**3GPP TSG-RAN Meeting #89-e RP-20xxxx**

**Online, 7-11 December, 2020**

**Agenda item:** 9.1.5

**Source:** Moderator(Qualcomm)

**Title:** Moderator's summary for email discussion [90E][49][RAN4\_OTA]

**Document for:** Discussion

# Introduction

This paper will summarize the companies inputs regarding the scope of the OTA work for Rel.17. There are 2 separate proposals, one for SISO TRP&TRS for FR1 and one for FR2 Dynamic OTA testing[1].

# Discussion

## Study on radiated metrics and test methodology for FR2 NR UEs under dynamic test environment

### Proposed SI Scope

The proposed SI scope is shown below [1]:

### Objective of SI or Core part WI or Testing part WI

The objective of this Study Item is to define end-to-end testing methodology for the verification of FR2 NR UEs performance in a dynamic environment.

The study proceeds within the following scope:

- For the following device types:

- Smartphone is the first priority.

- Other UE types are not precluded for discussion as a second priority

- Identify UE orientation rotation based dynamic OTA testing methodology:

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* Change UE rotation during the testing
* Study the feasibility of reusing 3D-MPAC system
* Test metric should be based on the current core/performance requirements

- The test methodology shall include both NSA and SA.

* For setups intended for measurements of UE characteristics in non-standalone (NSA) mode, an LTE link antenna setup is used to configure the NR link

- Using the channel models defined in TR38.901 as the starting point to develop dynamic environment

- Channel model framework in TR38.827 should be taken as the basis

- Study whether and which parameters for channel mode defined in TR38827 will have big impact on UE performance and could be reused for dynamic testing.

- Study the applicable test methodology verification procedures

- Study the preliminary uncertainty budget for the methodology

- The uncertainty budget in TR38827 should be the basis for developing the uncertainty.

 - Study the additional uncertainty due to the dynamic environment

- The dynamic environment tests shall take the test system complexity and test time into account to keep the whole test costs within a reasonable level.

During this study item, ongoing communication with 3GPP RAN WG5, CTIA OTA Working Group (MOSG, 5G mm-wave OTA Sub-Working group and MUSG), and CCSA TC9 WG1 shall be maintained to ensure industry coordination on this topic.

### Main Points for Discussion – intermediate round

Companies should express their opinions/comments related to the following main points.

Comments to fine tune the objectives

What could be streamlined/downscoped to limit the number of Tus per meeting

### Companies’ Comments

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| Company | Comments |
| Apple | We comment on the stability of the dynamic OTA SID scope, which is well summarized in the pre-RAN email discussion summary [RP-202629].Four major issues were identified in the email discussion: 1) timeline to develop the stage 1 and stage 2 scenarios, 2) dependencies on Rel-17 core work item progress (e.g. handling of multi-panel UEs), 3) relationship with other OTA items, and 4) relative priority with other OTA itemsOn issue #1, we agree with the moderator that the SID should have a clear timeline, and in our understanding this is a typical rapporteur task related to the work plan. Thus, we don’t view this issue as a blocking issue toward the SID's approval.On issue #2, a dependency on core functionality which has not yet been developed has been identified by at least 2 companies. From past experience with FR2 testability work in RAN4, we have observed that having clear agreements on core requirements for which test methodology work is undertaken is a necessary pre-requisite. In order to include an objective for test methodology development against a new core feature, such as multi-panel operation from Rel-17 FeMIMO, a further iteration to scope out the work is needed, and, in our understanding, this should occur after the corresponding UE RF core requirements are understood. Thus, issue #2 is a discussion point which can benefit from further scoping and, in our view, renders the SID as not ready for approval during this meeting.On issue #3, several companies have observed that this study should reuse the outcomes of the FR2 MIMO OTA test methodology as much as possible. Considering that the FR2 MIMO OTA work is still ongoing, progress on the dynamic OTA work can slow or become blocked if a dependency on an open issue in FR2 MIMO OTA is identified. From this perspective, the identified relationship to FR2 MIMO OTA seems to suggest that the dynamic OTA SI should be initiated after the conclusion of FR2 MIMO OTA work.On issue #4, we observe that RAN is considering the following OTA proposals during this meeting: FR1 TRP/TRS, FR2 dynamic OTA, and testability for 52.6-71 GHz. We observe that the outcomes of FR1 TRP/TRS and testability for 52.6-71 GHz will impact testability of UE RF requirements, while the dynamic OTA study will impact the testability of RRM and demodulation requirements. From the work phasing perspective of core and performance requirements, it seems quite natural to observe the same approach with the testability items. Also relying on the moderator’s summary of the 52.6-71 GHz discussion, where a dependency on the progress of core requirements from the 52.6-71 GHz WID was identified, we can phase the OTA proposals in the following manner: 1) FR1 TRP/TRS, 2) testability for 52.6-71 GHz, and 3) dynamic OTA. In addition, it seems to be a common preference to merge the objectives for testability of 52.6-71 GHz into the currently ongoing FR2 test methodology enhancement study, which can be done once the scope of this work is stabilized.An additional and useful data point is to compare the number of supporting companies between FR1 TRP/TRS (24) and dynamic OTA (10). This is a good indicator of industry need which should inform 3GPP work plan prioritization and is a clear endorsement to focus our efforts during this meeting on the FR1 TRP/TRS WID.In summary, we understand that the dynamic OTA proposal in RP-202634 can benefit from further refinement of its scope and can be phased to start after OTA items related to RF requirements have been added to the RAN4 work plan. |
| Qualcomm | We’d like to give some feedback to the comments received by email discussion and also by offline. We did the down-scope and made revisions directly in the summary above for your easy check. If it is possible to approve a down-scoped version, then we are fine to do just UE- orientation based scenario in this SI.Response to Apple’s issue#2:We have removed the multi-panel in the revised SID. Whether and how to deal with multi-panel UEs can be further discussed in working group meeting in agenda items of FeMIMO, FR2 HST, Testability enhancement, or Dynamic OTA WI/SI. We think it is necessary to consider the forward compatibility for above FR2 OTA items.Response to Apple’s issue#3:Most relevant preliminary study had been conducted in Rel-16 MIMO-OTA SI, i.e., the test system and test methodology have been done within Rle-16. The current Rel-17 MIMO OTA WI is to define the requirement rather than defining test method. Not much effort is expected with the revised objective, i.e. UE orientation only based Dynamic OTA testing. In the SID, we explicitly state the outcome of Rel-16 MIMO OTA SI i.e., TR38827 is the basis of this dynamic testing SI. Besides, we can also consider a slow-start, e.g. after RAN#92 to solve the limited TU budget issue. Response to Apple’s issue #4:There is another email thread discussing the 52.6-71GHz testability issue and there are three options on how to treat test method. Note that physical layer design available yet (e.g. SCS, BW, UE type, etc can affect work scope and required TU a lot). We suggest to pending on the corresponding WI progress. We can further discuss which SI/WIs to include that objective.We don’t think is it fair to count supporting company to prioritize the OTA work. We believe both FR1 and FR2 OTA SI/WI are important (we got the support form operators, certification lab, UE vendors and TE/CE vendors) and FR1 and FR2 OTA items are independent. We don’t see the reason and guidance to just approve one Rel-17 OTA proposal.Other comments received by email discussion and offline discussion:* The current FR2 OTA testing is enough and not essential
	+ As presented in RP-202632, this is a leftover item from Rel-15 and -16. Besides, there are operator specific KPIs about beam related UE performances in field especially because UE performance in dynamic environment is out of the current 3GPP FR2 certification/compliance test coverage
* An increase in test cost
	+ With the current objective i.e., UE orientation based, most likely reuse FR2 3D MPAC system. And cost aspect is clearly stated in the objective.

Hope the above feedback and down-scope version of SID is acceptable for companies. |
| Intel | 1) For the detailed objectives we suggest to further clarify that new test methods focus on the RRM and Demodulation requirements testing.2) On Issue #3 mentioned above, we share the view that timing of this work shall be further clarified taking into account FR2 MIMO OTA progress/conclusions. Some slow start in the 2nd half of the year or during the performance stage can be considered.3) On Issue #4, based on the discussion in the email thread on 52.6-71GHz OTA test methods many companies prefer to treat mmWave OTA test methods in a coordinated manner under umbrella of a single SI (with majority preference to use FR2 Test methods enhancements SI). We think that same approach can be used for Dynamic OTA testing (e.g. merge the objectives into FR2 Test Methods enhancements SI). This is the task we can perform in RAN #91 to have a clear scope of the work. |
| China Unicom | We think the radiated metrics and test methodology for FR2 NR UEs under dynamic test environment is needed for study. We support to study on this.  |
| MTK | We are not clear about the additional benefit we can get from this dynamic testing methodology, compared with what we had in Rel-15/16. In our view, when UE is rotating, the critical factors to guarantee smooth TX/RX beam switching are 1) how fast UE can identify a better Tx beam and Rx beam and then report the L1-RSRP to network, and 2) how fast UE can switch its Rx/Tx beam according network’s indication of TCI-state switch or spatial relation switch.Factor 1) is already covered by existing L1-RSRP measurement procedure test in current TS38.133 Section 7.6.3.1. In this test, the signal power of SSB#1 is –infinity during T1 and -87dBm/120KHz during T2. Assuming UE has no idea on which AoA TE transmits SSB#1 and has no knowledge of the exact time boundary between T1 and T2, in order to pass this test, UE already needs to search for SSB#1 with different Rx beams timely all the time. Factor 2) is already covered by TCI-state switch test case in Rel-15 and ongoing spatial relation switch test case in Rel-16. Therefore, we would like to first understand more what we are going to achieve on top of what we already have in Rel-15/16 test cases. |
| CAICT | For dynamic scenario, the channel model is different from TR38.827, which means new channel model validation procedure and pass/fail limits for validation need to be considered. As for the scope, we are open to further discuss. |
| Samsung | General comments for all OTA proposals in REl-17: In Rel-17, besides already approved SI on FR2 test methods and WI on MIMO OTA, there are the following OTA related proposals 1) SISO OTA 2) Dynamic OTA 3) 60GHz OTA. As tasked by RAN chair, we are supposed to down-scope the objectives for overall OTA work given the same group of delegates are supposed to cover all these OTA test methods related objectives. For 60GHz OTA, based on approved WI, RAN4 will definitely define the RF requirements for 52.6GHz – 71GHz. Given that, test methods cannot be removed from Rel-17 scope. The remaining issue for approval such objective is whether we are going to accommodate such objective in existing SI or a new SI. From our perspective, we are fine with either way. Therefore, if 60GHz OTA is approved in REl-17 RAN4 work plan, we have already had three major objectives in Rel-17. We need to be very careful about introducing any additional OTA related objectives in Rel-17 considering RAN4 workload and fact that same group of delegates will follow OTA related proposals.  |
| China Telecom | With the purpose of guaranteeing FR2 UE performance in mobility and rotation status, we support the study. |
| Qualcomm | Response to MTK’s comments.Firstly, we are very disappointed to see these comments now. We are doing the fine tuning at this stage. We believe we have explained the necessity/benefit in our previous email discussion and RAN4/ RAN-P motivation papers.All the current test cases regardless of RRM and MIMO OTA has the following restrictions. 1). The testing directions and UE orientation are pre-defined, and they are fixed during the testing. 2). Enough dwell time is given. 3). No-concurrent active Tx beam. The above restrictions make FR2 test results too optimistic and the beamforming for Tx/Rx are not well verified. In addition, as we listed in RP-202632, the current static test method could not satisfy operator specific field requirements on BM. In general, there is no test case to show if UE can do the beam switching seamlessly. Moreover, there is no test case to verify UE end-to-end T-put with Rx beam switching.  |

### Summary

Several companies expressed their views. Some comments are related to other items, relative priority or how to structure OTA discussions overall. This could be a separate discussion in itself, however, this e-mail discussion should focus on the scope/objectives of the proposed WID.

There was a comment about the usefulness of this proposal, such basic comments on the motivation should have been raised in the first round of e-mail discussion.

The proponents have agreed to downscope the proposal to what was Phase 1. This should address most of the comments on the scope that were previously made. The proponents should further clarify the relationship with the ongoing FR2 MIMO OTA item and whether there is any dependency foreseen. The discussion should continue based on the downscoped proposal.

### Main Points for Discussion – final round

Companies should express their opinions/comments related to the following main points based on the downscoped proposal above. The proponents are also involved to clarify the relationship with the FR2 MIMO OTA item.

1. Comments to fine tune the objectives

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| Company | Comments |
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### Summary after final round

## NR FR1 UE SA and EN-DC TRP and TRS

### Proposed WI scope

The proposed scope of the WI is given below:

### Objective of Core part WI

The objective of this Work Item is to extend SISO OTA methodology defined in TR37.902 to NR FR1 (NR SA and EN-DC) and to specify FR1 TRP and TRS performance requirements for both SA and EN-DC UEs.

Investigate and specify the following aspects:

* **General aspects**

- Considering the following device types:

- Smartphone

* Considering UEs with antenna configurations of 1Tx, 2Tx, 2 Rx and 4 Rx

- Tablet

- Laptop embedded equipment (LEE)

- Laptop mounted equipment (LME)

- Test scenarios:

- For smartphone, head/hand phantoms testing configuration is the first priority

- For other device types,

- Free space (FS) testing configuration is the first priority

- OTA performance requirements with head/hand/Laptop ground plane phantoms are second priority

- Environmental conditions:

- Normal temperature and voltage test conditions

* **SISO OTA Test methodology enhancement**

- Specify necessary enhancements of the SISO OTA test methodology for NR FR1 TRP and TRS, e.g.

- Using the test methodology defined in TR37.902 as well as the associated aspects related to measurement uncertainty in TR25.914 and section 4.2 of TS 37.144 as the basis for NR FR1

- Support UE operating frequency in the range of 410 MHz – 7125 MHz (i.e., test methods will cover all the NR FR1 bands)

- Support up to 100 MHz CBW

- Define the configured power settings for EN-DC (1 CC LTE with 1 CC NR)

- Develop the Measurement Uncertainty (MU) assessment [RAN5]

* Measurement Uncertainty (MU) aspects will be handled by RAN5 and the conclusions can be captured in a separate section of TR

- Consider UE with multi-antenna under SISO OTA Test Methodology, e.g.

- Study whether a test procedure for UL Transmit Diversity of SA, if this feature is supported by UE, is needed

* This task shall not start until RAN4 concludes on all of the corresponding requirements related to UL Transmit Diversity of SA

- Consider how to treat the UE with Tx switching and ensure predictable verification of TRP results

- Consider how to treat the UE with multiple antenna receivers and ensure predictable verification of TRS results

- Consider whether exceptional requirements to be tested for EN-DC TRS is needed, this will be treated as second priority

- Example: NSA TRS requirements for potential UE self-interference due to IMD3 in EN-DC

- Consider the testing time reduction for TRP and TRS among the bands and EN-DC band combinations that UE support

- Example: Alternative Single Point Offset TRP/TIS Test is not precluded

During the course of this work item, ongoing communication with 3GPP RAN WG5, CTIA OTA Working Group, CCSA TC9 WG1, GCF, ETSI MSG TFES and PTCRB shall be maintained to ensure industry coordination on this topic.

### Objective of Performance part WI

* **Performance part framework**
* Define a framework on how to handle requirements task for SA and EN-DC TRP and TRS before collecting trustable UE measurement results, the requirements task will follow the framework strictly, e.g.

- Main actions in the framework in sequence:

* Requirements task should be a step-by-step approach, bands selected as first priority in the WID will be defined for the first step
* Decide the minimum number of devices (e.g., at least [20 or 25]) for defining requirements
* Start lab alignment activity among volunteered certified labs before collecting measurement results
* Select sufficient devices those are commercially available in the market, and the measurement results of these devices from the aligned labs should be submitted for data processing
* Specify the requirements based on the measurement results with a per-band approach

- Start with one type of device requirement which is most efficient to collect enough results

- Only specify 4Rx requirement for n41, n78, n79

- Specifying requirements of SA with 1 CC is the first priority

- Define clear process of submitting and processing the measurement results (e.g. example decide which entity collects and manages the data)

* **Specify final requirements**
* Specify the NR FR1 SISO SA TRP and TRS requirements and tolerance:

- Band n41, n78, [n28] and n79 for PC3 *and PC2* UEs are the first priority

- Define the detailed requirements of the selected bands based on the conclusion of above requirement definition framework

* Specify the FR1 EN-DC TRP and TRS requirements and tolerance:

- For EN-DC, only NR requirements will be specified and no additional LTE requirements will be introduced.

- Only consider EN-DC combinations of 1 CC LTE with 1 CC NR

- Band n41, n78, [n28] and n79 related EN-DC band combinations for PC3 UEs are the first priority

- Further limiting the number of EN-DC band combinations

- Define the detailed requirements of the selected bands based on the conclusion of above requirement definition framework

### Main points for discussion

Companies should express their opinions/comments related to the following main points.

1. Comments to fine tune the objectives
2. What could be streamlined/downscoped to limit the number of Tus per meeting

### Companies’ Comments

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| --- | --- |
| Company | Comments |
| Company A | xxxx |
| Company B | xxxx |
| Apple | We comment on the stability of the FR1 TRP/TRS WID scope, which is well summarized in the pre-RAN email discussion summary [RP-202629].Four major issues have been identified by the moderator, which are: 1) how to structure the work plan in terms of methodology and requirements, 2) which bands to handle, 3) wording around methodology for OTA testing of EN-DC, and 4) how to handle Tx diversityWe agree with the moderator that handling of Tx diversity can be de-prioritized, which removes issue #4 as a blocking issue toward the WID’s approval.Issue #2 is very much business as usual in RAN4, when we consider past OTA experience. No band should be precluded from having OTA requirements defined, operators should be able to rely on the process to define OTA requirements for their bands, and from the work plan perspective there might be some phasing of band handling due to the need to perform lab alignment measurements, collection of data sets from multiple companies, etc. Thus, we don’t view issue #2 as a show stopper, and it has been useful to collect feedback from operators to understand their priorities.Issue #3 seems to be related to word smithing of the objective related to EN-DC measurement methodology and does not seem to involve a fundamental technical concern with the approach. No company comments propose to remove EN-DC from the scope of the work, and it is a fact that no TRP/TRS procedures are defined in any 3GPP document for EN-DC UEs.Thus, the main point of contention is Issue #1, and our understanding is that the fundamental concern comes from some operators who are wary of past experience with LTE TRP/TRS for handheld UEs, where RAN4 did not achieve consensus on requirements. We do observe that not all operators share this concern, but the concern should be resolved nonetheless in order to allow the WID to be added to the 3GPP work plan. Attempts to resolve this concern have ranged from wording suggestions to the WID objectives (the “famous” note, the proposal to reduce the WID scope down to just test methodology objectives, and the new note about RAN/RAN4/RAN5 leadership guidance). Our observation here is that the original “famous” note proposed a structured work flow between RAN4 and RAN5 and is, perhaps, the least acceptable solution to the “wary” camp of operators, since it provided no “guard rail” in case discussions on requirements fail to converge. On the other hand, the approach to develop only test methodology is the least acceptable solution for companies interested in developing OTA requirements: it was originally proposed a year ago in the form of a RAN5-led SI, was not approved by RAN, and served as the starting point for the TRP/TRS scoping discussions we are engaged in today. In our view, the WID proponent’s suggestion to rely on the RAN/RAN4/RAN5 leadership is an excellent solution and reflects the spirit of compromise we rely on in 3GPP to make steady progress with all RAN requirements.In summary, we believe that the TRP/TRS work item scope is quite stable as proposed in RP-202814 and should be given consideration in the fine-tuning for OTA items. |
| CMCC | We support the SISO OTA objectives.From the perspective of CMCC, this WID can meet the deployment request of operators, and the WID scope is stable. |
| Qualcomm | We support this WI. With pre-RAN email discussion, we think the current WID is stable. |
| China Unicom | We support for the SISO OTA objective and the scope of the WID is quite stable now. |
| Intel | We support this item and objectives. The scope is stable.With respect to down-scoping we prefer to deprioritize “test procedure for UL Transmit Diversity of SA” |
| Vodafone | Actually now we can accept starting this FR1 OTA work on the understanding that we aim to make fast progress on the test methodology and establishing the test campaign. In the meantime we would also be happy to start some tentative discussions around potential requirement values just to get an idea of whether there is likely to be some convergence. In order to streamline, we hope that the initial focus will be on smartphones, and discussions on other device types should not hold back progress on that. We also need to consider EN-DC and Standalone operation together.We proposed to add n28, but okay to confirm inclusion at the next meeting if some companies need more time to check that. |
| Xiaomi | We think the scope in the current version is quite stable, and would like to support this WID for SISO TRP&TRS for FR1. |
| SoftBank | Regarding the inclusion of low band (i.e. n28) in the WID, we originally had a concern. But we are OK to consider further given that this is a strong request from operator friends. We would request to come back at RAN#91e on this point to allow us to further check because this is a new proposal brought up this week.  |
| R&S | The scope and objectives for SISO OTA have been developed for more than a year providing current WID in RP-202814 as the stable consolidation of inputs from many companies and addressing most concerns to the date. Therefore, we support current WID. |
| MTK | We support the WID and also think the current version is quite stable. |
| Huawei, HiSilicon | We support the SISO OTA WI objectives and think that the WID is stable enough. |
| CAICT | We support this WI. After adequate discussion, the WID scope is quite stable. As reference lab, CAICT participated in the requirements development at LTE MIMO OTA phase. At NR phase, we would like to contribute testing efforts on FR1 TRP/TRS in R17 timeline. |
| Nokia | In the interests of keeping the work scope manageable, we would suggest to prioritise first specifying the NR FR1 SISO SA TRP and TRS requirements and tolerance. |
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### Summary

Based on the comments from the large majority of companies, the proposed objectives are stable. No further discussion on the scope is needed.

Whether or not to add any other bands to the work can be discussed in a subsequent meeting, this should not affect the progress of the work in the beginning.

# Conclusion

# References

1. RP-202634, “New SID on Study on radiated metrics and test methodology for FR2 NR UEs under dynamic test environment”, Qualcomm Incorporated
2. RP-202814, “New WID: Introduction of UE TRP (Total Radiated Power) and TRS (Total Radiated Sensitivity) requirements and test methodologies for FR1 (NR SA and EN-DC)”, Vivo, Oppo, CMCC, CAICT, Rohde & Schwarz