[97e-27-R17-MIMO-OTA] - Version 0.0.11
RAN

3GPP TSG RAN Meeting #97-e RP-222587

Electronic Meeting, September 12 - 16, 2022

Agenda item: 9.5.4.1

Source: RAN4 Vice-Chair (Samsung)

Title: Moderator's summary for discussion [97e-27-R17-MIMO-OTA]

Document for: Discussion & Decision

1 Introduction

This document provides as summary of the following email discussion during RAN#97e:

- Goal: Seek for the conclusion on Rel-17 MIMO OTA WI handling and proposal for continued Rel-18 MIMO WI

Email Thread Title	Related Documents
[97e-27-R17-MIMO-OTA]	Topic #1: Rel-17 MIMO OTA FR2 performance requirements handling:RP-222070, 2267, 2

2 Topic #1: Rel-17 MIMO OTA WI handling

2.1 Initial round

2.1.1 Proposals and comments collection

Issue 1-1: How to handle Rel-17 MIMO OTA WI performance part objective "FR2 MIMO OTA requirement"

- Option 1: Remove the unfinished performance part objective, i.e., specifying FR2 MIMO OTA performance requirements, from the Rel-17 NR MIMO OTA WID. (Oppo, CAICT)
    - Option 1b: Close the Rel-17 MIMO OTA WI and start a continuation WI in Rel-18 in September plenary meeting. The check point for the framework should be explicitly captured in the Rel-18 WID. (Qualcomm)

– Option 2: Extend Rel-17 MIMO OTA WI by one quarter to decide the framework of deriving FR2 MIMO OTA requirements and announce the closure of FR1part. (Qualcomm)

Feedback Form 1: Issue 1-1□How to handle Rel-17 MIMO OTA WI performance part objective "FR2 MIMO OTA requirement"

1 – CAICT

Support option1 as rapporteur. The FR2 framework and requirement development are highly relevant and we prefer to discuss them in a package in R18. Therefore, we support to close the R17 NR MIMO OTA WI and focus on the continued R18 NR MIMO OTA WI.

2 – ZTE Wistron Telecom AB

Both options are doable since anyway RAN4 has to work on the real identified issues, just a matter of administrative ways. As we commented in GTW, if a new Rel-18 WI is created, we need to make sure to be focused on the identified issues at first without being distracted by other objectives.

3 – Qualcomm Incorporated

We are fine with both options in general depending on the timeline for Rel-18 WI on MIMO OTA. Our point is the continuation of Rel-18 WI should start with the decision of framwork on how to specify the FR2 MIMO OTA requirements. Regarding the possible framework such as pure measurement, pure simualtion and hybrid of simualtion%measurement, we perfer hybrid appraoch as the starting point. We can further disucss the details in RAN4. Therefore, we propsoed opiton 1b. It is saying if it is agreed to start the Rel-18 WI on MIMO OTA in this meeting, we would like to have a clear checkpoint/timeplan on when the framwork should be finalized.

4 – TELECOM ITALIA S.p.A.

Based on the discussion in the GTW, it is clear there is no agreement on the methodology to follow to derive the requirements. Therefore, the activity should focus on defining a methodology, independently on choosing option 1 or 2. We have a slight preference on Option 2 to ensure the methodology is well understood

5 – Beijing Xiaomi Mobile Software

We support rapporteur's proposal. Due to lack of commercial devices and test systems, we cannot fininsh the FR2 performance work in Rel-17. Indeed we are not even confident that we can have enough devices and test systems in Rel-18. We support to conclude the Rel-17 WID without the FR2 performance requirement and postpone this work untill the more well-developed industry comes out.

6 – Guangdong OPPO Mobile Telecom.

Option 1 and 1b are ok for us, and they are not contradicting. The requirement definition framework is one of the objectives in the proposed Rel-18 WID, therefore both options are ok.

And the key point is whether to close the Rel-17 and start Rel-18 in this meeting. Our view is that extending the Rel-17 is meaningless since the key point to prevent the requirement definition is from lack of test system and also UE, even extend one or two meeting this issue cannot be solved. It has to be planned in a long term. Therefore there is no rush to conclude the choice of simulation based or measurement based

approach before the real comparison between them are derived. Therefore, it is more proper to close the Rel-17 and start Rel-18 to give companies more time to rethink about it.

7 – Samsung Electronics Co.

We support Option 1 as commented in GTW.

One quarter extension will not help the remaining issue.

8 – E-surfing Digital

China Telecom:

We support option 1. According to discussion on Monday GTW session, it looks option 1 can be agreeable to all companies.

9 – Huawei Technologies France

Option 1 or 1b are both fine for us. The scope of Rel-18 WI should be well controlled. The objectives should be focused and can be completed in the Rel-18 time frame.

10 – vivo Communication Technology

We are OK with Option 1 and Option 1b. As we commented in GTW, the main aspect is the framework for next steps.

11 – Apple Italia S.R.L.

Option 1. Regarding Option 1b, we would like to review the scope of the Rel-18 WID first. If the scope is agreeable, then it should be possible to start the Rel-18 MIMO OTA work after the September RAN.

12 – China Mobile Com. Corporation

We support option 1 as commented online

13 – VODAFONE Group Plc

We support option 1.

14 – AT&T GNS Belgium SPRL

We support Option 1 with Option 1b. There should be a clear checkpoint in the Rel-18 WID for the to ensure that the framework is finalized.

15 – MediaTek Inc.

Either Option 1 or 1b is fine to us.

We see little chance to conclude all remaining issue with one more quarter.

2.1.2 First round summary

Issue 1-1: How to handle Rel-17 MIMO OTA WI performance part objective "FR2 MIMO OTA requirement"

Observation:

- All the companies agreed it's not practical to conclude FR2 MIMO OTA requirements in Rel-17 and all the companies fine to continue the effort for FR2 MIMO OTA requirements in Rel-18 MIMO OTA WI.
- Regarding option 1/1b and option 2, seems option 1/1b acceptable for all the companies with majority supporting (only one company slightly prefer option 2).
- For option 1b, one company (Apple) suggest to review Rel-18 WID scope first; if the scope is agreeable, then it should be possible to start the R18 MIMO OTA after RAN#97. QC suggests to have a check point on FR2 requirements framework for Rel-18 MIMO OTA WI.

Based on all the observations, moderator suggests to conclude Rel-17 MIMO OTA WI in this RAN-P with removing the objective on (FR2 MIMO OTA requirements). FR2 MIMO OTA requirements shall be included in the continued Rel-18 MIMO OTA WI and regarding the starting point of Rel-18 MIMO OTA, this is subject to the discussion on topic #2 and RAN4 available TU capability. It's better we can decouple these two issues. For the suggestion of including a check point in the Rel-18 WID for FR2 performance requirements framework and prioritization of FR2 related work, we can further discuss in topic #2.

Proposal 1: Remove the unfinished performance part objective, i.e., specifying FR2 MIMO OTA performance requirements, from the Rel-17 NR MIMO OTA WID and conclude Rel-17 MIMO OTA WI in RAN#97.

- The objective "FR2 MIMO OTA performance requirements" shall be included in the continued Rel-18 MIMO OTA WI

2.2 Intermediate round

2.2.1 Proposals and comments collection

Proposal 1: Remove the unfinished performance part objective, i.e., specifying FR2 MIMO OTA performance requirements, from the Rel-17 NR MIMO OTA WID and conclude Rel-17 MIMO OTA WI in RAN#97.

- The objective "FR2 MIMO OTA performance requirements" shall be included in the continued Rel-18 MIMO OTA WI

Feedback Form 2: Comments on proposal 1

1 – AT&T GNS Belgium SPRL We are OK with Proposal 1.
2 – Guangdong OPPO Mobile Telecom. Support proposal.
3 – China Mobile Com. Corporation OK with proposal1.
4 – Qualcomm Incorporated We are OK with propsoal 1.
5 – Qualcomm Incorporated We are OK with propsoal 1.
6 – Qualcomm Incorporated We are OK with propsoal 1.
7 – CAICT Support proposal 1
8 – ZTE Wistron Telecom AB Ok with proposal 1.
9 – Huawei Technologies France We support proposal 1.
10 – VODAFONE Group Plc Support proposal 1.
11 – VODAFONE Group Plc Support proposal 1.
12 – Apple Italia S.R.L. OK with proposal 1

2.2.2 Second round summary

All the companies ok with proposal 1.

The conclusion as following: Proposal 1 agreed

Proposal 1: Remove the unfinished performance part objective, i.e., specifying FR2 MIMO OTA performance requirements, from the Rel-17 NR MIMO OTA WID and conclude Rel-17 MIMO OTA WI in RAN#97.

- The objective "FR2 MIMO OTA performance requirements" shall be included in the continued Rel-18 MIMO OTA WI

Recommendation of related T-docs

T-doc	Title
RP-222070	Views on R17 MIMO OTA
RP-222267	Discussion on NR MIMO OTA
RP-222280	Views on conclusions of MIMO OTA
RP□222349	Discussion on NR MIMO OTA
RP-222348 (Revised WID)	Revised WID: Multiple Input Multiple Output (MIMO) Over-the-Air (OTA) requirements f
RP-222347 (SR)	Status report for WI: Multiple Input Multiple Output (MIMO) Over-the-Air (OTA) requiren

With above recommendations, topic #1 concluded no further discussion needed.

3 Topic#2: Rel-18 MIMO WI proposal

3.1 Initial round

3.1.1 Proposals and comments collection

Issue 2-1: Proposed core part objectives for FR2□

- **FR2 MIMO OTA test methodology enhancement and leftovers**
  - Leftover issues from Rel-17 WI
    - Test parameters for FR2 MIMO OTA are defined in TS 38.151, further refinement and supplement is needed based on simulation alignment and practical measurement in the chambers.
      - For example: confirm maximum down link RS-EPRE for FR2 MIMO OTA.
    - Further check the FR2 channel model validation pass/fail limits if more practical measurement results are obtained, e.g.

        - Whether a tighter pass/fail limit for temporal correlation is necessary
        - Pass/fail criteria of power validation

- Specify necessary enhancements of the FR2 MIMO OTA test methodology for the other device types based on operators' interest,
    - E.g., Fixed wireless access (FWA) terminal
    - Test methodology defined in TS38.151 is the baseline

Feedback Form 3: Issue 2-1: Proposed core part objectives for FR2

1 – CAICT

We prepared a revised verion of R18 WID to ***down-scope the objectives and provide clear priorities*** in consideration of workload and TU per Chairman's guidance and companies' comments in Monday GTW.

Companies can provide comments based on following objectives.

Proposed core part objectives for FR2 are listed below:

FR2 MIMO OTA test methodology enhancement and leftovers

- **Leftover issues from Rel-17 WI**
    - Test parameters for FR2 MIMO OTA are defined in TS 38.151, further refinement and supplement is needed based on simulation alignment and practical measurement in the chambers. For example:
        - Confirm maximum down link RS-EPRE for FR2 MIMO OTA
        - Refining the number of the test points are not precluded.
    - Further check the FR2 channel model validation pass/fail limits if more practical measurement results are obtained, e.g.
        - Whether a tighter pass/fail limit for temporal correlation is necessary
        - Pass/fail criteria of power validation
    - PC3 is 1st priority, other PCs are not precluded
- **Study and define the framework for FR2 MIMO OTA requirement development**
    - Simulation results and/or measurements results will be considered in FR2 requirement definition
    - The correlation between simulation results and measurement results will be considered

- Simulation assumptions agreed in R17 MIMO OTA WI can be considered as the baseline
- Study how to handle the situation when not enough measurement results can be collected

2 – ZTE Wistron Telecom AB

We are fine with the first objective of the revision (Rel-17 leftover), but suggest to hold on the second objective until the first objective is finished up.

3 – Qualcomm Incorporated

We are fine with the revised objectives in geneal. For the framwork in the second objective, the current stagements mean pure measurement, pure simulation and hybird of simulaiton&measurement apporach are allowed. In the Rel-17 MIMO OTA discussion, the down-selection from these three apporaches have been disucssed for serval meetings but there was no conlcusion. To save the time, we suggest to starting with hybrid apprach in Rel-18 WI and we can check if it is feasible with a checkpoint for example one qualter.

To ZTE, per our understanding, the second bullet is the leftover from Rel-17. It is essential part to specify the FR2 MIMO OTA requirements in the new WI. Therefore, it should be kept. Probably we can move it as one of subbullets in Rel-17 leftovers.

4 – TELECOM ITALIA S.p.A.

If a new project is started at RAN#97, the objective should initially focus on definition of a methodology.

5 – Beijing Xiaomi Mobile Software

As stated in issue 2 that the situation as lack of devices and test systems seems cannot be changed fast considering the FR2 industry development. We prefer to postpone the FR2 MIMO OTA work until more developed devices and test systems come out and to continue the performance requirement work.

6 – Guangdong OPPO Mobile Telecom.

We support the revised version from CAICT, it is a good balance and more clear objective covering Rel-17 leftover issues.

For the framework, it is not a easy task and not sure whether down selected to hybrid approach as QC proposed is doable since companies may have different view on how this hybrid approach will be carried out. List all the three approach and based on contribution driven might be more acceptable to all.

7 – Samsung Electronics Co.

We are OK with the revised objective from CAICT.

8 – Guangdong OPPO Mobile Telecom.

To Xiaomi comment:

We agree that FR2 MIMO OTA requirement definition now is in a difficult situation due to lack of test system and also devices. This is exactly the reason why we suggest to close Rel-17 and plan it in Rel-18 with a long term view. And the work of FR2 in Rel-18 is started with requirement definition framework discussion which is going to solve the problem we faced in Rel-17, and is the key for FR2 requirement definition.

Currently all the options still on the table (simulation/measurement/hybrid), and requirement definition can only starts after the conclusion of requirement definition framework is solved. Hope this can solve the concern of rush into requirement definition without enough measurement results.

9 – Apple Italia S.R.L.

Regarding the simulation alignment objective, is this seeking to align simulation assumptions and results among companies or is the intention to also correlate simulations to measurements? We would like to suggest that a simulation to measurement alignment activity could help to progress the discussion related to FR2 MIMO OTA requirements.

10 – vivo Communication Technology

In general, we are quite supportive to the proposed work, they are valuable. But we would like to share some suggestions from TS editing perspective on how to manage the Rel-18 project.

I believe the intention of objective 1 for FR2 test methods aspects [Leftover issues from Rel-17 WI], is to confirm and to remove the square bracket for few FR2 parameters in the TS. But those parameters should be changed started from Rel-17, but not from Rel-18.

So, in our understanding, the normal procedure is to provide discussion paper and CRs in the maintenance of Rel-17 and Cat A CR for Rel-18, anyway there will be a dedicated Agenda for TS 38.161 maintenance in RAN4. So objective 1 [Leftover issues from Rel-17 WI] for FR2 test methods seems not needed in Rel-18 scope.

We can keep the framework for FR2 MIMO OTA in the core part.

11 – vivo Communication Technology

fix one error in our previous comments: Agenda for TS 38.1~~6~~**5**1 (MIMO OTA TS) maintenance

12 – Huawei Technologies France

We are fine with the revised objectives and also support the suggestion from Apple.

13 – CAICT

To ZTE: As QC clarified, the second objective is also part of R17 leftovers and should be kept. I will merge it into the first objective to make this clear.

To QC: Generally we can accept to start with hybrid approach, but companies may have different views on how to implement this ”hybrid”. Our suggestion is to discuss this topic in WG level per contribution driven approach.

To Xiaomi: We share similar views as OPPO. The FR2 work in Rel-18 is started with framework discussion which is the key for FR2 requirement definition. Performance work only starts after the performance requirement development framework is concluded. Therefore, we believe we can start with the framework definition without postponing the FR2 work.

The objectives are modified based on comments:

FR2 MIMO OTA test methodology enhancement and leftovers

- **Leftover issues from Rel-17 WI**

- Test parameters for FR2 MIMO OTA are defined in TS 38.151, further refinement and supplement is needed based on simulation alignment and practical measurement in the chambers. For example:
  - Refining the number of the test points are not precluded.
- Further check the FR2 channel model validation pass/fail limits if more practical measurement results are obtained, e.g.
  - Whether a tighter pass/fail limit for temporal correlation is necessary
  - Pass/fail criteria of power validation
- PC3 is 1st priority, other PCs are not precluded
- Study and define the framework for FR2 MIMO OTA requirement development
  - Simulation results and/or measurements results will be considered in FR2 requirement definition
  - The correlation between simulation results and measurement results will be considered
  - Simulation assumptions agreed in R17 MIMO OTA WI can be considered as the baseline
  - Study how to handle the situation when not enough measurement results can be collected

Issue 2-2: Proposed core part objectives for FR1□

- **FR1 MIMO OTA test methodology enhancement**
  - Specify necessary enhancements of the FR1 MIMO OTA test methodology for Smartphone in browsing mode using hand phantom.
    - Test methodology defined in TR38.827 and TS38.151 is the baseline
  - Specify necessary enhancements of the FR1 MIMO OTA test methodology (test methodology defined in TS38.151 is the baseline) for the following device types based on operators' interest.
    - Tablet
    - Laptop
    - Wearable device
    - Fixed wireless access (FWA) terminal
  - Test time reduction methodology for FR1 MIMO OTA is not precluded.
  - Study on enhancement to improve test accuracy and repeatability for FR1 MIMO OTA
  - Introduce more FR1 channel models based on operator requests
  - Refine FR1 channel model validation pass/fail limits, e.g.

- Pass/fail criteria of power validation

Feedback Form 4: Issue 2-2□Proposed core part objectives for FR1

1 – CAICT

We prepared a revised verion of R18 WID to ***down-scope the objectives and provide clear priorities*** in consideration of workload and TU per Chairman's guidance and companies' comments in Monday GTW.

Companies can provide comments based on following objectives.

Proposed core part objectives for FR1 are listed below:

FR1 MIMO OTA test methodology enhancement

- Specify necessary enhancements of the FR1 MIMO OTA test methodology for Smartphone in browsing mode using hand phantom.
  - Test methodology defined in TR38.827 and TS38.151 is the baseline
- Specify necessary enhancements of the FR1 MIMO OTA test methodology (test methodology defined in TS38.151 is the baseline) for the following device types in free space *based on operators' request.*
  - For example: Tablet
- Test time reduction methodology for FR1 MIMO OTA is not precluded.
- Introduce more FR1 channel models based on operator requests
- Refine FR1 channel model validation pass/fail limits, e.g.
  - Pass/fail criteria of power validation

Develop the preliminary Measurement Uncertainty (MU) corresponding to all newly defined test methodologies and test configurations

- Example expanded uncertainty for test method shall be defined.

2 – ZTE Wistron Telecom AB

We suggest to hold on FR1 related enhancement until Rel-17 leftover issues are finished.

3 – Qualcomm Incorporated

We are OK with revised proposed objectives. We are also fine with prioritizing the FR2 part as suggested by ZTE.

4 – Beijing Xiaomi Mobile Software

We are quite interesting in the FR1 enhancement part and think it has nothing to do with the FR2 left-over part since the FR1 part has been well developed with enough commercial devices and test systems.

5 – Samsung Electronics Co.

We also support the comment from ZTE focusing on leftover issue first.

6 – Guangdong OPPO Mobile Telecom.

We support the revised version from CAICT.

Regarding the intention of prioritize the FR2 Rel-17 work and hold on FR1, we may have different view on this. Though we agree that Rel-17 FR2 leftovers need to be solved but there might be no quick answer to it, studies/measurements and comparison might be needed for several meetings which is unknown, hold on FR1 will only lead to unnecessary work delay and put FR1 MIMO OTA enhancements in the risk of not finished in Rel-18 time frame. And from TU perspective in each meeting it is enough to accommodate both FR1 and FR2. Therefore, we don't see the necessity to prioritize FR2 and hold on FR1, both can be started.

7 – Apple Italia S.R.L.

We are not convinced that MIMO OTA requirements with hand phantom are as high of a priority as completing FS requirements for additional bands. In our understanding, the FR1 MIMO OTA requirements are an excellent complement of TRP and TRS requirements, where the hand and head+hand phantoms are already utilized.

8 – vivo Communication Technology

We share similar views as other companies, FR2 MIMO OTA work can be the 1st priority.

Regarding the hand phantom-based testing, technically it would be not easy to support the DMP, DML, and DMSU test cases in the chamber (if CTIA phantom is reused for MIMO OTA). Otherwise, potentially maybe new phantom suitable for FR1 MIMO OTA testing should be discussed and developed in RAN4. Or, revisit definition of TRMS for phantom-based test case.

9 – Huawei Technologies France

Similar views with Xiaomi and OPPO.

10 – Samsung Electronics Co.

We missed our comment on the objective itself in our previous comment.

Regarding hand phantom MIMO OTA, we share similar concern as Apple. At current stage FR1 MIMO OTA enhancement should still focus on free space to cover more bands or more UE type to satisfy industry demand. We also agree with vivo comment that current UE orientation and metric were defined for free space.

Hand phantom MIMO OTA will be a dramatic change and the motivation for this objective at current stage is not very convinced. We think it is a good combination to verify UE OTA performance with MIMO OTA under free space and TRP TRS under phantoms.

In our view, it should be removed from the objective.

11 – Guangdong OPPO Mobile Telecom.

To Apple comment:

We may have different view on the necessity of hand phantom. In our view, this is the similar story as TRP/TRS where new phantoms (head+hand) are added to evaluate UE performance under talking mode. Browsing mode is very important scenario for 5G NR devices not only for TRP/TRS (from coverage perspective) but also for MIMO OTA (from throughput perspective). We agree that MIMO OTA is a good complement to TRP/TRS, but it doesn't mean the hand impact to UE is enough to be evaluated by TRP/TRS where antenna correlation is not shown. Testing with hand phantom in both TRP/TRS and MIMO OTA can give a full picture of UE antenna performance. From this perspective, our view is the hand phantom is a good testing scenario and probably is more realistic than free space.

To Samsung comment:

We agree that more FR2 bands can be discussed in Rel-18 and this is indeed what is proposed in the WID, but this doesn't exclude the study of hand phantom based MIMO OTA.

12 – CAICT

To Apple: Just for clarification, the intention of studying hand phantom MIMO OTA is mainly focuses on the test method, and the requirement definition will still focus on more frequency bands in Free Space for the first priority.

To Vivo and Samsung: We agree that how to make the UE to fit the test condition DML, DMP, DMSU need to be studied if hand phantom is used for FR1 MIMO OTA. However, from our understanding, it is not necessary to revisit the TRMS definition for phantom-based test case. Hand-only, hand and head, head-only have been widely used for TRP TRS OTA measurement, the definition of TRP and TRS remain unchanged for all these scenarios.

Issue 2-3: Proposed performance objectives for FR2:

- **Specify FR2 MIMO OTA performance requirements (leftover issues from Rel-17 NR MIMO OTA WI):**
  - Finish the Rel-17 leftovers, including the following aspects:
    - Further study the figure of merits (FoM) and criteria for FR2 MIMO OTA.
      - Further check the additional criteria on the number of test points that can meet 70% maximum throughput
      - Decide whether other criteria for FR2 is needed
    - Define the framework for FR2 MIMO OTA performance requirements development.
      - Agreement in Rel-17 WI is the baseline, i.e., both simulation results and measurements results are permitted to define FR2 requirements. Further down-selection is not precluded.
    - Specify FR2 MIMO OTA performance requirements.

        - Bands n257, n258, n260, and n261 are the first priority.

- Study the FoM and criteria for FR2 MIMO OTA for other device types and features.
    - UEs with other power classes (PC), e.g., PC1
- Specify FR2 MIMO OTA performance requirements for other device types based on operators' interests,
    - E.g., Fixed wireless access (FWA) terminal
    - Bands n257, n258, n260, and n261 are the first priority.
- Specify recommended test tolerance (TT) for FR2 MIMO OTA performance requirements.

Feedback Form 5: Issue 2-3: Proposed performance objectives for FR2

1 – CAICT

We prepared a revised verion of R18 WID to ***down-scope the objectives and provide clear priorities*** in consideration of workload and TU per Chairman's guidance and companies' comments in Monday GTW.

Companies can provide comments based on following objectives.

Proposed performance part objectives for FR2 are listed below:

Specify FR2 MIMO OTA performance requirements:

- Rel-17 leftovers, including the following aspects:
    - Confirm the figure of merits (FoM) and criteria for FR2 MIMO OTA.
        - Further check the additional criteria on the number of test points that can meet 70% maximum throughput
        - Decide whether other criteria, e.g. 90% maximum throughput for FR2 is needed
    - Specify FR2 MIMO OTA performance requirements.
        - Performance work only starts after the performance requirement development framework is concluded
        - Target FR2-1 bands, e.g. n258, are the first priority.
        - PC3 is 1st priority, other PCs are not precluded.
- Study the FoM and criteria for FR2 MIMO OTA for other device types and features.
    - UEs with other power classes (PC), e.g., PC1

- Specify recommended test tolerance (TT) for FR2 MIMO OTA performance requirements.

2 – ZTE Wistron Telecom AB

We are fine with the revision.

3 – Qualcomm Incorporated

We are OK with the revised objectives

4 – Beijing Xiaomi Mobile Software

We can further discuss the framework first and after that we can start the performance requirement part.

5 – Samsung Electronics Co.

Generally we are fine with CAICT revised version, but a little further refinement is provided:

- Target FR2-1 bands, e.g. n258, ~~are the first priority~~. (otherwise it indicates FR2-2 is also included)
- Study the FoM and criteria for FR2 MIMO OTA for other device types ~~and features~~.

6 – Guangdong OPPO Mobile Telecom.

We support the revised version from CAICT. And also support the revision from Samsung.

7 – Apple Italia S.R.L.

Agree with the CAICT and Samsung proposals.

8 – vivo Communication Technology

We support the proposal. And also provide suggestion for consideration that additional criteria (if any) can be core part working scope, and performance part just focus on requirement values for bands.

9 – Huawei Technologies France

We are fine with the revised objectives and the revision from Samsung.

10 – CAICT

We are fine for the revision from Samsung.

Issue 2-4: Proposed performance objectives for FR1

- **Specify FR1 MIMO OTA performance requirements:**
  - Specify MIMO OTA performance requirements for other FR1 bands based on operators' requests and Rel-17 leftovers.
    - Define the framework for FR1 MIMO OTA performance requirements development

        - Consider reusing the lab alignment outcome and framework on performance test campaign in Rel-17 WI.
    - Bands n1, n28, n77 are the first priority.
    - Requirements for stand-alone (SA) mode are the first priority.
- Specify FR1 MIMO OTA performance requirements for browsing mode using hand phantom.
    - Decide whether additional lab alignment is needed for new using scenario
    - Bands n41, n78 are the first priority.
    - Requirements for stand-alone (SA) mode are the first priority.
- Specify recommended test tolerance (TT) for FR1 MIMO OTA performance requirements.

Feedback Form 6: Issue 2-4: Proposed performance objectives for FR1

1 – CAICT

We prepared a revised verion of R18 WID to ***down-scope the objectives and provide clear priorities*** in consideration of workload and TU per Chairman's guidance and companies' comments in Monday GTW.

Companies can provide comments based on following objectives.

Proposed performance part objectives for FR1 are listed below:

Specify FR1 MIMO OTA performance requirements:

- Specify MIMO OTA performance requirements for other FR1 bands based on operators' requests and Rel-17 leftovers.
    - Free space is 1st priority, hand phantom is 2nd priority.
    - Define the framework for FR1 MIMO OTA performance requirements development
        - Consider reusing the lab alignment outcome and framework on performance test campaign in Rel-17 WI.
    - Bands n1, n28, n77 are the first priority.
    - Requirements for stand-alone (SA) mode are the first priority.
- Specify recommended test tolerance (TT) for FR1 MIMO OTA performance requirements.

2 – ZTE Wistron Telecom AB

As commented on Issue 2-2, we suggest to hold on FR1 related enhancement until Rel-17 leftover issues are finished.

3 – Qualcomm Incorporated

We are OK with revised proposed objectives. We are also fine with prioritizing the FR2 part as suggested by ZTE.

4 – Beijing Xiaomi Mobile Software

Ok with the FR1 revised part. Again we see no relationship between the FR1 and FR2 work since they are totally different devices and test system.

5 – Samsung Electronics Co.

We prefer RAN4 to focus on leftover issue first as mentioned before.

6 – E-surfing Digital

China Telecom:

We support to specify MIMO OTA performance requirements for other FR1 bands based on operators' requests.

For band n1, there are already many commercial UEs, and the MIMO OTA requirements need to be defined in 3GPP.

We also propose to add n5 and n8, for which the carrier frequency is close to n28.

7 – Guangdong OPPO Mobile Telecom.

We support the revised version from CAICT.

We agree with Xiaomi comment that there is no relation between FR1 and FR2, both are important should start from the beginning. And as we commented in the previous topic, we don't see the necessity from procedure and TU point of view.

Regarding add more bands to the performance part, generally we do not have strong view on it, but we would like to suggest review the overall work load to make sure they can be accommodated, if not then some prioritization might be needed.

8 – Apple Italia S.R.L.

If we focus the FR1 performance part to only completing more bands in the FS test case, then this work should not overlap with any FR2 efforts, as it would entail a lab alignment activity in the new bands and another measurement campaign to derive the requirements. In our understanding, it would be beneficial to maintain a relationship to the TRP/TRS effort in Rel-18 from the perspective of providing test case coverage for the same bands (i.e. for each band in which OTA requirements are defined there would exist requirements for MIMO OTA, TRP, and TRS).

9 – vivo Communication Technology

We are OK with revised proposed objectives. We are also OK to prioritize the FR2 part as suggested by ZTE.

Regarding new band for FR1, we suggest to consider new lab alignment activity for bands below 1GHz. Based on the experience learnt from LTE MIMO OTA, there would be large gap between labs at low bands, for TRMS MIMO OTA performance, given the large noise introduced by power amplifier bank (total 32 high-power amplifiers) for FR1 16-probe MPAC system.

10 – Huawei Technologies France

Similar views with Xiaomi and OPPO.

11 – Samsung Electronics Co.

On the objective itself, as commented in issue 2-2, FR1 MIMO OTA enhancement should still focus on free space to cover more bands or more UE type to satisfy industry demand, rather than specifying new test scenario with hand phantom. It should be removed from the WID first.

12 – CAICT

We are OK to consider new lab alignment activity for bands below 1GHz.

Regarding n5/n8 bands, we do not have strong view since it is mainy based on operator's request. But considering the current status of the network and UEs, can we say that n1 has higher priority(1st priority) than n5 and n8?

For FR1 and FR2 work, we believe they are relatively independent because different resources (e.g. test systems, devices) will be allocated to FR1 and FR2, which can be promoted at the same time without conflict.

13 – CAICT

We are OK to consider new lab alignment activity for bands below 1GHz.

Regarding n5/n8 bands, we do not have strong view since it is mainy based on operator's request. But considering the current status of the network and UEs, can we say that n1 has higher priority(1st priority) than n5 and n8?

For FR1 and FR2 work, we believe they are relatively independent because different resources (e.g. test systems, devices) will be allocated to FR1 and FR2, which can be promoted at the same time without conflict.

Issue 2-5: Others

Please provide your comments on other part which not list above including timeline for Rel-18 MIMO OTA WI, the technical justification part from proposed WID (RP-222346).

Feedback Form 7: Issue 2-5: Others

1 – TELECOM ITALIA S.p.A.
Due to the discussion in Release 17 TRP/TRS performance requirements on the disclosure of the devices to be tested in laboratories, guidelines must be clearly identified. It is not acceptable to derive requirements without any knowledge of the set of devices tested by the labs - see RP-222160 for possible proposals

3.1.2 First round summary

Issue 2-1: Proposed core part objectives for FR2

Observation:

- Overall companies support the revised objectives provided by CAICT in comment table to down scope the objectives and focus on Rel-17 leftover issues.
- vivo comments on removing [ ] on the values of existing specification shall belongs to Rel-17 maintenance other than Rel-17 leftover.
- Regarding the candidate options of FR2 MIMO OTA requirements framework, QC proposed to take hybrid approach as starting point and companies share the concern due to lack of measurement data. And One company also share the concern the situation in FR2 can't be resolved soon. Apple also proposed to consider a simulation to measurement alignment activity. It's moderator's understanding, these activities not precluded based the proposed WID objectives and moderator suggests to leave all candidate options on the table and further discuss in RAN4.

Based on above observation, moderator suggest below modified objectives:

Proposal 2: Endorse below objectives for FR2 core part:

- **FR2 Test methodology:**
  - *Study and define the framework for FR2 MIMO OTA requirement development (1st priority)*
    - *Simulation results and/or measurements results will be considered in FR2 requirement definition*
    - *The correlation between simulation results and measurement results will be considered*
    - *Simulation assumptions agreed in R17 MIMO OTA WI can be considered as the baseline*
    - *Study how to handle the situation when not enough measurement results can be collected*
    - *Note: Revisit in [RAN#98]*
  - *Test parameters for FR2 MIMO OTA are defined in TS 38.151, further refinement and supplement is needed based on simulation alignment and practical measurement in the chambers. For example:*
    - *Refining the number of the test points are not precluded.*

- *Further check the FR2 channel model validation pass/fail limits if more practical measurement results are obtained, e.g.*
    - *Whether a tighter pass/fail limit for temporal correlation is necessary*
    - *Pass/fail criteria of power validation*
- *PC3 is 1st priority, other PCs are not precluded*

Issue 2-2: Proposed core part objectives for FR1

Observation:

- 4 companies (ZTE, vivo, Samsung, Qualcomm) prefer to prioritize the work on FR2 part; 3 companies (xiaomi, OPPO, and Huawei) believe FR1 and FR2 discussion not relevant. Moderator suggest to take as FR2 MIMO performance requirement framework as 1st priority for core part.
- Regarding detailed objectives, two companies (Apple and Samsung) have concern on 1st sub-objectives with hand phantom. All other parts seem stable enough.

Proposal 3: Endorse below objectives for FR1 core part:

- ***FR1 MIMO OTA test methodology enhancement***
    - *Specify necessary enhancements of the FR1 MIMO OTA test methodology (test methodology defined in TS38.151 is the baseline) for the following device types in free space* based on operators' request.
        - *For example: Tablet*
    - *Test time reduction methodology for FR1 MIMO OTA is not precluded.*
    - *Introduce more FR1 channel models based on operator requests*
    - *Refine FR1 channel model validation pass/fail limits, e.g.*
        - *Pass/fail criteria of power validation*
- ***Develop the preliminary Measurement Uncertainty (MU) corresponding to all newly defined test methodologies and test configurations***
    - *Example expanded uncertainty for test method shall be defined.*

Proposal 4: Further discuss whether below sub-objective can be including into Rel-18 MIMO WI:

- Option 1: not included

- Option 2: included with below detailed objectives:
    - *Specify necessary enhancements of the FR1 MIMO OTA test methodology for Smartphone in browsing mode using hand phantom.*
        - *Test methodology defined in TR38.827 and TS38.151 is the baseline*

Issue 2-3: Proposed performance objectives for FR2

Observation:

- All the companies fine with the revised objectives provided by CAICT in comment table to down scope the objectives.
- Samsung provides further refinement on the wording which seems acceptable for companies.

Proposal 5: Endorsed below objectives for FR2 perforfmance part:

- **Specify FR2 MIMO OTA performance requirements:**
    - Rel-17 leftovers, including the following aspects:
        - Confirm the figure of merits (FoM) and criteria for FR2 MIMO OTA.
            - Further check the additional criteria on the number of test points that can meet 70% maximum throughput
            - Decide whether other criteria, e.g. 90% maximum throughput for FR2 is needed
        - Specify FR2 MIMO OTA performance requirements.
            - Performance work only starts after the performance requirement development framework is concluded
            - Target FR2-1 bands, e.g. n258
            - PC3 is 1st priority, other PCs are not precluded.
    - Study the FoM and criteria for FR2 MIMO OTA for other device types.
        - UEs with other power classes (PC), e.g., PC1
    - Specify recommended test tolerance (TT) for FR2 MIMO OTA performance requirements.

Issue 2-4: Proposed performance objectives for FR1

Observation:

- Similar as core part discussion: 4 companies (ZTE, vivo, Samsung, Qualcomm) prefer to prioritize the work on FR2 part; 4 companies (xiaomi, OPPO, CAICT and Huawei) believe FR1 and FR2 discussion not relevant and one company (Apple) also pointed out if the work is only developing requirements for more bands in the FS test case, then no any overlap with FR2 effort. Moderator suggests to include the performance work without prioritization and the progress will be contribution driven.
- Regarding detailed objectives: China Telecom suggests to include band n1, n5 and n8 into the scope. Samsung proposed to remove hand phantom similar as core part. vivo we suggest to consider new lab alignment activity for bands below 1GHz

Proposal 6: Endorse below objective for FR1 performance part

- ***Specify FR1 MIMO OTA performance requirements:***
  - *Specify MIMO OTA performance requirements for other FR1 bands based on operators' requests and Rel-17 leftovers.*
    - *Free space is 1st priority, FFS hand phantom*
    - *Define the framework for FR1 MIMO OTA performance requirements development*
      - *Consider reusing the lab alignment outcome and framework on performance test campaign in Rel-17 WI.*
      - *Additional lab alignment activity not precluded for bands below 1GHz*
    - *Bands n1,n5, n28, n77 are the first priority.*
    - *Requirements for stand-alone (SA) mode are the first priority.*
  - *Specify recommended test tolerance (TT) for FR1 MIMO OTA performance requirements.*

Proposal 7: Further discuss whether hand phantom needed to be considered for FR1 performance part.

- Option1: not included
- Option2: include as 2nd priority

Issue 2-5: Others

- One company mentioned the measure device information disclosure issue. Moderator suggests to continue the discussion on thread [97e-28-R17-UE-TRP-TRS] to avoid duplicated discussion. And this issue can be further discussed in RAN4 during WI phase.

3.2 Intermediate round

3.2.1 Proposals and comments collection

3.2.1.1 Issue 2-1: Proposed core part objectives for FR2

Proposal 2: Endorse below objectives for FR2 core part:

FR2 Test methodology:

- ***Study and define the framework for FR2 MIMO OTA requirement development (1st priority)***
  - *Simulation results and/or measurements results will be considered in FR2 requirement definition*
  - *The correlation between simulation results and measurement results will be considered*
  - *Simulation assumptions agreed in R17 MIMO OTA WI can be considered as the baseline*
  - *Study how to handle the situation when not enough measurement results can be collected*
  - *Note: Revisit in [RAN#98]*
- *Test parameters for FR2 MIMO OTA are defined in TS 38.151, further refinement and supplement is needed based on simulation alignment and practical measurement in the chambers. For example:*
  - *Refining the number of the test points are not precluded.*
- *Further check the FR2 channel model validation pass/fail limits if more practical measurement results are obtained, e.g.*
  - *Whether a tighter pass/fail limit for temporal correlation is necessary*
  - *Pass/fail criteria of power validation*
- *PC3 is 1st priority, other PCs are not precluded*

Feedback Form 8: Comments on proposal 2

1 – Guangdong OPPO Mobile Telecom.

We support proposal 2, but for the 1st priority, we would like to get some clarification, which of the following understandings is correct?

- Understanding 1: no FR1 work before the FR2 MIMO OTA requirement framework is completed
- Understanding 2: no FR1 work before RAN#98 (FR2 framework checkpoint)
- Understanding 3: both FR1 and FR2 can be started at the same time but encourage RAN4 to focus on FR2 framework at the beginning

Among these three understandings, our preference is 3 since there is no dependency discussion between FR1 and FR2. The only reason we can see of prioritize FR2 work is to avoid of no results in Rel-18.

However, start FR1 early doesn't impact FR2.

The understanding 1 is not ok to us since what gate the FR2 requirement work is the lacking of test system and devices, how long this FR2 framework can be done is unknown at this moment. We do not prefer to hold on all the FR1 work and delay the discussions for the reason of FR2 practical difficulties since this may put the R18 MIMO OTA on the risk of not complete on time.

As a compromise, we can accept the understanding 2, and give FR2 MIMO OTA two meeting cycle to have a sufficient discussion. After that the FR1 discussion will start.

2 – Guangdong OPPO Mobile Telecom.

After checking with moderator on the meaning of first priority, it is confirmed that understanding 3 is the correct one. Then we are ok with the proposal 2.

3 – CAICT

We are fine with the objectives with the understanding that both FR2 and FR1 can be studied before RAN # 98, but encourage RAN4 to be more focused on the FR2 framework, especially in RAN4 GTW.

4 – China Telecommunications

Ok with the objective with a checking point added, and also agree that FR1 and FR2 objectives can be discussed in parallel.

5 – Qualcomm Incorporated

We prefer to fucus on FR2 framework before RAN#98 since it is the key to specify the FR2 MIMO OTA requirements (FR1 part can be started after RAN#98).

For the framework, the current wording "*Simulation results and/or measurements results will be considered in FR2 requirement definition* " means pure measurmenet, pure simualtion and hybrid simulation&measurement are possible. RAN4 already had serveral round discussions on how to down-select the apporach. We think hybrid simulation&measurement would be a good compromise and we can take this apprach as the starting point. We can revisit if it is not feasible at the checking poing which can make the RAN4 discsuion more effectively. With that, we would suggest to make the following changes:

Hybird of simulation results and measurements results will be considered as the starting point in FR2 requirement definition

NOTE: Revisit in RAN#98 if the hybird of imulation results and measurements results apporach is not feasibale

6 – ZTE Wistron Telecom AB

The objectives are fine to us. The 1st priority means to us that it is the focus with all necessary resources guaranteed.

7 – vivo Communication Technology

The suggested wording from QC is reasonable for us to manage the project, otherwise there would be no clear way to go even this work is shifted from Rel-17 to Rel-18.

8 – Huawei Technologies France We support proposal 2 with both FR1 and FR2 work going on in parallel before RAN#98.
9 – AT&T GNS Belgium SPRL We also support the wording from QC concerning the framework and the checkpoint at RAN#98.
10 – Apple Italia S.R.L. We support Proposal 2. Regarding Qualcomm's proposal on a hybrid method, we don't quite understand how this hybrid approach would work without a proper correlation between simulation and measurement as the first step. The current proposal 2 wording at least includes this consideration of harmonizing simulations and measurements.

3.2.1.2 Issue 2-2: Proposed core part objectives for FR1

Proposal 3: Endorse below objectives for FR1 core part:

FR1 MIMO OTA test methodology enhancement

- *Specify necessary enhancements of the FR1 MIMO OTA test methodology (test methodology defined in TS38.151 is the baseline) for the following device types in free space* based on operators' request.
  - *For example: Tablet*
- *Test time reduction methodology for FR1 MIMO OTA is not precluded.*
- *Introduce more FR1 channel models based on operator requests*
- *Refine FR1 channel model validation pass/fail limits, e.g.*
  - *Pass/fail criteria of power validation*

Develop the preliminary Measurement Uncertainty (MU) corresponding to all newly defined test methodologies and test configurations

- *Example expanded uncertainty for test method shall be defined.*

Proposal 4: Further discuss whether below sub-objective can be including into Rel-18 MIMO WI:

- Option 1: not included
- Option 2: included with below detailed objectives:
  - *Specify necessary enhancements of the FR1 MIMO OTA test methodology for Smartphone in browsing mode using hand phantom.*

- *Test methodology defined in TR38.827 and TS38.151 is the baseline*

Feedback Form 9: Comments on proposal 3 and 4

1 – Guangdong OPPO Mobile Telecom.

We support proposal 3.

For proposal 4, we prefer Option 2. Our view is that hand phantom is an important scenario to evaluate UE antenna MIMO performance in real NW. And the hand phantom also have been used in TRP/TRS as 1st priority in Rel-17, but what is missing in TRP/TRS is the antenna correlation among antennas which can only be tested in MIMO OTA system. This is the benefit of hand phantom can provide comparing to free space MIMO OTA test and also TRP/TRS tests. Meanwhile, we see the concerns from certain company, and to compromise, we can accept remove or deprioritize hand phantom from performance part, but it shall be included in the core part, i.e. in Rel-18 only define test method for hand phantom.

2 – CAICT

We support proposal 3. For proposal 4, we share similar views as OPPO.

The browsing mode is the most important use scenario for NR devices, especially from the perspective of throughput, however, there is no corresponding test method for this scenario after years of deep study in MIMO OTA. It is important whether the current test method used for MIMO OTA measurement in Free space can be reused or optimaized for testing with hand phantom. This phantom has been widely used in TRP TRS measurement and will not introduce great challenge to the FR1 MIMO OTA test method from our understanding. The study will be focus on test method rather than requirements.

To move forward, we can accept to modify the objective in core part as:

- *Study and if feasible to specify necessary enhancements of the FR1 MIMO OTA test methodology for Smartphone in browsing mode using hand phantom.*
    - *Test methodology defined in TR38.827 and TS38.151 is the baseline*

For performance part, we can accept remove or deprioritize hand phantom related objective to achieve compromise. Hope this is acceptable to all companies.

3 – vivo Communication Technology

We have a clarification question for the first bullet in Proposal 3, is the intention to increase the Quiet Zone size larger than 20cm? to support larger devices, then the 16-probe MPAC system should be revisited, more probes are needed.

Or, the intention is to discuss the new device but within 20cm? if so, we would like to know potential enhancement aspects needed.

4 – vivo Communication Technology

We have a clarification question for the first bullet in Proposal 3, is the intention to increase the Quiet Zone size larger than 20cm? to support larger devices, then the 16-probe MPAC system should be revisited, more probes are needed.

Or, the intention is to discuss the new device but within 20cm? if so, we would like to know potential enhancement aspects needed.

5 – CAICT

To vivo: The device type in the first bullet will be *based on operator's request*. We should try to reusing the existing test system setup as much as possible. Other test zone size larger than 20cm is FFS.

6 – vivo Communication Technology

Thanks for the feedback. Given FR1 MIMO OTA system is quite complex, we think it would be a risk if the system hardware configuration is changed frequently.

We are OK to define more FR1 requirements, but updating the 16-probe system (to potentially larger chamber with more probes) which was defined based on long-term analysis and very hard discussions in RAN4 in Rel-16, this is not a reasonable scope for us in Rel-18.

We suggest to clearly state the quiet zone of 20cm and 16-probe system should be reused:

- *For example: Tablet within 20cm*
- *Quiet zone of 20cm and 16-probe MPAC system should be unchanged*

7 – Huawei Technologies France

On proposal 3, we support the clarification text proposed by VIVO.

On proposal 4, we support option 2.

8 – CAICT

In general, we agree with vivo's comments that 16-probe system should be unchanged. Considerting that the quiet zone size depends on the probes setup, we can directly state that:

- *For example: Tablet*
- *16-probe MPAC system setup should be unchanged*

9 – vivo Communication Technology

For the phantom-based MIMO OTA testing, there is a technical issue we should consider is that the phantom with smartphone may need to be within the defined 20cm Test Zone size, we would doubt whether CTIA FR1 hand phantom can be used to meet this condition. Otherwise, RAN4 would need a large activity to involve phantom manufactures e.g. Speag, to define new phantom.

So we prefer the following wording:

- *Study, and if necessary and feasible, specify enhancements of the FR1 MIMO OTA test methodology for Smartphone in browsing mode using hand phantom.*

10 – Samsung Electronics Co.

We are still not convinced. We are talking about the motivation to introduce this brand new feature for MIMO OTA, but not about it is challenge or not. RAN4 discussed hand phantom for TRS since it has clear motivation from the market. But we are not sure of what it is for MIMO OTA (throughput).

We need more time to check until final round since we have never discussed this before even in RAN4.

11 – Apple Italia S.R.L.

On Proposal 3, we are not convinced that there is a strong enough interest to extend the methodology to tablets (we assume quiet zone size needs to be expanded), and we are not convinced that defining one more channel model, which would double the overall test time, is a good idea for the minimum requirement on multi-antenna reception. We are fine to keep test time reduction.

On Proposal 4, as we commented in the initial round, we are not convinced that the hand phantom test case would add much more value to the existing approach already defined for MIMO OTA. We note that during the development of this methodology for LTE, hand phantoms were also considered (both in 3GPP and CTIA), but in the end neither a stable test method nor performance requirements were defined for this.

12 – Apple Italia S.R.L.

On Proposal 3, we are not convinced that there is a strong enough interest to extend the methodology to tablets (we assume quiet zone size needs to be expanded), and we are not convinced that defining one more channel model, which would double the overall test time, is a good idea for the minimum requirement on multi-antenna reception. We are fine to keep test time reduction.

On Proposal 4, as we commented in the initial round, we are not convinced that the hand phantom test case would add much more value to the existing approach already defined for MIMO OTA. We note that during the development of this methodology for LTE, hand phantoms were also considered (both in 3GPP and CTIA), but in the end neither a stable test method nor performance requirements were defined for this.

13 – Apple Italia S.R.L.

On Proposal 3, we are not convinced that there is a strong enough interest to extend the methodology to tablets (we assume quiet zone size needs to be expanded), and we are not convinced that defining one more channel model, which would double the overall test time, is a good idea for the minimum requirement on multi-antenna reception. We are fine to keep test time reduction.

On Proposal 4, as we commented in the initial round, we are not convinced that the hand phantom test case would add much more value to the existing approach already defined for MIMO OTA. We note that during the development of this methodology for LTE, hand phantoms were also considered (both in 3GPP and CTIA), but in the end neither a stable test method nor performance requirements were defined for this.

14 – Apple Italia S.R.L.

On Proposal 3, we are not convinced that there is a strong enough interest to extend the methodology to tablets (we assume quiet zone size needs to be expanded), and we are not convinced that defining one more channel model, which would double the overall test time, is a good idea for the minimum requirement on multi-antenna reception. We are fine to keep test time reduction.

On Proposal 4, as we commented in the initial round, we are not convinced that the hand phantom test case would add much more value to the existing approach already defined for MIMO OTA. We note that during the development of this methodology for LTE, hand phantoms were also considered (both in 3GPP and CTIA), but in the end neither a stable test method nor performance requirements were defined for this.

3.2.1.3 Issue 2-3: Proposed performance objectives for FR2

Proposal 5: Endorsed below objectives for FR2 perforfmance part:

Specify FR2 MIMO OTA performance requirements:

- Rel-17 leftovers, including the following aspects:
  - Confirm the figure of merits (FoM) and criteria for FR2 MIMO OTA.
    - Further check the additional criteria on the number of test points that can meet 70% maximum throughput
    - Decide whether other criteria, e.g. 90% maximum throughput for FR2 is needed
  - Specify FR2 MIMO OTA performance requirements.
    - Performance work only starts after the performance requirement development framework is concluded
    - Target FR2-1 bands, e.g. n258
    - PC3 is 1st priority, other PCs are not precluded.
- Study the FoM and criteria for FR2 MIMO OTA for other device types.
  - UEs with other power classes (PC), e.g., PC1
- Specify recommended test tolerance (TT) for FR2 MIMO OTA performance requirements.

Feedback Form 10: comments on proposal 5

1 – Guangdong OPPO Mobile Telecom.

We support the proposal 5.

2 – Guangdong OPPO Mobile Telecom.

We support the proposal 5.

3 – CAICT

We support proposal 5. And we also propose to modify the wording as below:

- Refine~~Confirm~~ the figure of merits (FoM) and criteria for FR2 MIMO OTA if necessary.

4 – Qualcomm Incorporated We are OK with CAICT's revisions.
5 – ZTE Wistron Telecom AB Proposal 5 is fine to us.
6 – Huawei Technologies France We support proposal 5. A question on PC1 under other Power Classes. According to 38.101-2, PC1 is for FWA. Is this WI to include FWA performance?
7 – Apple Italia S.R.L. Fine with proposal 5.

3.2.1.4 Issue 2-4: Proposed performance objectives for FR1

Proposal 6: Endorse below objective for FR1 performance part

Specify FR1 MIMO OTA performance requirements:

- *Specify MIMO OTA performance requirements for other FR1 bands based on operators' requests and Rel-17 leftovers.*
  - *Free space is 1st priority, FFS hand phantom*
  - *Define the framework for FR1 MIMO OTA performance requirements development*
    - *Consider reusing the lab alignment outcome and framework on performance test campaign in Rel-17 WI.*
    - *Additional lab alignment activity not precluded for bands below 1GHz*
  - *Bands n1,n5, n28, n77 are the first priority.*
  - *Requirements for stand-alone (SA) mode are the first priority.*
- *Specify recommended test tolerance (TT) for FR1 MIMO OTA performance requirements.*

Proposal 7: Further discuss whether hand phantom needed to be considered for FR1 performance part.

- Option1: not included
- Option2: include as 2nd priority

Feedback Form 11: Comments on proposal 6 and 7

1 – Guangdong OPPO Mobile Telecom.

We support Proposal 6.

For Proposal 7, our view is that hand phantom is an important scenario to evaluate UE antenna MIMO performance in real NW. And the hand phantom also have been used in TRP/TRS as 1st priority in Rel-17, but what is missing in TRP/TRS is the antenna correlation among antennas which can only be tested in MIMO OTA system. This is the benefit of hand phantom can provide comparing to free space MIMO OTA test and also TRP/TRS tests. Meanwhile, we see the concerns from certain company, and to compromise, we can accept either Option 1 or Option 2 in the performance part, but it shall be included in the core part, i.e. in Rel-18 only define test method for hand phantom.

2 – CAICT

Support proposal 6.

For proposal 7, as we comment in Issue 2-2, we can accept remove or deprioritize hand phantom related objective in performance part to achieve compromise. But the objective in core part should be kept, detailed wording can be modified to address companies' concerns on hand phantom's impact on test methodology.

Modify the objective in core part as:

- *Study and if feasible to specify necessary enhancements of the FR1 MIMO OTA test methodology for Smartphone in browsing mode using hand phantom.*
    - *Test methodology defined in TR38.827 and TS38.151 is the baseline*

Hope this is acceptable to all companies.

3 – China Telecommunications

We support Proposal 6.

For Proposal 7, we support option 2.

4 – Huawei Technologies France

We support proposal 6 and option 2 in proposal 7.

5 – vivo Communication Technology

Phantom-based FR1 MIMO OTA requirements should be dropped in Rel-18.

6 – Samsung Electronics Co.

We support Option 1 for Proposal 7 as commented earlier.

7 – Apple Italia S.R.L.

We suggest removing the hand phantom objective, as there does not seem to be consensus to introduce the related methodology. We also don't think that lab alignment activities should be skipped for newly introduced bands. We saw quite large variation in lab alignment results in the Rel-17 work, and it would be valuable to continue the lab alignment activities to allow test labs opportunities to improve their procedures and to reduce this inter-lab variability. In the end, the activity is always valuable toward the overall reduction of the MU budget and can help the subsequent work in RAN5.

3.2.1.5 Issue 2-5: Others

Please provide your comments on the proposed WI justifcation part in the proposed WID. Moderator also observed no TU request excel in the proposed WID, moderator sugguests the proponent of Rel-18 MIMO OTA WI provide the TU request into inbox and companies can provide comments/sugguestions on the TU request.

Feedback Form 12: Others including comments on the proposed WI justifciation part and TU request

1 – CAICT

Follow moderator's guidanence, CAICT has uploaded the TU request in the draft folder [97e-27-R17-MIMO-OTA], the target date of core part is Dec 23, the target date of perf part is June 24. Please provide your comments if any.

https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_97e/Inbox/Drafts/%5B97e-27-R17-MIMO-OTA%5D/RP-22XXXX_NR_MIMO_OTA_enh_Time_budget_request.xls

2 – TELECOM ITALIA S.p.A.

We agree to discuss the (partial) disclosure of devices to be tested under the TRP/TRS discussion. However, the Work Item cannot be approved if the topic is not addressed.

3 – Guangdong OPPO Mobile Telecom.

To Telecom Italia comment:

For clarification, why the discussion in TRP/TRS disclosure issue will impact this MIMO OTA WI? We see no discussion about this in MIMO OTA. Do you mean the TRP/TRS WI will not be approved before this disclosure issue solved or MIMO OTA?

3.2.2 Second round summary

Issue 2-1: Proposed core part objectives for FR2

The proposed objective seems acceptable for all the companies in general. QC suggests to make refinement on FR2 requirements framework to take hybrid approach as starting point. And AT&T, vivo support such changes. Apple pointed out before we justify the correlation between simulation results and measurement results, it's hard to conclude hybrid approach workable or not.

Several companies questioned the meaning "first priority", after exchanges views between companies; now all the companies have common understanding, we will prioritize the discussion on FR2 MIMO OTA requirement framework during RAN4 meetings on the other hand no exclusion of handling FR1 related topics which should be contribution driven.

Updated proposal 2: Endorse below objectives for FR2 core part:

FR2 Test methodology:

- ***Study and define the framework for FR2 MIMO OTA requirement development (1st priority)***
    - *Hybrid of simulation results and measurements results will be considered as the starting point in FR2 requirement definition*
        - *Note: Revisit in RAN#98 if the hybrid of simulation results and measurements results approach is not feasible*
    - *The correlation between simulation results and measurement results will be considered*
    - *Simulation assumptions agreed in R17 MIMO OTA WI can be considered as the baseline*
    - *Study how to handle the situation when not enough measurement results can be collected*
- *Test parameters for FR2 MIMO OTA are defined in TS 38.151, further refinement and supplement is needed based on simulation alignment and practical measurement in the chambers. For example:*
    - *Refining the number of the test points are not precluded.*
- *Further check the FR2 channel model validation pass/fail limits if more practical measurement results are obtained, e.g.*
    - *Whether a tighter pass/fail limit for temporal correlation is necessary*
    - *Pass/fail criteria of power validation*
- *PC3 is 1st priority, other PCs are not precluded*

Issue 2-2: Proposed core part objectives for FR1

All the companies ok with proposal 3 in general. Apple questoned the necessary for further study tablet and more FR1 channel model and vivo suggests refinement which seems acceptable for everyone. To address Apple's concern, I made further refinement on 1st bulluet and 3nd main bullet.

Updated Proposal 3: Endorse below objectives for FR1 core part:

FR1 MIMO OTA test methodology enhancement

- *Study, and if necessary, specify enhancements of the FR1 MIMO OTA test methodology (test methodology defined in TS38.151 is the baseline) for the following device types in free space based on operators' request.*

    - *For example: Tablet*
    - *Quiet zone of 20cm and 16-probe MPAC system should be unchanged*

- *Test time reduction methodology for FR1 MIMO OTA is not precluded.*
- *Introduce more FR1 channel models based on operator requests if necessary*
- *Refine FR1 channel model validation pass/fail limits, e.g.*
    - *Pass/fail criteria of power validation*

Develop the preliminary Measurement Uncertainty (MU) corresponding to all newly defined test methodologies and test configurations

- *Example expanded uncertainty for test method shall be defined.*

For proposal 4 hand phantom issue, 5 companies support option 2 to include this for test method study and two companies (Samsung, Apple) share concern on that; meanwhile companies also fine to comprise without including for performance requirement.

Moderator suggest below compromised solution: Including hand phantom in core part for test methodology study and remove hand phantom from performance part.

Updated proposal 4: Including hand phantom in core part for test methodology study and remove hand phantom from performance part:

- Study, and if necessary and feasible, specify enhancements of the FR1 MIMO OTA test methodology for Smartphone in browsing mode using hand phantom.
    - Test methodology defined in TR38.827 and TS38.151 is the baseline

Issue 2-3: Proposed performance objectives for FR2

All the companies ok with proposal 5 with small refinement suggestion from CAICT.

Updated proposal 5: Endorsed below objectives for FR2 perforfmance part:

Specify FR2 MIMO OTA performance requirements:

- Rel-17 leftovers, including the following aspects:
    - Refine the figure of merits (FoM) and criteria for FR2 MIMO OTA if necessary.
        - Further check the additional criteria on the number of test points that can meet 70% maximum throughput
        - Decide whether other criteria, e.g. 90% maximum throughput for FR2 is needed

    - Specify FR2 MIMO OTA performance requirements.
        - Performance work only starts after the performance requirement development framework is concluded
        - Target FR2-1 bands, e.g. n258
        - PC3 is 1st priority, other PCs are not precluded.
- Study the FoM and criteria for FR2 MIMO OTA for other device types.
    - UEs with other power classes (PC), e.g., PC1
- Specify recommended test tolerance (TT) for FR2 MIMO OTA performance requirements.

Issue 2-4: Proposed performance objectives for FR1

Proposal 6 agreeable and for proposal 7(hand phantom) already covered by core part discussion with updated proposal 4 to drop from performance part.

Updated proposal 6: Endorse below objective for FR1 performance part

Specify FR1 MIMO OTA performance requirements:

- *Specify MIMO OTA performance requirements for other FR1 bands based on operators' requests and Rel-17 leftovers.*
    - *Free space*
    - *Define the framework for FR1 MIMO OTA performance requirements development*
        - *Consider reusing the lab alignment outcome and framework on performance test campaign in Rel-17 WI.*
        - *Additional lab alignment activity not precluded for bands below 1GHz*
    - *Bands n1,n5, n28, n77 are the first priority.*
    - *Requirements for stand-alone (SA) mode are the first priority.*
- *Specify recommended test tolerance (TT) for FR1 MIMO OTA performance requirements.*

Others

R18 WI proponent provides TU excel in inbox. Companies encouraged to further check during final round.

Telecomm Italia also mentioned test device disclosure issue, as explained in 1st round summary, we can continue the discussion under thread [97e-28-R17-UE-TRP-TRS].

3.3 Final round

Based on intermediate round discussion, the WID scope and detailed objectives seems stable enough. The updated propsoals list below:

All the proposals seems agreeable excpet update proposal 4 pending on companies' further confirmation.

Updated proposal 2: Endorse below objectives for FR2 core part: (Agreedable)

FR2 Test methodology:

- ***Study and define the framework for FR2 MIMO OTA requirement development (1st priority)***
  - *Hybrid of simulation results and measurements results will be considered as the starting point in FR2 requirement definition*
    - *Note: Revisit in RAN#98 if the hybrid of simulation results and measurements results approach is not feasible*
  - *The correlation between simulation results and measurement results will be considered*
  - *Simulation assumptions agreed in R17 MIMO OTA WI can be considered as the baseline*
  - *Study how to handle the situation when not enough measurement results can be collected*
- *Test parameters for FR2 MIMO OTA are defined in TS 38.151, further refinement and supplement is needed based on simulation alignment and practical measurement in the chambers. For example:*
  - *Refining the number of the test points are not precluded.*
- *Further check the FR2 channel model validation pass/fail limits if more practical measurement results are obtained, e.g.*
  - *Whether a tighter pass/fail limit for temporal correlation is necessary*
  - *Pass/fail criteria of power validation*
- *PC3 is 1st priority, other PCs are not precluded*

Updated Proposal 3: Endorse below objectives for FR1 core part: (Agreedable)

FR1 MIMO OTA test methodology enhancement

- *Study, and if necessary, specify enhancements of the FR1 MIMO OTA test methodology (test methodology defined in TS38.151 is the baseline) for the following device types in free space based on operators' request.*
  - *For example: Tablet*
  - *Quiet zone of 20cm and 16-probe MPAC system should be unchanged*

- *Test time reduction methodology for FR1 MIMO OTA is not precluded.*
- *Introduce more FR1 channel models based on operator requests if necessary*
- *Refine FR1 channel model validation pass/fail limits, e.g.*
    - *Pass/fail criteria of power validation*

Develop the preliminary Measurement Uncertainty (MU) corresponding to all newly defined test methodologies and test configurations

- *Example expanded uncertainty for test method shall be defined.*

Updated proposal 4: Including hand phantom in core part for test methodology study and remove hand phantom from performance part: (Agreedable ?)

- Study, and if necessary and feasible, specify enhancements of the FR1 MIMO OTA test methodology for Smartphone in browsing mode using hand phantom.
    - Test methodology defined in TR38.827 and TS38.151 is the baseline

Updated proposal 5: Endorsed below objectives for FR2 perforfmance part: (Agreedable)

Specify FR2 MIMO OTA performance requirements:

- Rel-17 leftovers, including the following aspects:
    - Refine the figure of merits (FoM) and criteria for FR2 MIMO OTA if necessary.
        - Further check the additional criteria on the number of test points that can meet 70% maximum throughput
        - Decide whether other criteria, e.g. 90% maximum throughput for FR2 is needed
    - Specify FR2 MIMO OTA performance requirements.
        - Performance work only starts after the performance requirement development framework is concluded
        - Target FR2-1 bands, e.g. n258
        - PC3 is 1st priority, other PCs are not precluded.
- Study the FoM and criteria for FR2 MIMO OTA for other device types.
    - UEs with other power classes (PC), e.g., PC1

- Specify recommended test tolerance (TT) for FR2 MIMO OTA performance requirements.

Updated proposal 6: Endorse below objective for FR1 performance part (Agreedable)

Specify FR1 MIMO OTA performance requirements:

- *Specify MIMO OTA performance requirements for other FR1 bands based on operators' requests and Rel-17 leftovers.*
  - *Free space*
  - *Define the framework for FR1 MIMO OTA performance requirements development*
    - *Consider reusing the lab alignment outcome and framework on performance test campaign in Rel-17 WI.*
    - *Additional lab alignment activity not precluded for bands below 1GHz*
  - *Bands n1,n5, n28, n77 are the first priority.*
  - *Requirements for stand-alone (SA) mode are the first priority.*
- *Specify recommended test tolerance (TT) for FR1 MIMO OTA performance requirements.*

3.3.1 Proposals and comments collection

For final round discussion, moderator suggests volunteer CAICT to provide the revised WID based on the conclusion from intermediate round into inbox folder:

https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_97e/Inbox/Drafts/%5B97e-27-R17-MIMO-OTA%5D

Companies, please provide your comments on the revised WID and TU request file.

Feedback Form 13: Comments on revised WID

1 – Guangdong OPPO Mobile Telecom.

Generally we support the proposals from moderator, some updates below:

For proposal 2:

- **We are ok** with start from hybrid approach, and encourage the group to focus on the framework in the following two meetings.
- Regarding the Note, after checking with proponent, it probably can be improved as below:

Note: Revisit in RAN#98 about the feasibility and progress of hybrid simulation and measurement approach.

For proposal 3:

- Regarding the Quiet zone and 16 probe MPAC system, our understanding is that the main point is reusing the current system if testing other device types, we are ok with that, but not necessarily to keep 20cm Quiet zone unchanged. Therefore suggest to remove the limitation of Quiet zone.
    - ~~**Quiet zone of 20cm and**~~ 16-probe MPAC system should be unchanged.

For proposal 4:

- **We support this proposal.**
- We believe nobody can deny that hand phantom is a very important scenario for antenna design and MIMO performance, but currently there is no testing approach to verify the antenna correlation which is a key factor for MIMO OTA throughput. The MIMO OTA system has been developed for such a long time, but up to now still keep in the basic free space scenario. It is understood if we are at the beginning of this technology development, but now MIMO OTA has been well studied and used in the industry. We need to move forward to provide the industry with more advanced MIMO testing approach to guide the antenna design and evaluation. Therefore, we still suggest the hand phantom to be included in the Rel-18 at least for test method.

For proposal 5/6: **We support the proposal.**

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2 – Guangdong OPPO Mobile Telecom.

Generally we support the proposals from moderator, some updates below:

For proposal 2:

- **We are ok** with start from hybrid approach, and encourage the group to focus on the framework in the following two meetings.
- Regarding the Note, after checking with proponent, it probably can be improved as below:

  Note: Revisit in RAN#98 about the feasibility and progress of hybrid simulation and measurement approach.

For proposal 3:

- Regarding the Quiet zone and 16 probe MPAC system, our understanding is that the main point is reusing the current system if testing other device types, we are ok with that, but not necessarily to keep 20cm Quiet zone unchanged. Therefore suggest to remove the limitation of Quiet zone.
    - ~~**Quiet zone of 20cm and**~~ 16-probe MPAC system should be unchanged.

For proposal 4:

- **We support this proposal.**

- We believe nobody can deny that hand phantom is a very important scenario for antenna design and MIMO performance, but currently there is no testing approach to verify the antenna correlation which is a key factor for MIMO OTA throughput. The MIMO OTA system has been developed for such a long time, but up to now still keep in the basic free space scenario. It is understood if we are at the beginning of this technology development, but now MIMO OTA has been well studied and used in the industry. We need to move forward to provide the industry with more advanced MIMO testing approach to guide the antenna design and evaluation. Therefore, we still suggest the hand phantom to be included in the Rel-18 at least for test method.

For proposal 5/6: **We support the proposal.**

3 – China Telecommunications

The WID in general looks good. We have a small comment:

We requested to add n8 for FR1 MIMO OTA requirement definition in the initial round, and there is no comment on that (as also seen in Moderator's initial round summary). It seems n8 was missed in the updated proposal for intermediate round. Sorry for not spotting this issue earlier. We would suggest to add n8 in the updated WID.

4 – Qualcomm Incorporated

We are fine with the propsoals from moderator and the WID provided by CAICT.

For the revisions from OPPO on propsoal 2. We made minor update as below:

- Note: Revisit in RAN#98 ~~about~~ **to check** the feasibility and progress of hybrid simulation and measurement approach.

5 – Samsung Electronics Co.

Thanks a lot. We are ok with moderator's Proposal 4 as a compromise. Let us further check if it is necessary in future RAN4 meetings.

6 – Samsung Electronics Co.

Thanks a lot. We are ok with moderator's Proposal 4 as a compromise. Let us further check if it is necessary in future RAN4 meetings.

7 – TELECOM ITALIA S.p.A.

In my understanding the conclusion on (partial) disclosure of the DUTs achieved under the TRP/TRS discussion (as concluded in proposal 1 in topic #1 (Rel 17 handling)) should be reflected in the WI description.

8 – Huawei Technologies France

We support the WID and the associated TU allocation.

9 – vivo Communication Technology

We support the WID, but We are not OK to remove 20cm Quiet zone conclusion, unless companies provide spatial correlation analysis to show why this can be changed without update of the test system.

10 – CAICT

We support the WID and proposals from moderator.

For proposal 2: we are Ok with the revision from QC.

For proposal 6: we are ok to add n8. Meanwhile, our understanding is that further down selection may be carried out during the WI according to the actual situation of commercial devices in the market and the request of operators, as we did in R17.

For the R17 (partial) information disclosure conclusion, we can capture the statement in the TRP/TRS discussion, i.e.

Taking following as a starting point to furhter discuss which information needed including for information disclosure:

els tested by the labs

- Number of vendors that produced the models
- percentage of tested devices per vendor
- Percentage of models per production year

Class of the devices

3.3.2 Final round summary

Based on final round comments and feedback, the latest draft WID contents in inbox seems stable and agreeable.

https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_97e/Inbox/Drafts/%5B97e-27-R17-MIMO-OTA%5D/rev%20of%20RP-222346%20R18%20New%20WID%20on%20NR%20MIMO%20OTA%20-v1.doc

Moderator sugguests to endorse latest draft Rel-18 MIMO WID.

4 Conclusion

Topic #1 Rel-17 MIMO OTA WI handling (Concluded in intermediate round)

Recommendation of related T-docs

Table 3:

T-doc	Title
RP-222070	Views on R17 MIMO OTA
RP-222267	Discussion on NR MIMO OTA
RP-222280	Views on conclusions of MIMO OTA
RP□222349	Discussion on NR MIMO OTA
RP-222348	Revised WID: Multiple Input Multiple Output (MIMO) Over-the-Air (OTA) requirements for NR Ues

RP-222347	Status report for WI: Multiple Input Multiple Output (MIMO) Over-the-Air (OTA) requirements for NR U

Topic #2 Rel-18 MIMO OTA WI proposal

Recommendation of related T-docs

Table 4:

Tdoc	Title
RP-222345	Motivation for Rel-18 new WI on NR MIMO OTA
RP-222346	New WI: Enhancement of Multiple Input Multiple Output (MIMO) Over-the-Air (OTA) requirement for NR