option 2: Full rotational degrees of freedom for simultaneously two active AoA is preferred.  Option 3: There will be limitation for the testing. But if option 1/2 are not feasible, option 3 is an alternative approach.  Option 4: it is not preferred. Testing two directions sequentially could not fully verify the UE performance for multiple panels. For example, with the small isolation from two AoAs, there will be interference between two panels. Option 4 is not feasible to test the real performance.  Option 5: Similar as option 3. Question to Samsung: Does anchor probe need to be in far-field? If no, how can we make sure the accuracy of EIS testing in anchor probe?  Option 6: RRM 2 AoA test setup not suitable for multi-panel TX/RX UE RF testing since there are only serval angular relations which is not enough to cover the multiple-panel UE RF testing. If the current RRM 2 AoA test setup can be extended to support full rotation of freedom for 2 AoAs, it should be fine to use it as the baseline. Otherwise, we need to consider a new test setup. Input from TE vendors on the possibility of extending the legacy RRM test setup is needed.  Sub topic 2-2 (RRM testing):  Support 2 as the starting point. Option 3 is not feasible for RRM testing. For option 4, we can have some discussion on feasibility of potential test setup before we get the feedback from RRM core requirements discussion.  Sub topic 2-3 (demodulation testing):  Topic 2-3-1 (Approach for multi-panel reception demodulation testing):  We Option 1.  Topic 2-3-2 (Baseline measurement setup for demodulation testing):  We support option 1 and option 2. Option 3 might not be enough to support the freedom for two AoAs in Demod testing  Topic 2-3-3 (The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing):  Option 1 is preferred. TE vendors’ input is welcome. To response KS’s comments, yes, full freedom for 2AoAs might not be needed if virtual cable approach is used. But we might need to do the AoA pair searching to select the proper directions with some side conditions (such as pass the REFSENSE requirements, minimizing the interference between two beams as much as possible, pass the isolation check for dual pol.) |
| Huawei,  HiSilicon | Issue 2-1-1(Quiet zone size and validation procedure):  Option 1, and further discussion is necessary due to the two AOAs.  Issue 2-1-2(Baseline measurement setup for RF testing):  Regarding Option4, Not sure whether any directions need to be covered.  Regarding other options, we are fine in the initial discussion, especially Option5.  Issue 2-1-3 (The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing) :  Option 2. It is not necessary that all combinations of angles be considered and several typical angles are sufficient when measured, especially for black-box testing.  Issue 2-1-4(Potential test methods for RF testing):  From the test system reuse and complexity perspective, we are open to further discuss Option3/4/5/6 and other options in the future. However, option 1 and 2 should be excluded due to adding the slider, which may result in increased costs. In addition, it is not necessary that all combinations of angles be considered and several typical angles are sufficient when measured, especially for black-box testing.  Issue 2-3-1(Approach for multi-panel reception demodulation testing):  Option 1.  Issue 2-3-3 (The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing):  Option 2. It is not necessary that all combinations of angles be considered and several typical angles are sufficient when measured, especially for black-box testing. |
| CAICT | Issue 2-1-2 Baseline measurement setup for RF testing  Support option 1 ,2 and option 5. Consider existing test setup as baseline and reuse them as much as possible would be helpful to reduce complexity.  38.827 has defined a 3D-MPAC test setup with multi-probes for FR2 MIMO OTA, it could be considered as a baseline for multi-AoAs testing  Issue 2-1-3 The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing  Support option 2. We are concerned about the complexity and cost of the test system that supports full rotation degrees. Inputs from TE vendors may be helpful. |
| vivo | Issue 2-1-1(Quiet zone size and validation procedure):  Option 1 is OK for us.  Issue 2-1-2(Baseline measurement setup for RF testing):  No strong view on down selection this meeting. We prefer to list the options as starting point for further discussion, future down-scoping can be done bases on core requirement conclusions.  Issue 2-1-3 (The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing):  Option 2. In general, it is not needed, considering the complexity of the system. However, this is dependent on how core requirements look like.  Issue 2-1-4(Potential test methods for RF testing):  We support to list the options as starting point for further discussion.  Issue 2-3-2(Baseline measurement setup for demodulation testing):  Option 1.  Issue 2-3-3 (The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing):  Option 2. Currently not see the necessarily to support full rotational degrees of freedom for simultaneously two active AoAs for Demodulation testing. |
| R&S | **Issue 2-1-1** (Quiet zone size and validation procedure): we certainly support Option 1. We agree to keep the same list of QZ sizes defined so far (i.e., 20cm, 30cm, 40cm, and 55cm) but prioritization is highly recommended (e.g. 30cm QZ for PC3) giving the implications on the test systems.  **Issue 2-1-2** (Baseline measurement setup for RF testing): As a general comment, and according to the SID, the existing test methods from TR 38.810, TR 38.883 and TS 38.508-1 shall be used as baseline and test system reuse, etc. shall be considered. So, we should focus on these test systems instead of adding new ones.  We support Option 3 as the proponent. We think that a careful selection of the relative AoA and corresponding definition in the TR will allow the reuse of existing test system vs. developing unique test system for multi-panel UE. In addition, it is not clear for us why a fixed relation between AoA is not sufficient for multi-panel UE testing.  Question for clarification, also related to Issue 2-1-3: is it expected that spherical coverage per panel is dependent on the active AoA from the other panel?  About Option 4 (multi-probe), this will require new test systems, and thus no reuse of existing ones.  With respect to Option 5 (reuse of MIMO OTA in TR 38.827), this option has even more limitations with respect to the fixed relation between AoA, in addition that respecting FF conditions for per probe is not a base conditions for such a setup.  About Option 6 (offset feeds), the achievable separation between AoA is to limited, just a few degrees.  **Issue 2-1-3** (The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing): considering full rotational degrees for simultaneous AoA require completely new and very complex systems. Very little could be reused from methods and systems already defined for FR2. This idea was explored already in the original FR2 testability study item with respect to RF blocking and RRM use cases, and it was abandoned due to the high system complexity.  **Issue 2-1-4** (Potential test methods for RF testing): We still support Option 6 with Enhanced IFF since a careful selection of the relative AoA (more than one if required), given the advantages of such setup. Option 6 could be combined with Option 4 (sequential + test command) in order to simplify the test procedure while being able to test almost infinite number of combinations.  For Option 1, the complexity of moving reflectors with full angle freedom would require massive installations due to chamber size and positioning system.  With respect to Options 2 and 3, DFF antennas would have an impact on overall MU and will limit the radiating aperture that can be tested with a certain implementation.  Option 5 seems like a quite effective implementation, although we are not sure about the accuracy expected with the anchor probe in terms of beam acquisition and actual measurements, and thus this would be equivalent to the sequential test described in Option 4, except for the test command.  **Issue 2-2** (Baseline measurement setup for RRM testing): we support Option 3 as the proponent. Actually, Enhanced IFF is one implementation of the Legacy RRM proposed in Options 1 and 3, with the advantage of IFF methodology for all angles.  We’d like to request additional comments on why the fixed relation between the angles is deemed not valid for multi-panel UE. Is it expected to test all possible angular relations for the 2 AoA? That would imply infinite number of combinations for testing.  **Issue 2-3-1** (Approach for multi-panel reception demodulation testing): we agree with Option 1.  **Issue 2-3-2** (Baseline measurement setup for demodulation testing): we support Option 3 as the proponent. Theoretically, NF based methodologies (like DNF in TR 38.810) could be feasible given the usage of the virtual cable approach. Even though, there was no conclusion on how NF coupling may affect / be compensated so performance requirements defined at baseband are properly tested. Therefore, existing implementations of Demod test systems are based on IFF methodologies.  **Issue 2-3-3** (the feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing): Option 2. This would add very high complexity to the test system and which from our point of view is probably not required to cover Demod. |
| Xiaomi | Sub topic 2-1:  Issue 2-1-1 (Quiet zone size and validation procedure):  Support Option 1  Issue 2-1-2 (Baseline measurement setup for RF testing):  As proponent of option 6 we believe the inter-band CA scenario is quite similar to the current 2AOA test setup scenario. As currently how far the 2 AOA should be separated has not been defined yet, we can further discuss the 2 feed antenna position after the core requirement being agreed.  Sub topic 2-2 (RRM testing):  We are fine with Options 4 to see clear how the requirement will be defined. |
| Anritsu | Issue 2-1-1: Agree with option 1.  Issue 2-1-2: Prefer Option 1 and 2 if our proposed method 3 (sequential 1AoA) is excluded. But we are fine to leave all the possible methods including our proposed test method 3 at this stage except for the option 6. Since option 6 (offset antenna test system for FR2 inter-band CA in TR 38.884) is assuming 1 IFF reflector with some offset antennae arranged within 10 cm range or so, it is not matching the current concept of multi-TRP scenario. And as for option 4 with any directions permutations, we fully agree with Keysight that the system will increase the system complexity a lot.  Issue 2-1-3: Support Option 2. Option 1 with full degree of freedom will increase the complexity of the test system and its cost to the impractical level. There should be alternative solutions to achieve the current objectives.  Issue 2-1-4: Prefer option 3, 4 and 5. If the intention of option 6 is including the idea of option 3, it is also fine to us at this moment. About the test methods for RF testing, we should be careful very much if we anticipate the possibility of increase with AoAs to connect simultaneously, or if we have a possibility to introduce FR2-1 + FR2-2 combinations.  Issue 2-2: Support option 1 and 4. At the same time, we’d like to clarify if there is a possibility that the handover test might be introduced in the future since the simultaneously active AoA might become 2 to at least 3 in that case.  Issue 2-3-1: Support option 1.  Issue 2-3-2: Support option 1 and 2.  Issue 2-3-3: Support option 2. Same as issue 2-1-3, Option 1 with full degree of freedom will increase the complexity of the test system and its cost to the impractical level. |
| Samsung | Sub topic 2-1:  Issue 2-1-1 (Quiet zone size and validation procedure):  We are fine to study QZ MU etc. in Option 1 but would like get more clarification on the reason “due to the larger radiating parts of the DUT”. In our understanding the two simultaneous radiation parts in DUT side i.e. two panels are non-coherent, would that affect QZ etc.?  Issue 2-1-2 (Baseline measurement setup for RF testing):  Different options have different applicable scenarios. Depending on how core requirements will be specified, further down-selection may be performed later. Before that, we’d better further investigate each option the pros and cons  Issue 2-1-3 (The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing):  It is too early to decide now. If possible, option 1 is better.  Sub topic 2-2 (RRM testing):  It is too early to decide now. Reuse legacy is better but still depends on RRM session.  Sub topic 2-3 (demodulation testing):  Issue 2-3-1 (Approach for multi-panel reception demodulation testing): Option 1  Issue 2-3-2 (Baseline measurement setup for demodulation testing): Option 1 and 2  Issue 2-3-3 (The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing):  Option 2 is possible. full degrees of freedom seems not necessary for demodulation as long as beam pair direction are not required to have to be two peak directions for each AoA. |
| OPPO | Issue 2-1-1: we support Option 1.  Issue 2-1-2: reusing the legacy test system is preferable options.  Issue 2-1-3: Option 2. We have similar view with Huawei and vivo that full rotational degrees of freedom is not necessary. |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#2-1** | **Issue 2-1-1: Quiet zone size and validation procedure**  *Summary of round 1 discussion: all the companies are OK to study the quiet zone size, MU definition and validation procedure.*  *Tentative agreements: Study the quiet zone size, MU definition and validation procedure for multi-Rx and multi-Tx if applicable. The same list of QZ sizes defined so far (i.e., 20cm, 30cm, 40cm, and 55cm) is starting point and 30cm QZ is with high priority.*  *Candidate options: N/A*  *Recommendations for 2nd round: Confirm the tentative agreements.*  **Issue 2-1-2: Baseline measurement setup for RF testing**  *Summary of round 1 discussion: there is no majority view on the baseline measurement setup for RF testing. Reusing from the legacy test setup as much as possible is preferred by most companies.*  *Tentative agreements: N/A*  *Candidate options:*   * *Option 1: Reuse legacy IFF/DFF system as much as possible and further study how to introduce additional DL antenna to support the 2AoA spherical coverage measurement. Whether to support 2 simultaneously active AoAs is FFS* * *Option 2: Enhanced IFF is selected as the baseline methodology for further study and definition of multi AoA methodology for multi-panel reception UEs. Reuse legacy RRM test setup, i.e., angular relationships between simultaneously active AoAs is 30°, 60°, 90°, 120° and 150°. Whether the list can be further reduced is FFS.* * *Option 3: Study new multi-probe test system targeted to enable the condition that the simultaneous reception/transmission paths to and from UE can be configured as any directions permutations by proper rotation system design* * *Option 4: The test method setup for FR2 MIMO OTA in TR 38.827 can be considered as the baseline together with those in TR 38.810 and TR 38.884.* * *Option 5: Current study on inter-band CA of FR2+FR2 with offset antenna can be the starting point of the new test methodology.*   *Recommendations for 2nd round: Continue to discuss the options with considerations that reusing from the legacy test setup as much as possible is preferred.*  **Issue 2-1-3: The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing**  *Summary of round 1 discussion: The concerns on high system complexity were raised for supporting full rotational degrees of freedom. Meanwhile, it is also related how to define the requirements in RF session.*  *Tentative agreements: N/A*  *Candidate options: N/A*  *Recommendations for 2nd round: continue to discuss the potential feasibility issues to support full rotational degrees of freedom for simultaneously two active AoAs*  **Issue 2-1-4: Potential test methods for RF testing**  *Tentative agreements: N/A*  *Candidate options: the options listed in the first round. Suggest to continuing investigate pros and cons for each option.*  *Recommendations for 2nd round: continue to investigate pros and cons for each option. Other options are not precluded.* |
| **Sub-topic#2-2** | **Issue 2-2: Baseline measurement setup for RRM testing**  *Tentative agreements: N/A.*  *Candidate options: the options listed in the first round and other options are not precluded.*  *Recommendations for 2nd round: continue to investigate pros and cons for each option. Other options are not precluded.* |
| **Sub-topic#2-3** | **Issue 2-3-1: Approach for multi-panel reception demodulation testing**  *Summary of 1st round discussion:*  *Tentative agreements: The virtual cable approach should be the baseline for multiple panels UE demodulation testing and only pure baseband performance shall be tested.*  *Candidate options: N/A.*  *Recommendations for 2nd round: confirm the tentative agreements.*  **Issue 2-3-2: Baseline measurement setup for demodulation testing**  *Tentative agreements: N/A.*  *Candidate options: Continue to discuss the listed options in the first round.*  *Recommendations for 2nd round: continue to investigate pros and cons for each option. Other options are not precluded.*  **Issue 2-3-3: The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing**  *Tentative agreements: N/A.*  *Candidate options: continue to discuss the necessity and feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing*  *Recommendations for 2nd round: continue to discuss the necessity and feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing.* |

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

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

### Sub-topic 2-1

*Sub-topic description: Test methods for RF requirements*

*Open issues and candidate options before e-meeting:*

**Issue 2-1-1: Quiet zone size and validation procedure**

* Proposals
  + Option 1: Study the quiet zone size, MU definition and validation procedure for multi-Rx and multi-Tx if applicable. The same list of QZ sizes defined so far (i.e., 20cm, 30cm, 40cm, and 55cm) is starting point and 30cm QZ is with high priority.
  + Option 2: specify other option if any
* Recommended WF
  + Option 1

**Issue 2-1-2: Baseline measurement setup for RF testing**

* Proposals: companies are encouraged to provide your view for the following options from considerations of reusing legacy system and feasibility of test setup aspects.
  + Option 1: Reuse legacy IFF/DFF system as much as possible and further study how to introduce additional DL antenna to support the 2AoA spherical coverage measurement. Whether to support 2 simultaneously active AoAs is FFS
  + Option 2: Enhanced IFF is selected as the baseline methodology for further study and definition of multi AoA methodology for multi-panel reception UEs. Reuse legacy RRM test setup, i.e., angular relationships between simultaneously active AoAs is 30°, 60°, 90°, 120° and 150°. Whether the list can be further reduced is FFS.
  + Option 3: Study new multi-probe test system targeted to enable the condition that the simultaneous reception/transmission paths to and from UE can be configured as any directions permutations by proper rotation system design
  + Option 4: The test method setup for FR2 MIMO OTA in TR 38.827 can be considered as the baseline together with those in TR 38.810 and TR 38.884.
  + Option 5: Current study on inter-band CA of FR2+FR2 with offset antenna can be the starting point of the new test methodology.
* Recommended WF
  + To further discuss above potential baseline measurement setups for RF testing. Other options are not precluded.
  + To evaluate and decide how many simultaneously active AoAs are needed.
  + Reusing legacy IFF/DFF system as much as possible is preferred.

**Issue 2-1-3: The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing**

* Proposals: companies are encouraged to share the views on the potential feasibility issues to support full rotational degrees of freedom for simultaneously two active AoAs
  + Option 1: It is feasible.
  + Option 2: It is not feasible. Specify the issues if any.
* Recommended WF
  + TBA

**Issue 2-1-4: Potential test methods for RF testing**

* Proposals: companies are encouraged to share the views on pros and cons for each option
  + Option 1(R4-2211549): IFF+IFF with moving reflectors, Test 2 AoAs simultaneously with 2 IFF (see example illustration below)

ダイアグラム

自動的に生成された説明

* + Option 2 (R4-2211549): IFF+DFF, DFF antennae as the second AoA NR anchor (see example illustration below)

ダイアグラム

自動的に生成された説明

* + Option 3 (R4-2211549): IFF+DFF, fixed DFF antennae as NR anchor (see example illustration below)

ダイアグラム

自動的に生成された説明

* + Option 4 (R4-2211549): Sequential tests by introducing a new test command to fix an active antenna in the DUT (see example illustration below)



* + Option 5 (R4-2211991): IFF+ rotating UE and anchor probe as a whole, the probes are divided into test probe and anchor probe (see example illustration below)



rotate UE and anchor probe as a whole

anchor probe

test probe

* + Option 6 (R4-2213627): Enhanced IFF method utilizing multiple compact antenna test ranges as per TS 38.508-1, i.e., reuse the legacy RRM test setup (see example illustration below)

****

* Recommended WF
  + To investigate pros and cons for each option.
  + Other options are not precluded.

### Sub-topic 2-2

*Sub-topic description: Test methods for RRM requirements*

*Open issues and candidate options before e-meeting:*

**Issue 2-2: Baseline measurement setup for RRM testing**

* Proposals: companies are encouraged to share the views on pros and cons for each option
  + Option 1 (Apple): Further discuss applicability of the legacy FR2 RRM test setup to the multi-panel reception RRM requirements
  + Option 2 (Qualcomm): Legacy RRM test setup could be baseline and to further consider more flexibility on the angular offset for multiple panels for UE RRM requirements testing.
  + Option 3 (R&S): Enhanced IFF is selected as the baseline methodology for further study and definition of multi AoA methodology for multi-panel reception UEs. Reuse legacy RRM test setup, i.e., angular relationships between simultaneously active AoAs is 30°, 60°, 90°, 120° and 150°. Whether the list can be further reduced is FFS.
  + Option 4 (vivo): Wait for the clear feedback from RRM session on which requirement will be specified and how the capability of test system should be.
* Recommended WF
  + To investigate pros and cons for each option.
  + Other options are not precluded.

### Sub-topic 2-3

*Sub-topic description: Test methods for demodulation requirements*

*Open issues and candidate options before e-meeting:*

**Issue 2-3-1: Approach for multi-panel reception demodulation testing**

* Proposals
  + Option 1: The virtual cable approach should be the baseline for multiple panels UE demodulation testing and only pure baseband performance shall be tested.
  + Option 2: Specify other option if any
* Recommended WF
  + Option 1

**Issue 2-3-2: Baseline measurement setup for demodulation testing**

* Proposals: companies are encouraged to share the views on pros and cons for each option
  + Option 1 (vivo): The Rel-15 measurement setup for UE demodulation should be baseline for further enhancement to support 4-layer MIMO. To discuss how to introduce additional DL antenna with reasonable angular separation.
  + Option 2 (Qualcomm): RAN4 to further study how to support the selection of beam pair (two AoAs) for UE demodulation requirements testing.
  + Option 3 (R&S): Enhanced IFF is selected as the baseline methodology for further study and definition of multi AoA methodology for multi-panel reception UEs. Reuse legacy RRM test setup, i.e., angular relationships between simultaneously active AoAs is 30°, 60°, 90°, 120° and 150°. Whether the list can be further reduced is FFS.
* Recommended WF
  + To investigate pros and cons for each option.
  + Other options are not precluded

**Issue 2-3-3: The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing**

* Proposals: continue to discuss the necessity and feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing
  + Option 1: It is necessary and feasible to support full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing
  + Option 2: It is not necessary. Please specify the reasons and the feasibility issues if Option 2 is selected.
* Recommended WF
  + TBA

## Companies views’ collection for 2nd round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Keysight Technologies | **Sub-Topic 2-1-1 (Quiet zone size and validation procedure)**  Support Option 1  **Sub-Topic 2-1-2 (Baseline measurement setup for RF testing)**  Option 1: Support  Option 2: we could support option 2 if the example of a specific implementation is removed.  Option 3: Do not Support as this is a very specific implementation of the FR2 2-AoA RRM OTA test methodology. Additionally, given RAN4’s prior agreement not to define probe locations (TR 38.810: ‘absolute position of the probes is left up to implementation’) but “just” relative angular differences between probes, the 2-AoA RRM OTA test setup does not seem suitable for multi-panel TX/RX testing as it cannot guarantee the same measurements (and same AoAs) performed between two TE vendors. As stated in Round 1, an RRM 2 AoA test setup with the same absolute position of at least 2 probes could be considered as a baseline.  Option 4: Concern (similar to feedback in Sub-topic 1-1). This option would require brand-new test systems and does not follow the recommendation for 2nd round (Continue to discuss the options with considerations that reusing from the legacy test setup as much as possible is preferred).  Option 5: Support. This test setup has a total of 6 probes with absolute probe locations and relative AoA differences fully defined. The angular separation between the 6 probes are approximately 10°, 20°, 30°, 40°, and 50° as tabulated below   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Angular Separation [°] | **#1** | **#2** | **#3** | **#4** | **#5** | **#6** | | **#1** | 0.0 | 11.2 | 20.6 | 20.6 | 20.6 | 30.0 | | **#2** | 11.2 | 0.0 | 29.9 | 9.9 | 14.1 | 20.6 | | **#3** | 20.6 | 29.9 | 0.0 | 39.9 | 41.2 | 50.2 | | **#4** | 20.6 | 9.9 | 39.9 | 0.0 | 10.0 | 11.2 | | **#5** | 20.6 | 14.1 | 41.2 | 10.0 | 0.0 | 11.2 | | **#6** | 30.0 | 20.6 | 50.2 | 11.2 | 11.2 | 0.0 |   If even larger AoA differences are needed, additional probe(s) could be added relatively easily.  Option 6: Do Not Support (see feedback in Round 1).  **Sub-Topic 2-1-3: The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing**  Option 1 is technically feasible with brand-new test systems with large footprints and high complexity, i.e., no re-use of existing test systems at all with certain limitations. It should be highlighted that the minimum separation between probes is finite (DFF: less than 10°, IFF: ~30°). To support a timely availability of multi-panel FR2 OTA testing, the re-use of existing FR2 OTA systems and/or slight modifications of those systems would be preferred, i.e., we tend to support Option 2 rather than Option 1 (even though we confirm feasibility in principle).  Sub-Topic 2-1-4 (Potential test methods for RF testing)  Option 1&2: Do not Support for the reasons provided in Round 1 and in Sub Topic 1-1.  Option 3: We have concerns by specifying type of probes (IFF: main, aux probes: DFF). In principle though, this Option would be acceptable by defining N (absolute) probe locations and the fixed AoA differences. See comments made in Round 1.  Option 4: support in principle but requires support from OEMs.  Option 5: slight concern as it is doubtful that a single relative AoA is sufficient  Option 6: Do not Support (see feedback in round 1 and feedback on Option 3 in Sub Topic 2-1-2).  **Sub-Topic 2-2 (Baseline measurement setup for RRM testing)**  Support: Option 4, concerns with Option 3 since it is a specific implementation of the FR2 2-AoA RRM test system.  **Sub-Topic 2-3-1: Approach for multi-panel reception demodulation testing**  Support Option 1  **Sub-Topic** **2-3-2: Baseline measurement setup for demodulation testing**  See Feedback from Round 1. Support Options 1 and 2; Concern with Option 3 since this is a specific implementation of probes (IFF vs DFF which is permitted for demod) and the fact that the relative AoAs from the RRM system are not necessarily needed for multi-panel demod testing.  **Sub-Topic** **2-3-3: The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing**  Support Option 2 as the “wireless cable mode” would not require full rotational degrees of freedom. |
| Samsung | **Sub-Topic 2-1-1 (Quiet zone size and validation procedure)**  In TR38.810 the QZ size is 15cm for PC3, so we would like to know the reason why 15cm is not included in the list.  **Sub-Topic 2-1-2 (Baseline measurement setup for RF testing)**  Option 1: generally okay with the proposal but the additional DL antenna should be configurable to any AoA in sphere related to the position of DUT.  Option 2: share the same view as Keysight.  Option 3: we wonder if a one-demension list (30°, 60°, 90°, 120° and 150°) is enough. the AoA can come from any direction in 3D.  Option 4: support as proponent. The objective of core WID explicitly indicates that new spherical coverage will be defined. For the new 2AoA spherical coverage, the rotation should guarantee the 2AoA pair freedom. Response to QC question “would multiple probes are all based on the far-field criterion?”, depending on core requirements, if anchor probe is not used for test, it may not be have to meet far field criteria, however further discussion is still expected.  Option 5: If reusing MIMO OTA probes, how would the 3D rotation for spherical coverage be performed?  Option 6: may not be feasible since the 2AoA may point to different directions far from each other.  **Sub-Topic 2-1-3: The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing**  Option 1. several solutions have been given in this meeting.  Sub-Topic 2-1-4 (Potential test methods for RF testing)  Option 1&2 can support full freedom while option 2 is more similar as existing system.  Option 3: we wonder the feasibility. if the DFF probes are fixed, many a very large number of DFF probes are needed..  Option 4: it seems not aligned with the feature: simultaneous multi-RX from different direction.  Option 5: clarification: the receiving AoA for anchor probe is not single, but it is preconfigured before test. Depending on different DUT, the receiving AoA of anchor probe can be configured with different AoA. After test starts, the anchor AoA is fixed. Response to QC question: our initial thinking is that the anchor probe may not have to be far field as there is no EIS test in anchor probe, there is only EIS test in the test probe (main probe)  Option 6: we wonder if a one-demension list (30°, 60°, 90°, 120° and 150°) is enough. the AoA can come from any direction in 3D.  **Sub-Topic 2-2 (Baseline measurement setup for RRM testing)**  Support Option 4.  **Sub-Topic 2-3-1: Approach for multi-panel reception demodulation testing**  Support Option 1  **Sub-Topic** **2-3-2: Baseline measurement setup for demodulation testing**  Support option 2.  Option 1 is also reasonable if the additional DL antenna can be configurable to certain AoA in sphere related to the position of DUT required for Demod test.  **Sub-Topic** **2-3-3: The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing**  This issue depends on beam pair directions selected for Demod test. If two beam peak directions are required for each direction, then option 1 is still necessary. |
| Qualcomm | **Issue 2-1-1: Quiet zone size and validation procedure**  **Support option 1**  **Issue 2-1-2: Baseline measurement setup for RF testing**  **We support the recommended WF on further discuss the pros and cons for each option in further. It is too early to decide the baseline setup at this stage.**  **In general, we support option 1 and option 3 which will have more flexibility. If industry does not accept a high complexity test system. We can consider the simplified test system for example option 2 and option 4. But what would be the angular separations are needed to further investigate. Option 5 is not feasible considering the fixed and small angular separation.**  **Issue 2-1-3: The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing**  **It is worth to evaluating the feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in RF testing.**  **Issue 2-1-4: Potential test methods for RF testing**  **Similar comments as Issue 2-1-2. Option 1, option 2 and option 5 are preferred which will have more have more flexibility to support the any angular separations. Option 3 and option 6 would be the simplified test system. the angular separations are needed to further investigate. Option 4 is not acceptable for us since it could not verify the performance of UE with simultaneous reception.**  **Issue 2-2: Baseline measurement setup for RRM testing**  **Need more discussion in next meeting.**  **Issue 2-3-1: Approach for multi-panel reception demodulation testing**  **Agree with option 1.**  **Issue 2-3-2: Baseline measurement setup for demodulation testing**  **Need more discussion**  **Issue 2-3-3: The feasibility of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing**  **Need to further discuss the necessity of supporting full rotational degrees of freedom for simultaneously two active AoAs in demodulation testing if virtual cable is the approach for demod testing.** |

# Topic #3: Test uncertainty assessments

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2212825 | vivo | Proposal 1: For multi-Rx spherical coverage test, RAN4 to discuss whether MU element of Quality of Quiet Zone should be revisited, and new element for positioner blocking should be added |

## Open issues summary

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

### Sub-topic 3-1

*Sub-topic description: Test uncertainty assessments*

*Open issues and candidate options before e-meeting:*

**Issue 3-1: MU impacts for Multi-Rx test system**

* Proposals
  + Option 1 (vivo): RAN4 to discuss whether MU element of Quality of Quiet Zone should be revisited, and new element for positioner blocking should be added.
  + Option 2: specify other option if any
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Keysight Technologies | Topic 3-1 (MU impacts for Multi-Rx test system): In general support Option 1 but the probe blocking by the positioner, especially if probes are placed in opposite hemispheres, are included already if the re-positioning concept is not considered and the QoQZ is evaluated for all (full 3D) reference antenna orientations. |
| Qualcomm | We support option 1. The impacted MU elements can be further discussed. |
| Huawei,  HiSilicon | Option 1. Further discussion after baseline measurement setup is defined. |
| vivo | Support as proponent. |
| R&S | Issue 3-1 (MU impacts for Multi-Rx test system): In general, we support Option 1 in the way that MU elements must be reviewed according to the selected methodology. In the specific case of QoQZ, it can be studied what needs to be updated in the procedure.  With respect to the positioner blocker, that term could be skipped (or included in the QoQZ like mentioned by QZ) depending on how the AoA are placed with respect to each other during the test procedure. |
| OPPO | Issue 3-1:  We support option 1. The MU should be revisited based on the agreed measurement setups. |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#3-1** | *Summary of 1st round discussion: all the companies are OK with option 1.*  *Tentative agreements:* *RAN4 to study the impact on MU element of Quality of Quiet Zone and positioner blocking.*  *Candidate options: N/A*  *Recommendations for 2nd round: To confirm the tentative agreements.* |

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

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

### Sub-topic 3-1

*Sub-topic description: Test uncertainty assessments*

*Open issues and candidate options before e-meeting:*

**Issue 3-1: MU impacts for Multi-Rx test system**

* Proposals
  + Option 1: RAN4 to study the impact on MU element of Quality of Quiet Zone and positioner blocking.
  + Option 2: specify other option if any
* Recommended WF
  + Option 1

## Companies views’ collection for 2nd round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Keysight Technologies | **Sub-Topic 3-1 (MU impacts for Multi-Rx test system)**  In general, support Option 1 but the probe blocking by the positioner, especially if probes are placed in opposite hemispheres, are included already if the re-positioning concept is not considered and the QoQZ is evaluated for all (full 3D) reference antenna orientations |
| Qualcomm | **Sub-Topic 3-1 (MU impacts for Multi-Rx test system)**  **We support option 1. For the blocking issues, we can study the potential impact once the test setup is confirmed.** |

# Topic #4: Maximum DL testable SNR for band n263

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2214197 | Qualcomm Incorporated | Proposal 1: The enhancements on the probe antenna gain for FR2-2 need to be confirmed by TE vendors.  Proposal 2: To update the table of maximum DL testable SNR preliminary extension for band n263 in TR 38.884 as below.  Proposal 3: To check the possibility of enhancing transmit power from TE.  Proposal 4: The maximum DL testable SNR for FR2-2 should be updated based on the latest conclusion on the backoff from P1.  Proposal 5: The feasibility of DNF for OTA demodulation test need to be verified.  Proposal 6: To agree the CR on TR 38.884 in [3]. |
| R4-2213180 | Qualcomm Incorporated | CR on TR 38.884 for FR2-2 maximum DL testable SNR |

## Open issues summary

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

### Sub-topic 4-1

*Sub-topic description: Maximum DL testable SNR for band n263*

*Open issues and candidate options before e-meeting:*

**Issue 4-1-1: Is it possible to enhance the antenna gain for n263 in IFF compared to 12dBi used for FR2-1?**

* Proposals
  + Option 1: Yes, please specify the values
  + Option 2: No, please specify the reasons
* Recommended WF
  + TBA

**Issue 4-1-2: Maximum DL testable SNR for 8RBs with 480kHz SCS for band n263**

* Proposals
  + Option 1: Yes, to add maximum DL testable SNR of [21.4]dB for 8RBs CBW in TR38.884
  + Option 2: No, please specify the reasons
* Recommended WF
  + TBA

**Issue 4-1-3: Maximum DL testable SNR for 800MHz CBW SCS for band n263**

* Proposals
  + Option 1: Yes, to revise maximum DL testable SNR from [-14.5]dB to [-10.5]dB for 800MHz CBW in TR38.884
  + Option 2: No, please specify the reasons
* Recommended WF
  + TBA

**Issue 4-1-4: Is it possible to enhance transmit power from TE?**

* Proposals
  + Option 1: Yes, please specify the values
  + Option 2: No, please specify the reasons
* Recommended WF
  + TBA

**Issue 4-1-5: Is it possible to enhance the parameter of backoff from P1?**

* Proposals
  + Option 1: Yes, please specify the values
  + Option 2: No, please specify the reasons
* Recommended WF
  + TBA

**Issue 4-1-6: Is it possible to use DNF method for demodulation OTA testing for band n263?**

* Proposals
  + Option 1: Yes, please specify the details on the feasibility of testing REFSENSE, RSRPB, etc by DNF.
  + Option 2: No, please specify the reasons
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Qualcomm | Issue 4-1-1: Input from TE vendors is welcome.  Issue 4-1-2: Option 1  Issue 4-1-3: Option 1  Issue 4-1-4: Input from TE vendors is welcome.  Issue 4-1-5: The endorsed Proposal 4 in R5-221628 states that: “For 64QAM scenarios (both Demod and CSI), consider fading backoff margin of 11.08 dB (replacing the current working assumption of 17.71 dB) corresponding to the 1e-3 faded signal clipping probability. We would like to update the SNR calculation based on the latest agreement in RAN5.  Issue 4-1-6: Input from TE vendors is welcome. Introducing alternative DNF approach will lead to cost much. |
| R&S | **Issue 4-1-1** (Is it possible to enhance the antenna gain for n263 in IFF compared to 12dBi used for FR2-1?): Option 2. As mentioned in the contribution, for the same IFF system with the same reflector, the feed HPBW has to stay the same across frequencies. Therefore, the gain is equivalent.  **Issue 4-1-2** (Maximum DL testable SNR for 8RBs with 480kHz SCS for band n263): No strong opinion, inclusion may be useful as guidance in Demod discussions.  **Issue 4-1-3 (**Maximum DL testable SNR for 800MHz CBW SCS for band n263): Option 1, update seems to be correct.  **Issue 4-1-4** (Is it possible to enhance transmit power from TE?): At this point, no. With the assumption of providing a test system that can cover FR2-1 as well as FR2-2, P1dB should remain as is. Also, when looking at PAs on the market, no increase in P1dB can be seen for higher frequency PAs.  **Issue 4-1-5 (**Is it possible to enhance the parameter of backoff from P1?): We are ok to follow the latest agreements from RAN5 here. They have studied the impacts in detail.  **Issue 4-1-6** (Is it possible to use DNF method for demodulation OTA testing for band n263?): In our understanding, it was not possible to conclude on the feasibility of DNF for demodulation in TR 38.810 due to the impact of a near-field test antenna setup into the UE array (e.g. lower UE antenna gain, change in the UE radiation pattern), and therefore the impact estimation on the performance requirements which are defined at baseband level based on concrete assumptions of the UE antenna gain. |
| Keysight Technologies | **Issue 4-1-1** (Is it possible to enhance the antenna gain for n263 in IFF compared to 12dBi used for FR2-1?): Support Option 2. The antenna gain is indirectly proportional to the beam width of the antenna, i.e., higher gain antennas have narrower beam width. In order to support the same QZs for FR2-2 as for FR2-1 with similar performance, the beam width needs to be the same. In summary, increasing the gain would lead to much worse QoQZ performance which is unacceptable  **Issue 4-1-6** (Is it possible to use DNF method for demodulation OTA testing for band n263?): : Support Option 1. We believe DNF is applicable to demodulation testing and will improve the testability aspects for UE demodulation testing related to marginal/insufficient SNR with increasing frequency due to the reduced free-space path losses. DNF was captured as permitted methodology in TR 38.810 but since most of the efforts focused on IFF methodology, not all feasibility aspects were addressed which we believe were addressed for the most part in the subsequent SI and TR 38.884. |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2213180 | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

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

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#4-1** | **Issue 4-1-1: Is it possible to enhance the antenna gain for n263 in IFF compared to 12dBi used for FR2-1?**  *Summary of 1st round discussion: Based on the TE vendors feedback, it seems 12dBi should be kept for IFF for FR2-2.*  *Tentative agreements: The probe antenna gain of 12dBi should be kept for IFF for FR2-2.*  *Candidate options: N/A*  *Recommendations for 2nd round: Confirm the tentative agreements*  **Issue 4-1-2: Maximum DL testable SNR for 8RBs with 480kHz SCS for band n263**  *Summary of 1st round discussion: Introducing the maximum DL testable SNR for 8RBs is acceptable.*  *Tentative agreements: Introducing the maximum DL testable SNR for 8RBs in TR38884. The conclusion to be reflected in revised R4-2213180.*  *Candidate options: N/A*  *Recommendations for 2nd round: Check the revised CR of R4-2213180 directly.*  **Issue 4-1-3: Maximum DL testable SNR for 800MHz CBW SCS for band n263**  *Summary of 1st round discussion: It is OK to revise maximum DL testable SNR for 800MHz CBW SCS for band n263 based on the calculation in R4-221419.*  *Tentative agreements: Introducing the maximum DL testable SNR for 8RBs in TR38884. The conclusion to be reflected in revised R4-2213180.*  *Candidate options: N/A*  *Recommendations for 2nd round: Check the revised CR of R4-2213180 directly.*  **Issue 4-1-4: Is it possible to enhance transmit power from TE?**  *Summary of 1st round discussion: Based on the TE vendors feedback, it seems no enhancements on the transmit power from TE at this point.*  *Tentative agreements: Keep the original parameters for transmit power of TE.*  *Candidate options: N/A*  *Recommendations for 2nd round: Confirm the tentative agreements*  **Issue 4-1-5: Is it possible to enhance the parameter of backoff from P1?**  *Summary of 1st round discussion: To update the SNR based on the latest agreements in RAN5 on backoff from P1.*  *Tentative agreements: update the SNR in TR38884 based on the latest agreements in RAN5 on backoff from P1.*  *Candidate options: N/A*  *Recommendations for 2nd round: Check the revised CR of R4-2213180 directly*  **Issue 4-1-6: Is it possible to use DNF method for demodulation OTA testing for band n263?**  *Summary of 1st round discussion: No consensus on the feasibility of using DNF method for demodulation OTA testing for band n263*  *Tentative agreements: N/A.*  *Candidate options: To further discuss the feasibly of using DNF method for demodulation OTA testing for band n263*  *Recommendations for 2nd round: To further discuss the feasibly of using DNF method for demodulation OTA testing for band n263* |

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

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

### Sub-topic 4-1

*Sub-topic description: Maximum DL testable SNR for band n263*

*Open issues and candidate options before e-meeting:*

**Issue 4-1-1: Is it possible to enhance the antenna gain for n263 in IFF compared to 12dBi used for FR2-1?**

* Proposals
  + Option 1: The probe antenna gain of 12dBi should be kept for IFF for FR2-2.
* Recommended WF
  + Option 1

**Issue 4-1-2: Maximum DL testable SNR for 8RBs with 480kHz SCS for band n263**

* Proposals
  + Option 1: Introducing the maximum DL testable SNR for 8RBs in TR38884. The conclusion to be reflected in revised R4-2213180 (please check the revisions folder in FTP).
* Recommended WF
  + Option 1

**Issue 4-1-3: Maximum DL testable SNR for 800MHz CBW SCS for band n263**

* Proposals
  + Option 1: Introducing the maximum DL testable SNR for 8RBs in TR38884. The conclusion to be reflected in revised R4-2213180 (please check the revisions folder in FTP).
* Recommended WF
  + Option 1

**Issue 4-1-4: Is it possible to enhance transmit power from TE?**

* Proposals
  + Option 1: Keep the original parameters for transmit power of TE at this stage.
* Recommended WF
  + Option 1

**Issue 4-1-5: Is it possible to enhance the parameter of backoff from P1?**

* Proposals
  + Option 1: update the SNR in TR38884 based on the latest agreements in RAN5 on backoff from P1. The updates to be reflected in revised R4-2213180 (please check the revisions folder in FTP)
* Recommended WF
  + Option 1

**Issue 4-1-6: Is it possible to use DNF method for demodulation OTA testing for band n263?**

* Proposals:
  + Option 1: Yes, please specify the details on the feasibility of testing REFSENSE, RSRPB, etc by DNF.
  + Option 2: No, please specify the reasons
* Recommended WF
  + To further discuss the feasibly of using DNF method for demodulation OTA testing for band n263

## Companies views’ collection for 2nd round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| Keysight Technologies | **Sub Topic 4-1-1: Is it possible to enhance the antenna gain for n263 in IFF compared to 12dBi used for FR2-1?**  Support Option 1  **Sub Topic 4-1-4: Is it possible to enhance transmit power from TE?**  Support Option 1  **Sub Topic 4-1-6: Is it possible to use DNF method for demodulation OTA testing for band n263?**  Support Option 1. We believe DNF is applicable to demodulation testing and will improve the testability aspects for UE demodulation testing related to marginal/insufficient SNR with increasing frequency due to the reduced free-space path losses in excess of 10dB. DNF was captured as permitted methodology in TR 38.810 but since most of the efforts focused on IFF methodology, not all feasibility aspects were addressed which we believe were addressed for the most part in the subsequent SI and TR 38.884. |
| Qualcomm | **Sub Topic 4-1-1: Is it possible to enhance the antenna gain for n263 in IFF compared to 12dBi used for FR2-1?**  **OK with option 1 meanwhile we encourage industry to improve the antenna gain to extend the testing range for FR2-2.**  **Issue 4-1-2: Maximum DL testable SNR for 8RBs with 480kHz SCS for band n263**  **Support option 1 as proponent**  **Issue 4-1-3: Maximum DL testable SNR for 800MHz CBW SCS for band n263**  **Support option 1 as proponent**  **Issue 4-1-4: Is it possible to enhance transmit power from TE?**  **OK with option 1 meanwhile we encourage industry to improve transmit power to extend the testing range for FR2-2.**  **Issue 4-1-5: Is it possible to enhance the parameter of backoff from P1?**  **Support option 1 as proponent**  **Issue 4-1-6: Is it possible to use DNF method for demodulation OTA testing for band n263?**  **Need more discussion on the feasibility of using DNF to test FR2-2 demodulation performance.** |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| Rev\_R4-2213180 | Company A |
| Company B |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |  |
| --- | --- | --- | --- |
| **New Tdoc number** | **Title** | **Source** | **Comments** |
|  | WF on NR FR2 OTA testing enhancements | Qualcomm Incorporated | To capture the WF |
|  |  |  |  |
|  |  |  |  |

**Existing tdocs**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Tdoc number** | **Revised to** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-2213181 |  | Work plan for Rel-18 FR2 OTA testing enhancements | Qualcomm Incorporated | Revised | To update the workplan based on the comments |
| R4-2212824 |  | Considerations on test system capability for Rel-18 FR2 OTA | vivo | Noted |  |
| R4-2213182 |  | Skeleton for TR 38.871 v0.0.1 | Qualcomm Incorporated | Revised | To update the skeleton based on the comments |
| R4-2213183 |  | Test methodology for FR2 UE with multi-panel | Qualcomm Incorporated | Noted |  |
| R4-2211549 |  | Views on FR2-1 RF OTA test for a device with multi-panel reception | Anritsu Corporation | Noted |  |
| R4-2211991 |  | Considerations on FR2 multiple AoA test | Samsung | Noted |  |
| R4-2212377 |  | Initial views on multi-panel FR2 test methodology | Apple | Noted |  |
| R4-2212823 |  | Discussion on test methodology for FR2 Multi-Rx | vivo | Noted |  |
| R4-2213183 |  | Test methodology for FR2 UE with multi-panel | Qualcomm Incorporated | Noted |  |
| R4-2213196 |  | on the testing enhancement of FR2 OTA | Xiaomi | Noted |  |
| R4-2213421 |  | General view on FR2 OTA testing enhancement | OPPO | Noted |  |
| R4-2213418 |  | Consideration on dual-panel test method of FR2 OTA | OPPO | Noted |  |
| R4-2213627 |  | Discussion on FR2 methods for UEs with multi-panel reception | ROHDE & SCHWARZ | Noted |  |
| R4-2212825 |  | Views on MU impacts for Multi-Rx test system | vivo | Noted |  |
| R4-2214197 |  | Discussion on maximun DL testable SNR for FR2-2 | Qualcomm Incorporated | Noted |  |
| R4-2213180 |  | CR on TR 38.884 for FR2-2 maximum DL testable SNR | Qualcomm Incorporated | Revised | To revise the CR |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

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

Notes:

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