3GPP TSG-RAN WG4 Meeting # 112 R4-2413434

**Maastricht, Netherlands, 19th – 23rd August, 2024**

**Agenda item:** 8.13.3

**Source:** Qualcomm Incorporated

**Title:** Topic summary for [112][334] NR\_FR2\_OTA

**Document for:** Information

# Introduction

*Briefly introduce background, the scope of this email discussion (e.g. list of treated agenda items) and provide some guidelines for email discussion if necessary.*

The summary is to summarize the open issues for Rel-19 SI on NR FR2 OTA testing Phase 3. The summary covers the contributions submitted under the following agendas:

* 8.13 Study on NR FR2 OTA (Over the Air) testing enhancement Phase 3
	+ 8.13.1 General aspects
	+ 8.13.2 RF testing methodology for FR2 non-handheld UE that can transmit simultaneously with multi-panel

# Topic #1: Test method for STxMP

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411531 | Rohde & Schwarz | **Observation 1:** No synchronisation errors are observed for up to 40 dB difference in signal power.**Proposal 1:** RAN4 shall conclude that the test of the STxMP is feasible up to a power difference of 40 dB.**Observation 2:** MU needs further investigation especially for in case of a large power imbalance.**Observation 3:** Channel estimation of the TE based on the DMRS of the signal under test can be used to measure the power of the signal under test.**Proposal 2:** Detailed MU analysis can be left to RAN5 to take into account the exact Test Case parameters. |
| R4-2411698 | Samsung | **Proposal 1: confirm the feasibility and agree on the configuration of rank 2 PUSCH transmission in EIRP measurement of STxMP under SDM scheme.****Proposal 2: for PUMAX,f,c,k (peak EIRP per TCI), re-use the UE declared AoA separation and orientation of Multi-RX.****Observation 1: the mapping relationship “panel1-TCI1-probe1, panel2-TCI2-probe2” need to be kept unchanged and no swap during the whole 3D scan****Proposal 3: further study how to keep the mapping relationship between panels and probes unchanged (no swap) during 3D scan****Proposal 4: consider 0.5dB as additional margin for EIRPmax and TRPmax test skipping rule,** **i.e., “If the peak EIRP and TRP of single carrier is no greater than EIRPmax – 3.5dB or TRPmax – 3.5dB, the corresponding EIRPmax or TRPmax verification can be skipped”** |
| R4-2412072 | vivo | **Observation 1:** The configured transmission power is verified by testing MOP, MPR, A-MPR respectively.**Observation 2:** The MPR requirement is relaxed by 3dB in RF spec to ensure the total radiated power of UE will not exceed the situation when only one antenna module is activated, so the UE can meet MPR of single carrier without any additional effort.**Proposal 1:** The MPR/A-MPR is not need to be verified during the test of the configured transmission power.**Observation 3:*** Even with peak search of sTxMP, the peak direction always aligns with peak direction of single antenna module.
* Due to the TE can only implemented with several fixed AoA offset, it is impossible to ensure TE can find two peak directions from arbitrary AoAs. For example, the case above require AoA offset =155°
* Under proper UE orientation and AoA offset, a AoA pair that close to the peak for each antenna module can be found, as the green part above.

**Proposal 2:** The following method is agreed to be used for sTxMP testing: For the selection of AoA pair, one of AoA is at the beam peak direction of single CC operation without STxMP enable (from Beam Peak Search for MOP in 6.2 of TS 38.101-2), another AoA is decided by UE declared orientation (listed in TS38.101-2) and AoA pair from set of {30deg, 60deg, 90deg, 120deg, 150deg} |
| R4-2412919 | Qualcomm Incorporated | **Observation 1: For multi-Tx UL measurement, since rank 2 PUSCH transmission under SDM scheme (i.e., one layer per TCI) is configured and DMRS resources are orthogonal for TCI1 and TCI2, TE should be able to decode and measure EIRP per TCI.****Proposal 1: RAN4 concludes not to specify signal level conditions and assumes EIRP can be distinguished per TCI in STxMP testing.****Proposal 2: RAN4 further study the feasibility of Option 2 assuming that test system defined in TR 38871 is used.****Proposal 3: Legacy PC1 and PC5 constant step size measurement grid for beam peak search defined in Annex M.2 of TS38.521-2 can be reused for Option 1 and Option 2.****Proposal 4: RAN4 to consider UE declaration on the peak directions, i.e., no beam peak search procedure.****Proposal 5: If the DUT cannot pass the skipping rule, i.e., peak EIRP of single CC operation is larger than EIRPmax - 3dB - additional margin, the beam peak directions selected in EIRP PUMAX,f,c,k testing is reused in EIRPmax testing if Option 2 is adopted. FFS on Option 1 and Option 3.****Proposal 6: If the DUT cannot use the skipping rule, i.e., peak TRP of single CC operation is larger than TRPmax - 3dB - additional margin, the beam peak directions selected in EIRP PUMAX,f,c,k testing is reused if Option 2 is adopted. FFS on Option 1 and Option 3.****Proposal 7: The legacy PC1 and PC5 constant step size measurement grid for TRP defined in Annex M.4 of TS38.521-2 can be used in TRPmax testing.** |
| R4- 2413198 | Nokia | **Observation 1:** Record the EIRPmax and TRPmax of joint transmission based on joint TCI states for each AoA pair set for the whole spherical test is a straightforward method.**Observation 2:** Resue of the same set up of OTA test equipment in multi-Rx is also very cost-efficient.**Proposal 1**: Record the EIRPmax and TRPmax of joint transmission based on joint TCI states for each AoA pair set for the whole spherical test can be illustrated as a similar table compared with Multi-Rx requirement:

|  |  |  |
| --- | --- | --- |
| AoA separation (degrees) | EIPRmax (dBm) | TRPmax (dBm) |
| 30 | highest measured value | highest calculated value |
| 60 | highest measured value | highest calculated value |
| 90 | highest measured value | highest calculated value |
| 120 | highest measured value | highest calculated value |
| 150 | highest measured value | highest calculated value |

**Observation 3**: TRPmax can be calculated based on EIRP OTA measurement data.**Proposal 2**: No need to redefine TRP OTA tests, the TRPmax verification can be done together with EIRPmax verification. **Observation 4**: Addition margin is agreed to be added to avoid the slightly change of antenna radiation pattern of one panel when the other panel is activated. **Observation 5**: There is huge amount of UEs from different vendors in the market, such impact of radiation patterns between two activated antennas can vary significantly. **Proposal 3**: Suggest the addition margin is 3dB due the variety of UE designs in the market.  |
| R4-2413263 | Qualcomm Incorporated | **Skeleton of TR 38.xyz: Study on NR frequency range 2 (FR2) OTA (Over the Air) testing Phase 3** |

## Open issues summary

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

### Sub-topic 1-1: Per-TCI EIRP measurement

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 1-1-1: Signal level condition for measuring/distinguishing EIRP per TCI**

* Proposals
	+ Proposal 1 (R&S): The test of STxMP is feasible up to a power difference of 40dB. Detailed MU analysis can be left to RAN5 to take into account the exact Test Case parameters.
	+ Proposal 2 (Samsung): Confirm the feasibility and agree on the configuration of rank 2 PUSCH transmission in EIRP measurement of STxMP under SDM scheme.
	+ Proposal 3 (Qualcomm): RAN4 concludes not to specify signal level conditions and assumes EIRP can be distinguished per TCI in STxMP testing.
* Recommended WF
	+ RAN4 confirms the feasibility of measuring EIRP per TCI with the configuration of rank 2 PUSCH transmission under SDM scheme.
		- A power difference of [40dB] is assumed.
		- Detailed MU analysis can be left to RAN5 if needed, taking into account the exact Test Case parameters.

### Sub-topic 1-2: Test method for EIRP PUMAX,f,c,k testing

**Issue 1-2-1: AoA separation and UE orientation for EIRP PUMAX,f,c,k testing**

* Proposals
	+ Proposal 1 (Samsung): For PUMAX,f,c,k (peak EIRP per TCI), re-use the UE declared AoA separation and orientation of Multi-RX. Further study how to keep the mapping relationship between panels and probes unchanged (no swap) during 3D scan.
	+ Proposal 2 (vivo): For the selection of AoA pair, one of AoA is at the beam peak direction of single CC operation without STxMP enable (from Beam Peak Search for MOP in 6.2 of TS 38.101-2), another AoA is decided by UE declared orientation (listed in TS38.101-2) and AoA pair from set of {30deg, 60deg, 90deg, 120deg, 150deg}.
		- *Moderator’s note: Another AoA is declared by UE and no search procedure is needed.*
	+ Proposal 3 (Qualcomm): RAN4 to consider UE declaration on the peak directions, i.e., no beam peak search procedure.
		- *Moderator’s note: The specific test directions, i.e., [theta, phi], AoA pair and UE orientation are declared by UE.*
* Recommended WF
	+ Further discuss the above proposals from feasibility and complexity, etc., aspects.

**Issue 1-2-2: Applicability of ΔMPRSTxMP, MPR and A-MPR for EIRP PUMAX,f,c,k testing**

* Proposals
	+ Proposal 1 (vivo): The MPR requirement is relaxed by 3dB in RF spec to ensure the total radiated power of UE will not exceed the situation when only one antenna module is activated, so the UE can meet MPR of single carrier without any additional effort. The MPR/A-MPR is not need to be verified during the test of the configured transmission power.
* Recommended WF
	+ Discuss whether the fixed value of ΔMPRSTxMP = 3dB applies for EIRP PUMAX,f,c,k, EIRPmax and TRPmax verification.
	+ If the fixed value of ΔMPRSTxMP = 3dB applies for EIRP PUMAX,f,c,k, EIRPmax and TRPmax verification, to further discuss whether EIRPmax, TRPmax and MPR/A-MPR test can be skipped since it can be covered by legacy single Tx measurement.

**Issue 1-2-3: Measurement grid for EIRP PUMAX,f,c,k testing**

* Proposals
	+ Proposal 1 (Qualcomm): Legacy PC1 and PC5 constant step size measurement grid for beam peak search defined in Annex M.2 of TS38.521-2 can be reused for Proposal 1 in Issue 1-2-1.
* Recommended WF
	+ Further discuss measurement grid for EIRP PUMAX,f,c,k testing based on the conclusion in Issue 1-2-1 and Issue 1-2-2.

### Sub-topic 1-3: Test method for EIRPmax

**Issue 1-3-1: AoA separation and UE orientation EIRPmax testing**

* Proposals
	+ Proposal 1 (Qualcomm): If Proposal 2 in Issue 1-2-1 is agreed, the beam peak directions selected in EIRP PUMAX,f,c,k testing can be reused. FFS on other proposals in Issue 1-2-1.
	+ Proposal 2 (Nokia): Record the EIRPmax and TRPmax of joint transmission based on joint TCI states for each AoA pair set for the whole spherical test can be illustrated as a similar table compared with Multi-Rx requirement:

|  |  |  |
| --- | --- | --- |
| AoA separation (degrees) | EIPRmax (dBm) | TRPmax (dBm) |
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| 90 | highest measured value | highest calculated value |
| 120 | highest measured value | highest calculated value |
| 150 | highest measured value | highest calculated value |

* + Proposal 3 (Moderator): If the fixed value of ΔMPRSTxMP = 3dB applies for EIRP PUMAX,f,c,k, EIRPmax and TRPmax verification, EIRPmax test can be skipped.
* Recommended WF
	+ Need further discussion considering the conclusion in and 1-2-2.

**Issue 1-3-2: Additional margin for skipping rule for EIRPmax testing**

* Proposals
	+ Proposal 1 (Samsung): Consider 0.5dB as additional margin for EIRPmax test skipping rule.
	+ Proposal 2 (Nokia): Suggest the addition margin is 3dB due the variety of UE designs in the market.
* Recommended WF
	+ Further discuss additional margin considering the conclusion in Issue 1-3-1.

*Moderator’s note: the following agreements were made in RAN4#111.*

|  |
| --- |
| ***Issue 1-5-1: Skipping rule for EIRPmax testing**** *Agreements:*
	+ *RAN4 agree on the skipping rule proposal for EIRPmax, i.e., “If the peak EIRP of single CC operation without STxMP (from Peak EIRP for MOP in 6.2 of TS 38.101-2) is smaller than EIRPmax - 3dB –additional margin , the corresponding EIRPmax verification can be skipped”.*
		- *Further check on the handling of the test case skip as part of conformance test. FFS on additional margin, such as systematic error of beam peak search, etc.*
		- *The slightly change of antenna radiation pattern of one panel when the other panel is activated if any, which might varry the test results of EIRPmax, can be compensated by addition margin.*
 |

### Sub-topic 1-4: Test method for TRP PTMAX,f,c

**Issue 1-4-1: AoA separation and UE orientation TRPmax testing**

* Proposals
	+ Proposal 1 (Qualcomm): If Proposal 2 in Issue 1-2-1 is agreed, the beam peak directions selected in EIRP PUMAX,f,c,k testing can be reused. FFS on other proposals in Issue 1-2-1.
	+ Proposal 2 (Nokia): No need to redefine TRP OTA tests, the TRPmax verification can be done together with EIRPmax verification.
	+ Proposal 3 (Moderator): If the fixed value of ΔMPRSTxMP = 3dB applies for EIRP PUMAX,f,c,k, EIRPmax and TRPmax, TRPmax test can be skipped.
* Recommended WF
	+ Need further discussion considering the conclusion in Issue 1-2-2.

**Issue 1-4-2: Additional margin for skipping rule for EIRPmax testing**

* Proposals
	+ Proposal 1 (Samsung): Consider 0.5dB as additional margin for TRPmax test skipping rule.
	+ Proposal 2 (Nokia): Suggest the addition margin is 3dB due the variety of UE designs in the market.
* Recommended WF
	+ Further discuss additional margin considering the conclusion in Issue 1-4-1.

*Moderator’s note: the following agreements were made in RAN4#111.*

|  |
| --- |
| ***Issue 1-6-1: Skipping rule for TRPmax testing**** *Agreements:*
	+ *RAN4 agree on the skipping rule proposal for TRPmax, i.e., “If the peak TRP of single CC operation without STxMP (from TRP for MOP in 6.2 of TS 38.101-2) is smaller than TRPmax - 3dB – additional margin[], the corresponding TRPmax verification can be skipped”.*
		- *Further check on the handling of the test case skip as part of conformance test. FFS on additional margin, such as systematic error of beam peak search, etc.*
		- *The slightly change of antenna radiation pattern of one panel when the other panel is activated if any, which might vary the test results of* *TRPmax, can be compensated by addition margin.*
 |

**Issue 1-4-3: Measurement grid for TRPmax testing**

* Proposals
	+ Proposal 1 (Qualcomm): The legacy PC1 and PC5 constant step size measurement grid for TRP defined in Annex M.4 of TS38.521-2 can be used in TRPmax testing.
* Recommended WF
	+ Further discuss additional margin considering the conclusion in Issue 1-4-1.

### Sub-topic 1-5: TR Skeleton

**Issue 1-5-1: TR Skeleton**

* Proposals
	+ Proposal 1 (Qualcomm): To discuss and approve the TR skeleton in R4-2413263.
* Recommended WF
	+ Approve the TR skeleton in R4-2413263.

# Topic #2: Test method for VSAT

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2413229 | Eutelsat Group | **Propoasl1: It is proposed to discuss [4] at RAN4 #112 towards presenting an updated version of [4] at RAN #105 in September.**[4] R4-2413125 New SID on VSAT test methods (Eutelsat Group, RAN4 #112 Maastricht Aug 2024) |

## Open issues summary

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

### Sub-topic 2-1: Test method for VSAT

*Sub-topic description*

*Open issues and candidate options before meeting:*

**Issue 2-1-1: Test method for Ka and Ku band VSAT**

* Proposals
	+ Proposal 1 (Eutelsat): It is proposed to discuss [4, R4-2413125] at RAN4 #112 towards presenting an updated version of [4, R4-2413125] at RAN #105 in September.
* Recommended WF
	+ Collect companies’ views. The decision should be made by the plenary.