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

**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.

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
| Keysight Technologies | Thorsten Hertel | [Thorsten.hertel@keysight.com](mailto:Thorsten.hertel@keysight.com) |
| Apple | Anatoliy Ioffe | aioffe@apple.com |
| Qualcomm | Bin Han | binhan@qti.qualcomm.com |

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** |
| XXX | Sub topic 1-1:  Sub topic 1-2:  ….  Others: |
| 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. |

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

### CRs/TPs

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

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

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

## Discussion on 2nd round (if applicable)

# Topic #2: 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)

****

* 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.) |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

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

# 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. |

### CRs/TPs comments collection

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

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

## Summary for 1st round

### Open issues

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

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

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

# 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. |

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

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

# Recommendations for Tdocs

## 1st round

**New tdocs**

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

**Existing tdocs**

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

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