**3GPP TSG-RAN WG4 Meeting #111 R4-2410128**

**Fukuoka City, Fukuoka, Japan, 20th – 24th May, 2024**

**Agenda item:** 10.4.3

**Source:** Moderator (vivo)

**Title:** Topic summary for [111][338] TRP\_TRS\_MIMO\_OTA

**Document for:** Information

# Introduction

This summary covers the discussions for Rel-19 OTA WI.

# Topic #1: General

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407061 | Apple | **[draft] LS response to GCF-CAG on 5G NR FR1 OTA Technical Specifications** |
| R4-2408100 | vivo | **Reply LS on 3GPP NR TRP TRS OTA requirements** |

## Open issues summary

### Sub-topic 1-1 General for WI

**Issue 1-1-1: Reply LS to GCF CAG**

* Proposals
  + **Proposal 1: Discuss the reply content to GCF CAG, using R4-2408100 and R4-2407061 as starting point.**
* Recommended WF
  + Discuss and conclude in this meeting

# Topic #2: XR OTA

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2410930 | CTIA | The CTIA Certification OTA NFP Sub-Working Group meeting held on Wednesday May 1st welcomed the request for a collaboration between the groups to develop phantom test methodology for head worn eXtended Reality (XR) devices.  The CTIA Certification OTA NFP Sub-Working Group has already started the development of phantoms for AR/VR devices.  Our scope of work for the proposed development will include:   * Phantom Development * Positioning Guidelines * MU   The group has also noted the 3GPP time scale for the phantom development of September 2025 and our group will expedite this work to try to accommodate this milestone.  We propose to keep RAN4 updated on a regular basis, especially after important design and manufacturing milestones have been reached. |
| R4-2407059 | Apple | **Observation 1: Handheld radiated requirements for no eMBB technology since 3G have been verified in the free space position.**  **Proposal 1: RAN4 should continue to develop XR OTA test methodology for FR1 non-RedCap headworn XR devices.**  **Proposal 2: RAN4 to no longer consider free space testing for headworn XR devices.** |
| R4-2407104 | Huawei, HiSilicon | **Proposal 1**: the parameter cellBarred2RxXR-r18 (ENUMERATED) should be set to {false} during OTA tests for XR devices with 2Rx.  **Proposal 2**: use parameter supportOf2RxXR-r18 to identify XR devices with 2Rx.  **Proposal 3:** exclude free space test for XR devices  **Proposal 4**: in order to save battery power, test TRP at [X] dB below the maximum transmit power and scale up [X] dB to obtain TRP at maximum transmit power.  **Proposal 5**: device types to be tested are limited to under [X] grams. |
| R4-2407896 | Samsung | **Proposal 1: free space testing of hear-worn XR devices is not specified as test method for conformance**  **Proposal 2:** **RAN4 to discuss if head-worn XR devices with external 5G (e.g.** **XR5G-V1/V2/V3, XR5G-A1/A2/A5) are in scope or not.** |
| R4-2407997 | Facebook Japan G.K. | **Proposal 1: *The defined test methodologies of TRP/TRS for FR1 non-Redcap XR devices shall be applied to all possible 5G XR device types except the XR device form-factors based on smartphone UE i.e. XR5G-P1 in figure 1.***  **Proposal 2: *RAN4 needs to define the explicit XR test mode based on XR device usage scenarios and environments.***  **Proposal 3: *For Free space test methodology, we are prefer not to decide the 2nd priority in XR OTA scope. RAN4 only focus on definition of test methodology for head phantom scenarios in Rel-19.***  **Proposal 4: *RAN4 can consider using the existing coarse measurement grid points for both horizontal and vertical polarization of XR TRP/TRS measurements for Anechoic Chamber method to consider OTA test time based on the allowed small tolerance of the standard deviation and the mean error.*** |
| R4-2408105 | vivo | **Proposal 1: RAN4 should also consider Free Space scenario for XR devices. The positioning guideline and corresponding UE mechanical mode description should be defined.**  **Proposal 2:** **RAN4 can consider low transmission power configuration (e.g., 13dBm) for XR device TRS testing.** |
| R4-2408691 | Nokia | **Observation 1**: The output power levels of the XR devices can be used to separate the XR types, which also reflects the size, shape, and possible battery capacity.  **Proposal 1**: It is suggested to separate the XR devices by type-A and type-B, which Type-A power class XR devices should have a higher output power level than Type-B power class XR devices. |
| R4-2408904 | OPPO | ***Proposal 1: RAN4 focuses on head phantom scenario for XR OTA test.***  ***Proposal 2: If head phantom is identified as not feasible, Free space scenario can be considered as*** ***backup solution.***  ***Proposal 3:*** ***Take 1Tx XR device OTA test methodology as 1st priority in R19 WI.*** |
| R4-2409187 | CAICT, SAICT | ***Observation 1: The main or even the only usage scenario of headworn XR devices is wearing them on the head, and there is currently no usage state working in free space.***  **Proposal 1: Focus on headworn scenario for XR OTA test methodology development. Only when the technical feasibility of implementing the head phantom testing setup is considered unattainable, will further consideration be given to whether to consider the free space testing scenario as a secondary option.**  **Proposal 2:** **The feasibility of using the existing coarser measurement grid as a potential solution to reduce XR OTA testing time needs further study. Input from companies is encouraged.** |

## Open issues summary

### Sub-topic 2-1 XR test scnarios and configurations

**Issue 2-1-1: XR device type**

* Proposals
  + **Proposal 1: device types to be tested are limited to under [X] grams. (Huawei)**
  + **Proposal 2: RAN4 to discuss if head-worn XR devices with external 5G (e.g. XR5G-V1/V2/V3, XR5G-A1/A2/A5) are in scope or not. (Samsung)**
  + **Proposal 3: The defined test methodologies of TRP/TRS for FR1 non-Redcap XR devices shall be applied to all possible 5G XR device types except the XR device form-factors based on smartphone UE i.e. XR5G-P1 in figure 1. (Meta)**
  + **Proposal 4：It is suggested to separate the XR devices by type-A and type-B, which Type-A power class XR devices should have a higher output power level than Type-B power class XR devices. (Nokia)**
* Recommended WF
  + TBD.

**Issue 2-1-2: Whether consider Free-space-based XR test scenarios in RAN4**

* Proposals
  + **Option 1: Yes, as guidance to the industry, or backup solution.**
  + **Option 2: No**
* Recommended WF
  + Discuss based on CTIA reply LS

**Issue 2-1-3: How to identify 2Rx-XR device?**

* Proposals
  + **Proposal 1: The parameter cellBarred2RxXR-r18 (ENUMERATED) should be set to {false} during OTA tests for XR devices with 2Rx. Use parameter supportOf2RxXR-r18 to identify XR devices with 2Rx. (Huawei)**
* Recommended WF
  + TBD

**Issue 2-1-4: TRP TRS test method for XR**

* Proposals
  + **Proposal 1: RAN4 needs to define the explicit XR test mode based on XR device usage scenarios and environments. (Meta)**
  + **Proposal 2: Take 1Tx XR device OTA test methodology as 1st priority in R19 WI. (OPPO)**
* Recommended WF
  + TBD

### Sub-topic 2-2 Testing time reduction for XR OTA

**Issue 2-2-1: alternative test configurations for Testing time reduction solutions**

* Proposals
  + **Proposal 1: RAN4 can consider low transmission power configuration (e.g., 13dBm) for XR device TRS testing. (vivo)**
  + **Proposal 2: RAN4 can test TRP at [X] dB below the maximum transmit power and scale up [X] dB to obtain TRP at maximum transmit power. (Huawei)**
* Recommended WF
  + consider both Proposal 1 and Proposal 2

**Issue 2-2-2: Coarse measurement grids**

* Proposals
  + **Proposal 1: RAN4 can consider using the existing coarse measurement grid points for both horizontal and vertical polarization of XR TRP/TRS measurements for Anechoic Chamber method to consider OTA test time based on the allowed small tolerance of the standard deviation and the mean error. (Meta)**
  + **Proposal 2: The feasibility of using the existing coarser measurement grid as a potential solution to reduce XR OTA testing time needs further study. Input from companies is encouraged. (CAICT)**
* Recommended WF
  + TBD

# Topic #3: NTN OTA

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407060 | Apple | **Observation 1: The “VSAT” category of devise includes a diverse range of device form factors and antenna solutions.**  **Observation 2: For handheld UEs, RAN4 should discuss whether it is feasible to assume that a connection manager assists the user with positioning the device.**  **Proposal 1: RAN4 to** **prioritize the handheld UE device type for Rel-19 NTN OTA work.**  **Proposal 2:** **RAN4 to prioritize the browsing mode (with hand phantom) test condition for NR/IoT NTN devices.**  **Proposal 3:** **NR/IoT NTN radiated requirements shall be verified when Doppler conditions are set to zero and delay conditions are set to constant for all types of satellites.**  **Proposal 4:** **RAN4 shall strive to specify a single set of OTA requirements applicable to both GSO and NGSO types of UEs.**  **Proposal 5:** **RAN4 shall strive to match the bands, power class, and test configurations of the IoT/NTN radiated specification with the conducted MOP/REFSENS conditions (TS 36.102 and TS 38.101-5).**  **Proposal 6:** **RAN4 to consider the range of elevation and azimuth angles which have dominant impact on radiated performance of the device under the assumed user interaction scenario as a parameter declared by the manufacturer.**  **Proposal 7:** **RAN4 to consider defining the NTN OTA metric as the outage value corresponding to the Nth percentile of the CDF of EIRP/EIS over the specified range of angles (Nth percentile FFS).** |
| R4-2407105 | Huawei, HiSilicon | **Proposal 1**: test NTN devices in both browsing and talk modes.  **Proposal 2**: consider WRP and WRS defined in R4-2404278 as performance metrics for NTN devices.  **Proposal 3**: consider EIRP and EIS CDF percentile thresholds as performance metrics for NTN devices.  **Proposal 4:** NTN browsing mode is tested with data rate of 3 kbps and NTN talk mode is tested with VoIP with AMR 4.75 kbps.  **Proposal 5**: Decide if above 10 GHz bands are included in the NTN work item or not, because test methodologies or performance metrics may differ.  **Proposal 6**: limit the work scope in the NTN work item to PC3 UE and derive PC2 performance metrics from those of PC3.  **Proposal 7**: limit the scope of NTN work item to bandwidth above 5MHz and derive performance metrics of less than 5 MHz bandwidth from those above 5 MHz bandwidth.  **Proposal 8:** limit the work scope to handheld devices and exclude VSAT type in FR1  **Proposal 9:** limit the work scope to handheld devices and exclude IoT NTN devices from the work scope in FR1  **Proposal 10:** No need to distinguish between GEO and NGEO applications during performance definition  **Proposal 11:** use 5 MHz bandwidth and 15 kHz SCS as test parameters |
| R4-2407798 | Nokia | **withdrawn** |
| R4-2407809 | Xiaomi | **Proposal 1: the following typical UE types can be considered for UE types in R19 when discussing test method.**  **Handheld UE**  **VSAT-like UE（UE fixed and mobile）**  **Vehicle UE**  **Observation 1: NTN UE devices could be classified by antenna gain and spherical coverage.**  **e.g.**  **Type 1 UE: low antenna gain but high spherical coverage.**  **Type 2 UE: High gain but low spherical coverage.**  **Type 3 UE: Medium gain and Medium spherical coverage.**  **Proposal 2:** **Different performance metrics could be considered for different UE types for FR1 UE NTN devices.**  **e.g.**   * **Type 1 UE: integrated power/sensitivity within declared half sphere** * **Type 2 UE: peak EIRP/EIS only** * **Type 3 UE: peak EIRP/EIS + X%-tile spherical coverage within declared the supported elevation angles.** |
| R4-2407897 | Samsung | **Proposal 1: Develop test method and performance metric focusing on handheld UE firstly, and then check if the outcome can be applied to other UE type or not later.**  **Observation 1: radiation pattern affects the final performance dramatically. It would be very challenging to optimize the radiation pattern for all usage scenarios including free space, browsing mode and talk mode.**  **Proposal 2: the usage scenario of talk mode (Beside head and hand) is not necessary to be specified for NTN UE OTA testing**  **Proposal 3: Further discuss which one should be prioritized or down-selected between free space and browsing mode.**  **Proposal 4:** **Further discuss “peak EIRP/EIS + TRP/TRS” as one more option for performance metric candidate of handheld NTN UE.** |
| R4-2408106 | vivo | **Proposal 1: For NR NTN, RAN4 can consider FR1 UE type, e.g., handheld and FR1 VSAT-like device, as 1st priority.**  **Proposal 2:** **For IoT-NTN, RAN4 can consider several UE types, e.g., handheld, sensor, smartwatch, camera, as 1st priority.**  **Proposal 3: Consider the following usage scenarios for handheld device performance metric discussion:**   * **Handheld head+hand talk mode** * **Handheld Hand only talk mode and browsing mode** * **Free space mode** * **Other usage scenarios**   **Proposal 4:** **The following performance metric for handheld devices can be considered as starting point:**   * **Handheld device head+hand talk mode: TRP/TRS and X%-tile spherical coverage within a sector. FFS peak EIRP/EIS** * **Handheld device Hand-only browsing mode and talk mode: Peak EIRP/EIS and X%-tile spherical coverage within a range a spherical sector. FFS TRP/TRS** * **Free space mode: FFS** * **Other usage scenarios: FFS**   **Proposal 5:** **RAN4 decide whether selecting 15MHz (mid test channel BW defined in RAN5 38.508-1) or 10MHz as the CBW for NR FR1 NTN OTA testing.**  **Proposal 6:** **Adding a new positioning guideline for hand only talk mode, i.e., DUT’s main display is aligned with vertical.** |
| R4-2408610 | CAICT. | ***Proposal 1:Consider handheld UE as the first priority for NR NTN and IoT NTN.***  ***Proposal 2:Using O4 and O5 in Issue 3-2-2 of R4-2406086 as the starting point performance metric for NR-NTN.***  ***Proposal 3:******Only free space testing is needed for*** ***UEs with directional antenna with main lobe beamwidth less than 30degree.*** |
| R4-2408692 | Nokia | **Observation 1**: In Rel18, 5 NTN UE types was agreed and together with their support for different satellite orbits.  **Proposal 1:** Follow the Rel18 5 NTN UE types, already different satellite orbits are supported by those UE types.  **Observation 2**: EIPR, EIS and spherical coverage as performance metrics for each NTN UE type can be based on the current Rel18 standardization structure of UE requirements.  **Observation 3**: The NTN UE only communicate with satellites in space, the half-sphere antenna radiation pattern of an NTN device is reasonable.  **Observation 4**: Due to the long distance between the UE on the ground and the satellites in the sky, UE will need to use a beam (i.e. high-gain antenna pattern) to communicate with satellites. It is reasonable to consider the directivity and gain of the antenna radiation pattern in the performance metric of the NTN UE types.  **Proposal 2**: RAN4 shall consider EIPR, EIS, spherical coverage, as well as directivity and gain of the antenna radiation pattern as performance metrics for each NTN UE type, and verify the performance metric for a UE at least with a half sphere. |
| R4-2408905 | OPPO | ***Observation 1: For high orbit satellite, UE is required to have a high gain in the dedicated direction when communicating to the satellite, while other directions are not desired.***  ***Observation 2: For low orbit satellite, UE is required to guarantee the connecting performance in a large angle range over 120 degree on top half of the sphere.***  ***Observation 3: Satellite handover/switching techniques for service continuity of low orbit satellite require UE to have a wide beam to cover the satellite potential visible area.***  ***Proposal 1: It is proposed to define different performance metrics for high orbit satellite communication (such as GEO) and low orbit satellite communication (i.e. LEO).***  ***Proposal 2: Define the directional OTA metrics for NR-NTN using high satellite orbit, and the candidate options are as below. Further down-selection may be needed.***  ***Option 1: Peak EIRP/EIS only***  ***Option 2: Conical TRP/EIRP for Tx and conical TRS/EIS for Rx***  ***Proposal 3: Define the OTA performance metrics covering a wide beam or half sphere for NR-NTN using low satellite orbit, and the candidate options are as below. further down-selection may be needed.***  ***Option 1: Integrated power/sensitivity within declared half sphere***  ***Option 2: Conical TRP/EIRP for Tx and conical TRS/EIS for Rx with large conical apex angle*** |
| R4-2409430 | Qualcomm Incorporated | **Observation 1: VSAT could be either fixed VSAT or mobile VSAT and has many types of UE form factor. It is difficult to study the OTA test method and performance metric before there is a clear definition of VSAT-like device.**  **Proposal 1: RAN4 to prioritize handheld UE for FR1 NR NTN OTA discussion.**  **Proposal 2:** **It is encouraged interested companies to provide input including definition, DUT size, antenna design, etc., to other UE type if any.**  **Proposal 3: RAN4 should discuss the target UE form factors and corresponding size, antenna design, etc., for IoT NTN OTA testing.**  **Proposal 4: For** **GSO scenario, conical TRP/EIRP for Tx and conical TRS/EIS for Rx can be considered as the starting point for the metric of NTN device OTA testing. FFS on the range of q and f.**  **Proposal 5: For NGSO scenario, CDF-like performance metric with hemisphere scan can be considered as the starting point.**  **Proposal 6: In NTN OTA testing, the test method should not limit UE implementation on pol., and whether the antenna is shared or separate from TN antenna. From TE PoV, the test setup should support different UE implementation on the antenna design.**  **Proposal 7: UE vendors are encouraged to provide feedback on the other aspects including TAS, number of Tx antenna, etc, that affect NTN radiated performance.** |
| R4-2409771 | Keysight Technologies UK Ltd | **Observation 1: VSAT or VSAT like devices were not in scope for FR1 NTN in REl-17**  **Observation 2: VSAT-like devices might not fit into the NR FR1 OTA quiet zone of 30 cm.**  **Proposal 1: A clarification is needed whether VSAT or VSAT like devices should be in scope of this WI.**  **Proposal 2: If VSAT like devices are in scope, OEMs/Satellite Operators to provide testability device information for VSAT-like device types, e.g., device size, weight, typical antenna patterns.**  **Proposal 3: OEMs/Satellite Operators to provide testability device information for IoT-NTN device types, e.g., device size, weight, typical antenna patterns.**  **Proposal 4: No longer consider single-directional metrics such as peak EIRP/EIS and/or partial radiated quantities such as the spherical integration over a cone or single hemisphere**  **Proposal 5: Focus on full 3D assessment but allow the antenna performance in one direction/hemishpere to dominate the metric, e.g., spherical coverage with EIRP-CDF and EIS-CCDF at [>50%], weighted TRPs/TRSs, weighted radiated power/sensitivity rather than conventional TRP/TRS.** |

## Open issues summary

### Sub-topic 3-1 UE type and usage scenarios for NTN (NR-NTN and IoT-NTN)

**Issue 3-1-1: UE type for NR-NTN**

* Proposals
  + **Option 1: Prioritize Handheld UE and VSAT-like UE.**
  + **Option 2: Prioritize Handheld UE only.**
  + **Option 3: Prioritize Handheld UE, VSAT-like UE (fixed and mobile), Vehicle UE**
* Recommended WF
  + By default, the OTA WI UE type should be aligned with NTN RF core WIs (closed and/or on-going).

**Issue 3-1-2:** **Alignment on understanding of VSAT-like UE for NR-NTN**

* Proposals
  + **Proposal 1: If VSAT like devices are in scope, OEMs/Satellite Operators to provide testability device information for VSAT-like device types, e.g., device size, weight, typical antenna patterns. (Keysight)**
  + **Proposal 2: It is encouraged interested companies to provide input including definition, DUT size, antenna design, etc., to other UE type if any. (Qualcomm)**
* Recommended WF
  + TBD

**Issue 3-1-3: Power Class for NR-NTN devices**

* Proposals
  + **Option 1: Prioritize PC3. Derive PC2 performance metric based on PC3.**
  + **Option 2: other**
* Recommended WF
  + PC3 in this release.

**Issue 3-1-4: UE type for IoT-NTN**

* Proposals
  + **Proposal 1: For IoT-NTN, RAN4 can consider several UE types, e.g., handheld, sensor, smartwatch, camera, as 1st priority. (vivo)**
* Recommended WF
  + TBA

**Issue 3-1-5: Alignment on understanding of IoT-NTN devices**

* Proposals
  + **Proposal 1: OEMs/Satellite Operators to provide testability device information for IoT-NTN device types, e.g., device size, weight, typical antenna patterns. (Keysight)**
  + **Proposal 2: RAN4 should discuss the target UE form factors and corresponding size, antenna design, etc., for IoT NTN OTA testing. (Qualcomm)**
* Recommended WF
  + TBA

**Issue 3-1-6: Usage scenarios for NR-NTN and IoT-NTN handheld UE**

* Proposals
  + **Option 1: Prioritize the browsing mode (with hand phantom)**
  + **Option 2: Prioritize the browsing mode (with hand phantom) and Free Space**
  + **Option 3: Prioritize browsing mode (with hand phantom) and talk mode (Head+Hand)**
  + **Option 4: Prioritize Head+Hand talk mode, hand only browsing mode and talk mode (new positioning guideline), and Free Space**
  + **Option 5: Prioritize Free Space mode**
* Recommended WF
  + Collecting views on potential scenarios

**Issue 3-1-7: Usage scenarios for NR-NTN VSAT-like UE**

* Proposals
  + **Option 1: FS**
  + **Option 2: other**
* Recommended WF
  + Collecting views on potential scenarios

**Issue 3-1-8: Usage scenarios for other IoT-NTN device, non-handheld type**

* Proposals
  + **Option 1: FS**
  + **Option 2: other**
* Recommended WF
  + Collecting views on potential scenarios

### Sub-topic 3-2 UE performance metric

**Issue 3-2-1: Categorized performance metric for NR-NTN handheld**

* Proposals
  + **Direction 1: Only single point performance metric, i.e., Peak EIRP/EIS**
  + **Direction 2: Single point + measured full sphere (integrated or CDF), e.g.,** 
    - **D2a, Peak EIRP/EIS+TRP/TRS,**
    - **D2b, Peak EIRP/EIS+ full Spherical coverage CDF**
  + **Direction 3: Single point + measured partial sphere (integrated or CDF), e.g.,** 
    - **D3a, Peak EIRP/EIS+ partial TRP/TRS (e.g., within selected 30, 60, 90, 180 degree** **range of angles),**
    - **D3b, Peak EIRP/EIS+ partial Spherical coverage CDF (e.g., within selected 30, 60, 90, 180 degree** **range of angles)**
  + **Direction 4: Only Full sphere (integrated TRP/TRS or Spherical coverage CDF)** **with/without weighting,** 
    - **D4a, Spherical Coverage with EIRP-CDF and EIS-CCDF at [>50%]-ile**
    - **D4b, TRP/TRS or Weighted metric, e.g., weighted TRP/TRS (with larger weight for declared hemisphere)**
  + **Direction 5: Only Partial sphere (integrated or CDF)** **(e.g., within selected 30, 60, 90, 180 degree range of angles),**
* Recommended WF
  + Collecting views

**Issue 3-2-2: How to decide the Angle as measured partial sphere for NR-NTN**

* Proposals
  + **Proposal 1: RAN4 to consider the range of elevation and azimuth angles which have dominant impact on radiated performance of the device under the assumed user interaction scenario as a parameter declared by the manufacturer.**
* Recommended WF
  + Collecting vies

**Issue 3-2-3: Whether performance metric should be different for GEO and** **NGEO (including LEO and MEO)**

* Proposals
  + **Option 1: Yes**
  + **Option 2: no**
* Recommended WF
  + TBD

**Issue 3-2-4: If Yes, which performance metric should be specified for each UE type?**

* Proposals
  + **Option 1: Directional metrics for GEO (e.g. EIRP/EIS) and wide beam or half sphere for NGEO.**
  + **Option 2: Conical TRP/EIRP/TRS/EIS for GEO and CDF-like performance metric for NGEO.**
  + **Option 3: Different performance metrics could be considered for different UE types**
    - **Type 1 UE: integrated power/sensitivity within declared half sphere**
    - **Type 2 UE: peak EIRP/EIS only**
    - **Type 3 UE: peak EIRP/EIS + X%-tile spherical coverage within declared the supported elevation angles.**
  + **Option 4: other** **Categorized performance metric in Issue 3-2-1**
* Recommended WF
  + TBD

**Issue 3-2-5: If No, which Generic performance metric should be specified for all UE types?**

* Proposals
  + **Option 1: Nth percentile of the CDF of EIRP/EIS over the specified range of angles (Nth percentile FFS).**
  + **Option 2: EIPR, EIS, spherical coverage, as well as directivity and gain of the antenna radiation pattern as performance metrics for each NTN UE type, and verify the performance metric for a UE at least with a half sphere.**
  + **Option 3: Consider EIRP and EIS CDF percentile thresholds as performance metrics for NTN devices, alternatively consider Weighted Radiated Power/Sensitivity (WRP/S).**
  + **Option 4: other Categorized performance metric in Issue 3-2-1**
* Recommended WF
  + TBD

**Issue 3-2-6: For Handheld UE, whether performance metric should be different for different scenarios concluded in Issue 3-1-6**

* Proposals
  + **Option 1: Yes**
  + **Option 2: no**
* Recommended WF
  + TBA

**Issue 3-2-7: Proper performance metric for NR-NTN** **UEs with directional antenna with main lobe beamwidth less than 30degree**

* Proposals
  + **Proposal 1: Only Free Space testing is needed.**
* Recommended WF
  + TBA

**Issue 3-2-8: Views on Requirements work for NR-NTN**

* Proposals
  + **Proposal 1: RAN4 shall strive to specify a single set of OTA requirements applicable to both GSO and NGSO types of UEs.**
* Recommended WF
  + Collecting vies

### Sub-topic 3-3 NTN OTA test methodologies

*Moderator: it was agreed in the WF that above 10 GHz bands are not included in the NTN OTA discussion.*

**Issue 3-3-1: Test method for NR-NTN and IoT-NTN**

* Proposals
  + **Proposal 1: In NTN OTA testing, the test method should not limit UE implementation on pol., and whether the antenna is shared or separate from TN antenna. From TE PoV, the test setup should support different UE implementation on the antenna design. (Qualcomm)**
* Recommended WF
  + Collecting views

**Issue 3-3-2: CBW for NR-NTN bands**

* Proposals
  + **Proposal 1: RAN4 shall strive to match the bands, power class, and test configurations of the IoT/NTN radiated specification with the conducted MOP/REFSENS conditions (TS 38.101-5). (Apple)**
  + **Proposal 2: RAN4 decide whether selecting 15MHz (mid test channel BW defined in RAN5 38.508-1) or 10MHz as the CBW for NR FR1 NTN OTA testing. (vivo)**
  + **Proposal 3: use 5 MHz bandwidth and 15 kHz SCS as test parameters. (Huawei)**
* Recommended WF
  + TBD

**Issue 3-3-3: CBW and RBs for IoT-NTN bands**

* Proposals
  + **Proposal 1: RAN4 shall strive to match the bands, power class, and test configurations of the IoT/NTN radiated specification with the conducted MOP/REFSENS conditions (TS 36.102). (Apple)**
* Recommended WF
  + TBA

**Issue 3-3-4: Doppler parameter of NR-NTN UE**

* Proposals
  + **Proposal 1: NR/IoT NTN radiated requirements shall be verified when Doppler conditions are set to zero and delay conditions are set to constant for all types of satellites. (Apple)**
* Recommended WF
  + Collecting views

**Issue 3-3-5: New positioning guideline of hand only talk mode**

* Proposals
  + **Proposal 1: Adding a new positioning guideline for hand only talk mode, i.e., DUT’s main display is aligned with vertical. (vivo)**
* Recommended WF
  + Collecting views

# Topic #4: FR1 dynamic MIMO OTA

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2407103 | Huawei, HiSilicon | **Proposal 1: dynamic channel model should consist of number of segments with fixed channel models available in 3GPP.**  **Proposal 2: the number of segments in a dynamic channel should be in the range of [8] to [12].**  **Proposal 3: parameters would need to be interpolated between segments to ensure continuity of dynamic channels.**  **Proposal 4: Pathloss variation in a dynamic model should account for achievable chamber dynamic range.**  **Proposal 5: A dynamic channel should balance between high and low throughput segments by using lengths of corresponding segments.**  **Proposal 6: Throughput CDF can be a good candidate for performance metric with either a fixed percentile or a combination of a number of percentiles.**  **Proposal 7:** **link adaption should be included and mapping tables between CQI and MCS for available rank values should be agreed.** |
| R4-2407666 | CAICT | **Proposal 1: RAN4 should adopt noise-limited environmental condition to maintain consistency with 3GPP static LTE and NR MIMO OTA test methodologies.**  **Proposal 2: Perform a measurement campaign on both environmental conditions, to compare their effectiveness of distinguishing between different UE MIMO OTA performance.**  **Proposal 3: RAN4 decide a preliminary noise-limited based dynamic MIMO OTA test method for performing the measurement campaign.**  **Proposal 4: Use CTIA dynamic channel models for the comparison measurement campaign.**  **Proposal 5: The UE throughput data collected during the measurement campaign can be used to study/verify the UE performance metrics.**  **Proposal 6: Define a 30-cm QZ/test zone size for dynamic FR1 MIMO OTA testing.** |
| R4-2407667 | CAICT | Draft skeleton for new TR FR1 dynamic MIMO OTA |
| R4-2407799 | Nokia | **withdrawn** |
| R4-2407898 | Samsung | **Proposal 1: RAN4 to confirm throughput instead of sensitivity as performance metric for dynamic MIMO OTA.**  **Proposal 2: The CTMT can be recorded and reported separately per UE orientation/rotation, but the pass/fail limits for requirements should be based on the average results of all orientations and rotations, i.e., the CDF of TMT with throughput results for all orientations and rotations included.** |
| R4-2408107 | vivo | **Proposal 1: RAN4 should study a procedure to verify the consistency of different test equipment/test system on Scheduling Algorithm in dynamic channel model system. This can be considered as an additional aspect of system validation.**  **Proposal 2: Alignment on basic channel model parameters of UMi and UMa is valuable. These parameters should be rediscussed in RAN4, FFS whether minor modification is needed.**  **Proposal 3: RAN4 can further discuss whether few new dynamic channel models are needed to present more real-world scenarios. Input from operators is required.** |
| R4-2408693 | Nokia | **Observation 1**: For a timespan of a dynamic channel, if the channel impulse responses in different time slices are similar, it can be represented by one typical channel impulse response.  **Observation 2**: A dynamic channel based on a route can be sectioned due to the similarity of the channel environment/surroundings between Tx and Rx. Each of the dynamic channel sections can be simplified to one typical channel impulse response.  **Proposal 1:** Simplify a dynamic channel into a few typical channel impulse responses due to the similarity of the channel environment/surroundings between Tx and Rx in a certain time span.  **Observation 3**: A few typical channel impulse responses can be converted into a few fixed-value CDL-models. Then, a dynamic channel scenario can be represented by a few CDL-models.  **Observation 4**: If a dynamic channel scenario can be represented by a few typical CDL-models, the current OTA test procedure can be reused, and the extra test effort is measuring the performance of a UE a few times based on the number of CDL-models.  **Proposal 2**: RAN4 shall consider to represent a dynamic channel scenario by a few (typical) CDl-models. The current OTA test procedure can be reused, and the extra test effort is measuring the performance of a UE a few times based on the number of CDL-models. |
| R4-2408906 | OPPO | ***Observation 1: When a UE moving along the route with certain DoT and velocity, the velocity not only introduces Doppler effect to the channel environment, but also change the AoAs arriving at the UE in the spatial-domain.***  ***Proposal 1: The angle changes on AoA when a UE moving along the route should be reflected in the dynamic channel model to emulate the typical real-world scenario.*** |
| R4-2409431 | Qualcomm Incorporated | **Proposal 1: RAN4 to consider the following aspects regarding the dynamic OTA modelling:**   * **How to create a drive route, DoT (Direction of Travel), velocity, AoA, etc, parameters** * **How to define the midway points on the drive route** * **How to interpolate channel parameters for continuous channel modelling** * **Whether/how to change UE orientation, such as via switching the probes and/or UE positioner** * **Other aspects are not precluded**   **Proposal 2: RAN4 should try to align FR1 dynamic OTA test methodology with CTIA and other SDOs if any to avoid the standard fragmentation.**  **Proposal 3: The CDF of UE throughput could be considered as the starting point for performance metric of FR1 dynamic MIMO OTA testing.** |
| R4-2409769 | Keysight Technologies UK Ltd | ***Observation 1: CTIA completed the definition of an FR1 MIMO OTA test plan based on a simplified virtual drive test approach with dynamic channel models (based solely on 3GPP CDL models) to introduce more realism.***  ***Observation 2: CTIA has been developing a dynamic MIMO OTA test plan for about two years and is close to completion.***  ***Observation 3: The link adaptation concept introduces more real-world conditions as fixed MCS conditions are found in lab testing but not in the field***  ***Observation 4: While data throughput test cases with VRMC have not been validated, the risk of inconsistencies seems small/manageable.***  ***Observation 5: CTIA selected the SIR-based environment in their test plan.***  ***Observation 6: Measurements clearly demonstrated that the SIR-based environment can differentiate between good and bad DUT performance in dynamic MIMO OTA conditions (dynamic channel model and link adaptation).***  ***Observation 7: A UE noise-limited environment might be unrealistic as the OTA system noise floor is typically above the UE noise floor.***  ***Observation 8: The signal power based on the full UMa path loss model, Figure 5, has a very similar shape as the SIR curve of the SIR-based approach, Figure 4, and could result in similar results as the SIR-based approach***  ***Observation 9: The signal power based on the FSPL & K-factor path loss model, Figure 6, has a very limited dynamic range and could thus result in very limited TP variations.***  ***Proposal 1: 3GPP to adopt the UMa and/or the UMi route waypoint parameterization and dynamic channel modelling concept from CTIA.***  ***Proposal 2: Harmonize the FR1 dynamic MIMO OTA methodologies developed in different SDOs (CTIA and 3GPP) as much as possible***  ***Proposal 3: Include the dynamic link adaptation concept in the 3GPP dynamic MIMO OTA test plan.***  ***Proposal 4: System integrators to confirm the system noise floor levels***  ***Proposal 5: Consider Option 1, i.e., the full path loss model from [10], for the UE Noise-limited environment even though the signal power resembles the SIR curve from the SIR-based environment.***  ***Proposal 6: Await the decision of the environmental test condition until after side-by-side measurement campaign using both UE noise-limited and SIR-based environmental conditions with select smartphone UEs.***  ***Proposal 7: 3GPP to adopt the same performance metrics of TMT and CTMT for 10%, 50% and 90%; whether to combine these three metrics into one or keep all three is FFS.***  ***Proposal 8: 3GPP to adopt the similar channel model validation procedures as CTIA.***  ***Proposal 9: 3GPP to adopt the continuous, two-probe interference technique.***  ***Proposal 10: 3GPP to adopt the four device orientations DMP, DML (both left and right tilt), and DMSU and four rotations (0°, 90°, 180°, 270°) per orientation.*** |

## Open issues summary

### Sub-topic 4-1 Dynamic channel model generation and validation

**Issue 4-1-1: Alignment of dynamic channel model parameters in different SDOs**

* Proposals
  + **Option 1: Consider adopting the** **UMa and/or the UMi dynamic channel models defined in CTIA. FFS whether minor modification is needed.**
  + **Option 2: Consider adopting the UMa and/or the UMi dynamic channel models defined in CTIA. Besides, RAN4 also develop few new channel models.**
  + **Option 3: RAN4 define new channel model but not consider the defined UMa and UMi from other SDOs.**
* Recommended WF
  + Option 1 or Option 2

**Issue 4-1-2: If new channel model is needed (i.e., Option 2 in issue 4-1-1), Framework for dynamic Channel model generation**

* Proposals
  + **Proposal 1: dynamic channel model should consist of number of segments with fixed channel models available in 3GPP. (Huawei)** 
    - **the number of segments in a dynamic channel should be in the range of [8] to [12].**
    - **parameters would need to be interpolated between segments to ensure continuity of dynamic channels**
    - **Pathloss variation in a dynamic model should account for achievable chamber dynamic range**
    - **A dynamic channel should balance between high and low throughput segments by using lengths of corresponding segments**
  + **Proposal 2: RAN4 shall consider to represent a dynamic channel scenario by a few (typical) CDl-models. The current OTA test procedure can be reused, and the extra test effort is measuring the performance of a UE a few times based on the number of CDL-models. (Nokia)**
  + **Proposal 3: RAN4 to consider the following aspects regarding the dynamic OTA modelling. (Qualcomm)**
    - **How to create a drive route, DoT (Direction of Travel), velocity, AoA, etc, parameters**
    - **How to define the midway points on the drive route**
    - **How to interpolate channel parameters for continuous channel modelling**
    - **Whether/how to change UE orientation, such as via switching the probes and/or UE positioner**
    - **Other aspects are not precluded**
  + **Proposal 4: The angle changes on AoA when a UE moving along the route should be reflected in the dynamic channel model to emulate the typical real-world scenario. (OPPO)**
* Recommended WF
  + Collecting views

**Issue 4-1-3: Channel model validation methodology**

* Proposals
  + **Proposal 1: 3GPP to adopt the similar channel model validation procedures as other SDOs. (Keysight)**
* Recommended WF
  + TBA

### Sub-topic 4-2 Test system for FR1 dynamic MIMO OTA

*Moderator: in the WF, agreed “RAN4 should discuss proper test zone size (e.g., 30cm test zone size as target) for the newly defined dynamic FR1 MIMO OTA channel model. Acceptable criteria (e.g., Spatial Correlation deviation) for dynamic channel model generation in the chamber should also be discussed.”*

**Issue 4-2-1: Test zone of test system for dynamic channel model**

* Proposals
  + **Proposal 1: Define a 30-cm QZ/test zone size for dynamic FR1 MIMO OTA testing.**
* Recommended WF
  + AC 30cm QZ can be conclude. Dynamic channel model Test zone of UMi and UMa needs analysis.

**Issue 4-2-2: Link adaption configuration for Dynamic FR1 MIMO OTA**

* Proposals
  + **Proposal 1: Conclude** **dynamic link adaptation should be adopted. FFS details, e.g.,**
    - **mapping tables between CQI and MCS for available rank values**
* Recommended WF
  + TBA

**Issue 4-2-3: Test system Dynamic-link-adaption verification**

* Proposals
  + **Proposal 1: RAN4 should study a procedure to verify the consistency of different test equipment/test system on Scheduling Algorithm in dynamic channel model system. This can be considered as an additional aspect of system validation.**
* Recommended WF
  + TBA

**Issue 4-2-4: Environmental condition for RAN4 FR1 dynamic MIMO OTA**

* Proposals
  + **Option 1: Adopt noise-limited environmental condition in RAN4.** 
    - **Further comparison of different environmental conditions can be studied**
  + **Option 2: Do not conclude environmental test condition until after side-by-side measurement campaign of** **different environmental conditions with real smartphones.**
  + **3**
* Recommended WF
  + Option 1 and option 3

**Issue 4-2-5: Noise floor of noise-limited system for FR1 dynamic MIMO OTA**

* Proposals
  + **Proposal 1: System integrators to confirm the system noise floor levels. (Keysight)**
* Recommended WF
  + TBA

### Sub-topic 4-3 UE Performance metric

**Issue 4-3-1: UE measurement campaign to decide final performance metric**

* Proposals
  + **Proposal 1: The UE throughput data collected during the measurement campaign can be used to study/verify the UE performance metrics. (CAICT)**
* Recommended WF
  + Collecting views.

**Issue 4-3-2: Potential UE performance metric for dynamic MIMO OTA testing**

* Proposals
  + **Proposal 1: 3GPP to adopt the same performance metrics of TMT and CTMT for 10%, 50% and 90%; whether to combine these three metrics into one or keep all three is FFS. (Keysight)**
  + **Proposal 2: RAN4 to confirm throughput instead of sensitivity as performance metric for dynamic MIMO OTA. (Samsung)**
  + **Proposal 3: The CTMT can be recorded and reported separately per UE orientation/rotation, but the pass/fail limits for requirements should be based on the average results of all orientations and rotations, i.e., the CDF of TMT with throughput results for all orientations and rotations included. (Samsung)**
  + **Proposal 4: The CDF of UE throughput could be considered as the starting point for performance metric of FR1 dynamic MIMO OTA testing. (Qualcomm)**
* Recommended WF
  + Collecting views.

**Issue 4-3-3: UE orientations for dynamic MIMO OTA testing**

* Proposals
  + **Proposal 1: 3GPP to adopt the four device orientations DMP, DML (both left and right tilt), and DMSU and four rotations (0°, 90°, 180°, 270°) per orientation. (Keysight)**
* Recommended WF
  + TBA

### Sub-topic 4-4 Draft TR skeleton

**Issue 4-4-1: Skeleton for FR1 dynamic MIMO OTA TR 38.8xy**

* Proposals
  + **Proposal 1: approved the draft skeleton in R4-2407667.**
* Recommended WF
  + Check and confirm