**3GPP TSG-RAN WG4 Meeting #112 R4-2413433**

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

**Agenda item:** 8.12.4

**Source:** Moderator (vivo)

**Title:** Topic summary for [112][333] TRP\_TRS\_MIMO\_OTA

**Document for:** Information

# Introduction

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

# Topic #1: General

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2412050 | vivo | Reply LS on 3GPP NR TRP TRS OTA requirements |
| R4-2412056 | vivo, CAICT | Updated Workplan of Rel-19 OTA WI |

## Open issues summary

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

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

* Proposals
  + **Reply LS to GCF CAG in R4-2412050, agreeable or not?**
* Recommended WF
  + agreeable

**Issue 1-1-2: Updated WP for Rel-19 OTA WI**

* Proposals
  + **Updated Workplan of Rel-19 OTA WI in R4-2412056, agreeable or not?**
* Recommended WF
  + agreeable

# Topic #2: XR OTA

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411025 | Huawei, HiSilicon | **Proposal 1**: define XR device performance according to their form factors, namely category 1 for head mounted displays and category 2 for glasses. Include both category 1 and 2 in this work item.  **Observation 1**: If both category 1 for glasses and category 2 for head mounted displays are included in this work item, there may be a need to communicate such agreement to CTIA regarding head phantom development.  **Proposal 2:** only test XR devices with 5G link to gNB in networks, not those with side link connections.  **Proposal 3**: prioritize 1Tx XR devices in this work item as XR devices with 2Tx may not be available before the end of 2025.  **Observation 2**: XR devices with 1Rx could be treated as 4Rx devices if parameter supportOf2RxXR-r18 is not set on those devices. |
| R4-2411149 | Apple | **Proposal 1:** **1Tx XR device should be prioritized in Rel-19.**  **Proposal 2:** **Use UE capability supportOf2RxXR-r18 to identify XR devices with 2Rx.** |
| R4-2411695 | Samsung | **Proposal 1: Prioritize 1Tx XR devices than 2Tx in Rel-19**  **Proposal 2: prioritize the head-worn XR devices with 5G modem inside, i.e. XR5G-V4, XR5G-A3 and XR5G-A4. FFS if head-worn XR devices with 5G sidelink for tethering should be considered.** |
| R4-2412263 | Meta | **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, e.g., XR5G-P1.  **Proposal 2:**  Existing smartphone and wristwear OTA test methodology and performance can be valuable and provide insights to the OTA performance of XR device types XR5G-A1 and XR5G-A2. |
| R4-2412496 | OPPO | ***Observation: For the second and third sub group, the 5G technology is not embedded in the wearable devices, and therefore, 5G RF front-end and antennas are not assembled in the wearable devices.***  ***Proposal: RAN4 focuses the device type of XR OTA test methodology on the first sub group, i.e. XR5G-V4, XR5G-A3, XR5G-A4, XR5G-A5, in Rel-19 TRP TRS MIMO OTA WI.*** |
| R4-2412677 | CAICT, SAICT | **Proposal 1: Prioritize 1Tx XR devices for OTA testing in Release 19.**  **Proposal 2: The OTA testing methodologies defined in this WI are applicable to headworn XR devices with wireless connections (Group 2 and 1-b). The OTA performance requirements defined in this WI are specifically intended for XR devices with internal 5G modules (Group 2).** |
| R4-2413195 | Nokia | **Observation 1**: There are 266 and 62 measurement grids defined in current standard TS 38.161, a simple change of the location of 62 measurement grids based on 266 measurement grids can be made.  **Observation 2**: Define 4 of 62 interpolated measurement grids based on 266 measurement grids at the same time, the locations of each of four “62 interpolated measurement grids” can be different from each other.  **Observation 3**: Each OTA test time based on interpolated 62 measurement grids is reduced, and the accuracy of measurement results can be the same as using 266 measurement grids in OTA tests by averaging those results.  **Proposal 1**: Define 4 of 62-points interpolated measurement grids based on 266 measurement grids at the same time, the locations of each four of 62-points interpolated measurement grids is different from each other on the sphere, they can be considered orthogonal to each other.  **Proposal 2**: Averaging the measurement results from 4 of interpolated 62 measurement grids by  to achieve the same accuracy level of using 266 measurement grids during OTA tests.  **Observation 4**: It is possible to split the fine measurement grids into a few sectors and using the fine measurement grids that only within a few sectors to increase the accuracy of OTA measurements for peak EIPR.  **Observation 5**: Using a coarse measurement grid in OTA test to measure peak EIPR first, then based on the direction of peak EIPR, apply corresponding sectors of a fine measurement grids to increase the accuracy of measured peak EIRP.  **Observation 6**: Combine the coarse measurement grids and a few sectors of fine measurement grids during OTA test can reduce the total measurement time and maintain high accuracy of peak EIPR measurement.  **Proposal 3**: Define the 8 or 16 sectors of a fine measurement grids, for example, define 8 or 16 sectors of 266 measurement grids.  **Proposal 4**: Combine 62 coarse measurements girds and a few sectors of fine measurements during peak EIPR measurement. For example, using 62 measurement grids in OTA test to measure peak EIPR first, then based on the direction of peak EIPR, apply corresponding sectors of 266 measurement grids to measure the peak EIPR again to increase the accuracy of measured peak EIRP. |
| R4-241xxxx | CTIA | ***Reply LS to RAN4 on XR OTA phantom*** |
|  |  |  |

## Open issues summary

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

**Issue 2-1-1: Discussions on Reply LS from CTIA on XR OTA test phantom**

* Proposals
  + **Discuss on reply LS.**
* Recommended WF
  + TBD.

**Issue 2-1-2: Whether RAN4 need (and how) to categorize XR device type**

* Proposals
  + **Option 1: Based on form factors, namely category 1 for head mounted displays and category 2 for glasses.**
  + **Option 2: Based on form factors: smartphone XR, and other**
* Recommended WF
  + TBD.

**Issue 2-1-3: Considerations on XR device type**

* Proposals
  + **Option 1: Include both category 1 and 2 in this work item. (Huawei)**
  + **Option 2: prioritize the head-worn XR devices with 5G modem inside, i.e. XR5G-V4, XR5G-A3 and XR5G-A4. (Samsung)**
  + **Option 3: Consider all possible 5G XR device types except the XR device form-factors based on smartphone UE, e.g., XR5G-P1. (meta)**
  + **Option 4: RAN4 focuses the device type of XR OTA test methodology on the first sub group, i.e. XR5G-V4, XR5G-A3, XR5G-A4, XR5G-A5. (OPPO)**
  + **Option 5: focus on headworn XR devices with wireless connections (Group 2 and 1-b). (CAICT)**
* Recommended WF
  + TBD.

**Issue 2-1-4: Whether WI should focus on the XR devices those connected to gNB directly**

* Proposals
  + **Option 1: Only test XR devices with 5G link to gNB in networks, not those with side link connections.**
  + **Option 2: FFS head-worn XR devices with 5G sidelink for tethering should be considered.**
* Recommended WF
  + TBD

**Issue 2-1-5: Considerations for XR devices those connected to gNB directly**

* Proposals
  + **Proposal 1: Existing smartphone and wristwear OTA test methodology and performance can be valuable and provide insights to the OTA performance of XR device types XR5G-A1 and XR5G-A2. (meta)**
* Recommended WF
  + TBD

**Issue 2-1-6: Prioritize 1Tx XR devices?**

* Proposals
  + **Option 1: prioritize 1Tx XR (Huawei, Apple, Samsung, CAICT)**
* Recommended WF
  + agreeable

**Issue 2-1-7: How to identify 2Rx XR devices?**

* Proposals
  + **Option 1: Use UE capability supportOf2RxXR-r18 to identify XR devices with 2Rx.**
* Recommended WF
  + agreeable

**Issue 2-1-8: TRP TRS requirements for XR**

* Proposals
  + **Proposal 1: The OTA performance requirements defined in this WI are specifically intended for XR devices with internal 5G modules (Group 2). (CAICT)**
* Recommended WF
  + TBD

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

**Issue 2-2-1: Coarse measurement grids**

* Proposals
* **Proposal 1**: Define 4 of 62-points interpolated measurement grids based on 266 measurement grids at the same time, the locations of each four of 62-points interpolated measurement grids is different from each other on the sphere, they can be considered orthogonal to each other.
* **Proposal 2**: Averaging the measurement results from 4 of interpolated 62 measurement grids by

to achieve the same accuracy level of using 266 measurement grids during OTA tests.

* **Proposal 3:** Define the 8 or 16 sectors of a fine measurement grids, for example, define 8 or 16 sectors of 266 measurement grids.
* **Proposal 4:** Combine 62 coarse measurements girds and a few sectors of fine measurements during peak EIPR measurement. For example, using 62 measurement grids in OTA test to measure peak EIPR first, then based on the direction of peak EIPR, apply corresponding sectors of 266 measurement grids to measure the peak EIPR again to increase the accuracy of measured peak EIRP.
* Recommended WF
  + TBD

# Topic #3: NTN OTA

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411024 | Huawei, HiSilicon | **Proposal 1**: deprioritise IoT NTN devices in this work item  **Proposal 2**: measure all 360 degrees solid angle for NTN TRP and TRS because partial sphere measurement may not capture the main beam direction without prior knowledge from device manufacturers.  **Proposal 3**: calculate TRP and TRS using measured data within [90] degrees solid angle containing the main beam if CDF/CCDF or maximum is not used as performance metrics.  **Observation 1**: CDF/CCDF for TRP/TRS is an effective and simple approach for NTN OTA tests.  **Proposal 4**: main beam is found by averaging transmit and receive power within a solid angle of [60 degrees] for TRP and TRS, respectively.  **Observation 2:** the main beam directions of uplink and downlink could be different, especially for band n254.  **Proposal 5**: the bandwidth for NTN TRP and TRS test should be 5MHz.  **Proposal 6**: prioritise browsing scenario with hand phantom.  **Proposal 7**: use the same metric for NGEO and GEO satellites NGEO satellites tracking functionality if available in UE switched off during NTN OTA measurement. |
| R4-2411253 | Keysight Technologies UK Ltd | *Observation 1: OEMs suggest that in emergency situations, the optimal device orientation could be suggested to the user using device prompts*  *Observation 2: Satellite operators suggest that in emergency situations, the device orientation could be arbitrary*  *Observation 3: Ideally, the selected metric should show rather limited dependence on the device orientations*  *Observation 4: While the peak EIRP, TRP, and WRP metrics generally show no variability in terms of device orientations and NTN antenna patterns, the CDF metric shows generally small variability and the UHRP and weighted TRP metrics show strong variability.*  **Proposal 1: No longer consider partial radiated power and/or weighted TRPs but focus on TRP, WRP, or CDF metrics with optional peak EIRP. Consider similar metrics for the RX measurements.** |
| R4-2411545 | Inmarsat, Viasat | *Withdrawn* |
| R4-2411546 | Inmarsat, Viasat | ***Observation 1:*** *For the defined worst case scenario with a tilt angle of 45 degrees from zenith, the beam pattern can be relaxed by a total portion of 130 degrees in a single azimuth slice, but may lose functionality in certain use cases.*  ***Observation 2:*** *If a device with hemispherical bias is held upside down in a bag/user’s pocket etc. with the degraded hemisphere pointing towards the satellite orbital path, the device may have a total loss of functionality.*  ***Proposal 1:*** *For mobile handsets, adopt the use of dual antennas (one high gain and directional and one low gain omni) with antenna switching in order to permit the device to retain full functionality even when upside down or in other challenging modes of operation.*  ***Proposal 2:*** *Consider the use of a single high gain omni, or an omni with a partial hemispherical bias which does not degrade antenna performance in the bottom hemisphere significantly enough to prevent control channel link closure and enable the device to retain full functionality.*  ***Proposal 3:*** *Usage locales for mobile handset as follows: Outside, under tree cover, inside vehicle.*  ***Proposal 4:*** *Consider the following usage modes with related considerations:*   * *Flat / Leaning on an object or stand*   + *Handset is used to tether other devices and placed against a surface, no human fading conditions* * *Browsing mode / new talk mode*   + *Handset is held out in-front of user as if browsing on the internet or using a video call* * *Head and Hand (regular voice call)*   + *Conventional held up to ear*   + *Potentially reduced requirement since the handset may be pointed significantly away from zenith and the data rate requirement for this use case may be less* * *Upside down (control channel link closure) and in pocket / purse or backpack*   + *Upside down in user’s pocket – with human fading across half of the hemisphere, either from 0° <= azimuth <= 180° or 180° <= azimuth <= 360°*   *.*  ***Observation 3:*** *This type of fixed use handset safety device has different modes of operation, and usually concerns itself with MO rather than MT calls / data transfer.*  ***Observation 4:*** *This type of fixed use handset safety device, when operating over GSO can use pointing aids and a directional antenna.*  ***Observation 5:*** *This type of fixed use handset safety device, when operating over NGSO may be able to use a biased omnidirectional antenna due to the fixed upright mode of operation.*  ***Proposal 5:*** *The usage locales for fixed handset safety device are outdoors and under light tree cover.*  ***Proposal 6:*** *The modes of operation for fixed handset safety device are head and hand, and hand / ‘browsing’.*  ***Observation 6:*** *Fixed industrial IoT can use a directional antenna for GSO operation since once set up the device will not need to re-point.*  ***Observation 7:*** *Fixed industrial IoT can use an omni antenna with an upper hemisphere bias over the expected operating region for NGSO operation.*  ***Proposal 7:*** *The usage locales for fixed industrial IoT are open sky or under tree cover.*  ***Proposal 8:*** *The modes of operation for fixed industrial IoT are free space (approx. pole mounted) and on a surface (since these devices will be mounted on a surface).*  ***Observation 8:*** *Mobile IoT can have two differing requirements depending on the predictability of the fixture’s motion.*  ***Proposal 9:*** *The usage locales for mobile IoT are open sky or under tree cover.*  ***Proposal 10:*** *The modes of operation for mobile IoT are on a surface (as the IoT may be mounted on something) and head and hand (represents animal fading).* |
| R4-2411598 | Xiaomi | **Proposal 1: the UE performance metric should be down select from direction 4 and 5**  Whether performance metric for should be different for GEO and NGEO?  **Observation 1: As the spherical coverage for handheld UE should be large even it only supports GSO scenario, given the orientation of handheld UE is flexible, developing different performance metrics for GSO and NGSO is meaningful for fixed UE other than handheld UE.**  **Proposal 2: Both browsing mode and talk mode shall be considered, but if prioritization is needed, browsing mode can be prioritized.** |
| R4-2411696 | Samsung | **Proposal 1: the browsing mode (with hand phantom) should be prioritized for NTN UE OTA testing.**  **Proposal 2: Adopt full sphere TRP TRS as performance metric for NTN handheld UE, and larger weights and be put on the declared hemisphere, e.g., upper hemisphere, in the TRP TRS integration.** |
| R4-2412055 | vivo | **Proposal 1: For IoT-NTN test method development, RAN4 can consider handheld UE type as 1st priority.**  **Proposal 2: All the following usage scenarios for NTN handheld device should be considered:**   * **Head+hand talk mode, Handheld Hand only talk mode and browsing mode, Free space mode**   **Proposal 3: Consider direction 3 as 1st priority and further discuss details.**  **Proposal 4: Select 5MHz CBW for NR FR1 NTN OTA testing.**  **Proposal 5: Adopt the above Table 1 and Table 2 test parameters for NR-NTN OTA testing.**  **Proposal 6: RAN4 should further discuss and decide which set of parameters is a typical case to verify IoT-NTN OTA performance, e.g. QPSK 1 tone with 15kHz SCS.** |
| R4-2412497 | OPPO | ***Observation 1: Peak EIRP/EIS is not needed to be measured if the UE is not required to point to certain direction during the satellite communication.***  **Proposal 1: If the UE is not required to point to certain direction during the satellite communication, single point requirement is not specified, i.e. exclude Direction 2 and Direction3.**  **Proposal 2: Partial sphere of UE is a propriate performance matric for NTN OTA. The range of partial sphere can be further studied.** |
| R4-2412678 | CAICT, SAICT | **Proposal 1: More detailed information of NTN devices’ antenna pattern from UE vendors are needed.**  **- For handheld NTN devices with directional antenna, OTA testing should be performed in a partial sphere.**  **- For handheld NTN devices with omni-directional antenna, OTA testing should be in a full spherical range.**  **Proposal 2: Support Option 1 (Prioritize the browsing mode) and Option 2 (Prioritize the browsing mode and FS) as the Usage scenario for NTN handheld UE.** |
| R4-2412920 | Qualcomm Incorporated | **Proposal 1: RAN4 consider the following usage scenarios for NR NTN and IoT NTN devices;**   * **For NR NTN handheld UE**   + **Talk mode**     - **Talk mode with Head+Hand**     - **Talk mode with Hand only (via speaker)**   + **Browsing mode**      - **Browsing mode with Hand only** * **For IoT NTN handheld UE: Browsing mode with Hand only.** * **For IoT NTN non-handheld UE (for vertical): Free Space.**   **Proposal 2: For GSO scenario, D3a, i.e., Peak EIRP/EIS+ partial TRP/TRS should be considered as the starting point for the NR-NTN handheld UE. FFS on the range of angles.**  **Proposal 3: For NGSO scenario, D3b, Peak EIRP/EIS+ partial Spherical coverage should be considered as the starting point. FFS on the range of angles.**  **Proposal 4: RAN4 to confirm the TE can accommodate different UE polarization implementations, i.e., either circular polarization or cross polarization.** |
| R4-2413196 | Nokia | **Observation 1**: Talk mode to enable basic NTN communications. The browser mode is very important for daily communications, but it is not mandatary.  **Observation 2**: In the talk mode and browsing mode, only need to consider hand phantom during the test for the UEs with external antenna, which is too big, cable connected, and far enough from user.  **Proposal 1**: Option 4: Prioritize Head+Hand talk mode, hand only browsing mode and talk mode (new positioning guideline), and Free Space.  **Observation 3**: only measure the UE RF performance for partial sphere (up half sphere) would be enough for NTN and IoT NTN UEs  **Observation 4**: TRP/TIS is the metric to measure the performance of UE in FR1 frequency range. Whereas the spherical coverage is normally used to measure the performance of UE in FR2 frequency range.  **Proposal 2**: Direction 3: Single point + measured partial sphere (integrated or CDF), e.g., and define both D3a and D3b: 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).  **Proposal 3**: Study the Specific Absorption Rate (SAR) and Maximum Permissible Exposure (MPE) issues for NTN UEs (not IoT NTN UEs), and define the corresponding requirements. |
| R4-2413451 | Inmarsat, Viasat | ***Observation 1:*** *NTN devices may include small form factor switched antenna / phased array devices with pointing aids to provide high data rate services. In the case of the iSatHub, a VSAT-like device in FR1 that utilises antenna switching and pointing aids for the purpose of user tethering has an EIRP of 40dBm and an antenna gain of 8dBi.*  ***Observation 2:*** *High gain antennas leveraging circular polarisation discrimination can be used to achieve a reliable high throughput system on a small form factor, with a relatively simple antenna design with some beamforming capability. In this case a small form factor phased array antenna with an RHCP antenna gain across the frequency band of interest of 13dBi for both Rx/Tx. The phased array enables some beamsteering capabilities.*  ***Observation 3:*** *To compete performance-wise with current safety service offerings, antennas must be incredibly high performance to achieve similar EIRP with PC3. PC1 devices may make this more realistic.*  ***Observation 4:*** *Many azimuth and elevation test points can be leveraged to assess the quality of the antenna over the entire satellite coverage area.*  ***Observation 5:*** *Circular Polarisation can be leveraged to improve resilience to linear / opposite circular polarisation rejection performance, and axial ratio is a measure of the quality of this isolation.*  ***Observation 6:*** *G/T can be used to assess the entire receiver chain, and takes into account the directivity of the antenna and the noise contributions of the entire receiver system. This can be done just using system information and a radiation pattern rather than TRS/TIS which is a complex text.*  ***Observation 7:*** *Thorough testing of the antenna in the right conditions may allow antenna manufacturers to decouple the antenna from the rest of the device and to test them separately with reasonable confidence of functionality when they are integrated together.* |
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## Open issues summary

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

***Moderator: for the preferred usage scenarios, views are summarized rather than listing proposals from companies.***

**Issue 3-1-1: Usage scenarios for NR-NTN mobile handheld UE**

* Proposals
  + **Option 1: Prioritize hand only browsing mode. (Huawei, Xiaomi, Samsung, CAICT)**
  + **Option 2: Prioritize the hand only browsing mode and Free Space. (CAICT)**
  + **Option 3: Prioritize hand only browsing mode, hand only talk mode (via speaker), and Head+Hand talk mode. (Qualcomm)**
  + **Option 4: Prioritize Head+Hand talk mode, hand only browsing mode, hand only talk mode (via speaker), and Free Space. (vivo, Nokia, Inmarsat, Viasat)**
  + **Option 5: Prioritize Head+Hand talk mode, hand only browsing mode, hand only talk mode (via speaker), Free Space, and Upside down in pocket. (Inmarsat, Viasat)**
    - **Usage locales for mobile handset as follows: Outside, under tree cover, inside vehicle**
* Recommended WF
  + Down selection is needed

**Issue 3-1-2: Consideration on NTN antenna**

* Proposals
  + **Proposal 1: For mobile handsets, adopt the use of dual antennas (one high gain and directional and one low gain omni) with antenna switching in order to permit the device to retain full functionality even when upside down or in other challenging modes of operation. (Inmarsat)**
  + **Proposal 2: Consider the use of a single high gain omni, or an omni with a partial hemispherical bias which does not degrade antenna performance in the bottom hemisphere significantly enough to prevent control channel link closure and enable the device to retain full functionality. (Inmarsat)**
* Recommended WF
  + Collecting views from companies

**Issue 3-1-3: Usage scenarios for NR-NTN fixed handset safety device**

* Proposals
  + **Option 1: The usage locales for fixed handset safety device are outdoors and under light tree cover. The modes of operation for fixed handset safety device are head and hand, and hand / ‘browsing’. (Inmarsat, Viasat)**
* Recommended WF
  + Collecting views from companies

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

* Proposals
  + **Proposal 1: For IoT-NTN test method development, RAN4 can consider handheld UE type as 1st priority. (vivo)**
  + **Proposal 2: deprioritise IoT NTN devices. (Huawei)**
* Recommended WF
  + TBA

**Issue 3-1-5: Usage scenarios for IoT-NTN handheld UE**

* Proposals
  + **Option 1: Browsing mode with Hand only. (Qualcomm)**
  + **Option 2: Prioritize Head+Hand talk mode, hand only browsing mode, hand only talk mode (via speaker), and Free Space. (vivo)**
  + **Option 3: The usage locales for mobile IoT are open sky or under tree cover. The modes of operation for mobile IoT are on a surface (as the IoT may be mounted on something) and head and hand (represents animal fading). (Inmarsat, Viasat)**
* Recommended WF
  + Collecting views on potential scenarios

**Issue 3-1-6: Usage scenarios for IoT-NTN non-handheld UE (or fixed industrial IoT)**

* Proposals
  + **Option 1: For vertical, Free Space. (Qualcomm)**
  + **Option 2: The usage locales for fixed industrial IoT are open sky or under tree cover. The modes of operation for fixed industrial IoT are free space (approx. pole mounted) and on a surface (since these devices will be mounted on a surface). (Inmarsat, Viasat)**
* Recommended WF
  + Check and confirm

**Issue 3-1-7: Align understandings of NR-NTN and VSAT-like UE information**

* Proposals
  + **Option 1: Group discuss and align understanding based on the information shared in R4-2413451 from Inmarsat.**
* Recommended WF
  + TBD

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

**Issue 3-2-1: Whether full sphere or partial sphere (including half sphere) should be measured?**

* Proposals
  + **Option 1: Consider full sphere measurements. (Huawei, Keysight, Xiaomi, Samsung)**
  + **Option 2: Consider partial sphere measurements. (vivo, Xiaomi, OPPO, Qualcomm)**
  + **Option 3: Consider full sphere measurement but partial sphere performance. (Huawei)**
  + **Option 4: Partial or full sphere based on UE antenna type. (CAICT)**
    - **directional antenna with partial sphere**
    - **omni-directional antenna with full sphere**
* Recommended WF
  + TBA

***Moderator: options last meeting***

*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*
* *D2c, optional Peak EIRP/EIS+ TRP, WRP*

*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),*

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

* Proposals

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Performance metric** | **TRP/TRS** | **weighted TRP/TRS** | **WRP** | **Full CDF** | **partial sphere TRP/TRS** | **partial sphere CDF** | **partial sphere CDF** | **peak EIRP/EIS** |
| Keysight | Y |  | Y | Y |  |  |  | Y |
| Xiaomi | Y | Y |  | Y | Y | Y |  |  |
| Samsung | Y | Y |  |  |  |  |  |  |
| OPPO |  |  |  |  | Y | Y |  |  |
| vivo |  |  |  |  | Y | Y | Y |  |
| Nokia |  |  |  |  | Y | Y | Y |  |
| Qualcomm |  |  |  |  | Y(GSO) |  | Y(NGSO) | Y |
| CAICT | Y(directional) |  |  |  | Y(omni-directional) |  |  |  |
| Inmarsat |  |  |  |  |  |  |  |  |

Moderator: instead of listing proposals from each company, the preferred metric is summarized. However, whether selecting one or a combination of some preferred metric should be discussed.

* Recommended WF
  + TBA

**Issue 3-2-3: Detailed angle partial sphere for NR-NTN**

* Proposals
  + **Proposal 1: calculate TRP and TRS using measured data within [90] degrees solid angle containing the main beam if CDF/CCDF or maximum is not used as performance metrics. (Huawei)**
  + **Proposal 2: FFS detailed degrees for partial sphere metric**
* Recommended WF
  + Collecting vies

**Issue 3-2-4: Whether performance metric should be different for GEO and** **NGEO (including LEO and MEO)**

* Proposals
  + **Option 1: use the same metric for NGEO and GEO satellites NGEO satellites tracking functionality if available in UE switched off during NTN OTA measurement. (Huawei)**
  + **Option 2: no**
* Recommended WF
  + TBD

**Issue 3-2-5: Views on Requirements work for NR-NTN**

* Proposals
  + **Proposal 1: Study the Specific Absorption Rate (SAR) and Maximum Permissible Exposure (MPE) issues for NTN UEs (not IoT NTN UEs), and define the corresponding requirements. (Nokia)**
* Recommended WF
  + Collecting vies

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

**Issue 3-3-1: CBW for NR-NTN bands**

* Proposals
  + **Proposal 1: Select 5MHz CBW for NR FR1 NTN OTA testing. (Huawei, vivo)**
* Recommended WF
  + TBD

**Issue 3-3-2: detailed test parameters for NR-NTN bands**

* Proposals
  + **Proposal 1: Adopt the Table 1 and Table 2 test parameters for NR-NTN OTA testing. (vivo)**
* Table 1: NR FR1 NR-NTN TRP measurement parameters

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | CBW [MHz] | SCS (kHz) | UL modulation | Range | UL Carrier centre  [ARFCN] | UL Carrier Center (MHz) | DL Carrier centre  [ARFCN] | DL Carrier Center (MHz) | UL RB Allocation  (LCRB @ RBstart) | DL configuration |
| n256 | 5 | 15 | DFT-s-OFDM  QPSK | Low | 396500 | 1982.5 | 434500 | 2172.5 | 12@6 | N/A |
| Mid | 399000 | 1995 | 437000 | 2185 |
| High | 401500 | 2007.5 | 439500 | 2197.5 |
| n255 | 5 | 15 | DFT-s-OFDM  QPSK | Low | 325800 | 1629 | 305500 | 1527.5 | 12@6 | N/A |
| Mid | 328700 | 1643.5 | 308400 | 1542 |
| High | 331600 | 1658 | 311300 | 1556.5 |

* Table 2: NR FR1 NR-NTN TRS measurement parameters

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| NR Band | CBW (MHz) | SCS (kHz) | DL modulation | UL modulation | Range | UL Carrier centre  [ARFCN] | UL Carrier Center (MHz) | DL Carrier centre  [ARFCN] | DL Carrier Center (MHz) | UL RB Allocation  (LCRB @ RBstart) | DL Configuration (FULL RB, LCRB @ RBstart) |
| n256 | 5 | 15 | CP-OFDM QPSK | DFT-s-OFDM  QPSK | Low | 396500 | 1982.5 | 434500 | 2172.5 | 25@0 | 25@0 |
| Mid | 399000 | 1995 | 437000 | 2185 |
| High | 401500 | 2007.5 | 439500 | 2197.5 |
| n255 | 5 | 15 | CP-OFDM QPSK | DFT-s-OFDM  QPSK | Low | 325800 | 1629 | 305500 | 1527.5 | 25@0 | 25@0 |
| Mid | 328700 | 1643.5 | 308400 | 1542 |
| High | 331600 | 1658 | 311300 | 1556.5 |

* Recommended WF
  + TBD

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

* Proposals
  + **Proposal 1: Select 5MHz CBW for NR FR1 NTN OTA testing. (Huawei, vivo)**
* Recommended WF
  + TBD

**Issue 3-3-4: How to resolve UE antenna circular polarization issue**

* Proposals
  + **Proposal 1: RAN4 to confirm the TE can accommodate different UE polarization implementations, i.e., either circular polarization or cross polarization. (Qualcomm)**
* Recommended WF
  + TBA

# Topic #4: FR1 dynamic MIMO OTA

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2411023 | Huawei, HiSilicon | **Proposal 1**: test equipment shall implement the mapping between MCS and CQI/rank according to Table A.4-2 and Table A.4-3 in the annex of TS 38.101-4 to ensure consistency in downlink resources allocations among test equipment vendors.  **Proposal 2**: use maximum of absolute differences in information bit payloads across all CQI/rank values between Table A.4-2 or Table A.4-3 in TS 38.101-4 and test equipment allocation as the validation metric. The pass/fail threshold is zero bit.  **Proposal 3**: use 50% UMi and 50% UMa along the test route of dynamic channel  **Proposal 4**: UMi and UMa have 5 segments each with the 5 segments represented by CDL-A, CDL-B, CDL-C, CDL-D and CDL-E, respectively.  **Proposal 5**: use Procedure A in Section 7.6.3.2 of TS 38.901 to model UE mobility.  **Observation 1**: Procedure A has the following limit “The updated distance of UT/BS should be limited within 1 meter, i.e. v\*t < 1 meter”  **Proposal 6**: use linear interpolation between different segments.  **Proposal 7**: set the maximum number of HARQ transmissions to [8] for all configurations, namely TDD, FDD, 2x2 and 4x4 MIMO. |
| R4-2411252 | Keysight Technologies UK Ltd, Spirent Communications | Proposal 1: approve the TP with the understanding that additional changes and modifications can be made |
| R4-2411264 | Apple | **Proposal 1 3GPP RAN4 to initially adopt the work done by CTIA on MIMO Multi-Probe Anechoic Chamber (MPAC) dynamic Channel Model in its integrity.**  **Proposal 2 3GPP RAN4, to consider the need to modify or replace the CTIA MIMO Multi-Probe Anechoic Chamber (MPAC) dynamic Channel Model, after measurement results are analyzed.** |
| R4-2411265 | Apple | **Proposal: RAN4 shall gather data adopting both FoM(s), i.e.: Throughput vs. Noise-limited and Throughput vs. Interference-limited environmental conditions. Thus, analysing measurement results to define the proper MIMO OTA radiated performance that corresponds to network deployment priority.** |
| R4-2411572 | CAICT | **Proposal 1: Perform a measurement campaign on both environmental conditions, to compare their effectiveness of distinguishing between different UE MIMO OTA performance.**  **Proposal 2: Collect measurement throughput data from different UEs during the measurement campaign to study and check the candidate device orientations (DMP, DML, DMSU) and rotations (0°, 90°, 180°, 270°).** |
| R4-2411573 | CAICT | *Updated TR skeleton* |
| R4-2411697 | Samsung | **Proposal 1: take the mapping table between CQI and MCS used for demodulation in TS 38.101-4 as reference for dynamic MCS adaption.**  **Proposal 2: TE directly follow the UE reported Rank Indicator (RI) for rank adaption in dynamic MIMO OTA testing.** |
| R4-2412921 | Qualcomm Incorporated | **Proposal 1: RAN4 to consider the following aspects regarding the dynamic OTA modelling:**   * **How to create a driving 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. Therefore, RAN4 should consider using the interference-limited environment condition in RAN4 FR1 Dynamic MIMO OTA test method.**  **Proposal 3: The mapping between CQI and MCS specified in section 5.2.2.1 of TS 38.124 and PMI codebook specified in section 5.2.2.2 of TS 38.124 should be used for link adaptation in FR1 dynamic OTA testing.** |
| R4-2413197 | Nokia | **Observation 1**: A dynamic channel can be represented by a few typical channel impulse responses.  **Observation 2**: The same static channel model can be used twice to represent a route of dynamic channel in separate time spans based on a similarity level of channel parameters.  **Proposal 1**: A similarity level of impulse response should be defined for using the same static channel, i.e., CDL model, to represent two physical locations of a route due to similar channel parameters in different physical locations.  **Proposal 2**: Using the static CDL models to represent a dynamic channel scenario, the order of CDL models can be randomly applied and no need to apply a CDL model twice during the OTA test. |
|  |  |  |

## Open issues summary

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

**Issue 4-1-1: TR skeleton**

* Proposals
  + **Proposal 1: approve the TR skeleton in R4-2411573.**
* Recommended WF
  + agreeable

**Issue 4-1-2: TP for Channel model and validation methodology**

* Proposals
  + **Proposal 1: approve the TP in R4-2411252with the understanding that additional changes and modifications can be made. (Keysight)**
* Recommended WF
  + TBA

**Issue 4-1-3: On adopting Umi and Uma channel models**

* Proposals
  + **Proposal 1: 3GPP RAN4 to initially adopt the work done by CTIA on MIMO Multi-Probe Anechoic Chamber (MPAC) dynamic Channel Model in its integrity. (Apple)**
* Recommended WF
  + TBA

**Issue 4-1-4: Channel model modification in 3GPP**

* Proposals
  + **Proposal 1: use 50% UMi and 50% UMa along the test route of dynamic channel. (Huawei)**
    - UMi and UMa have 5 segments each with the 5 segments represented by CDL-A, CDL-B, CDL-C, CDL-D and CDL-E, respectively
    - use Procedure A in Section 7.6.3.2 of TS 38.901 to model UE mobility
    - use linear interpolation between different segments
  + **Proposal 2: 3GPP RAN4, to consider the need to modify or replace the CTIA MIMO Multi-Probe Anechoic Chamber (MPAC) dynamic Channel Model, after measurement results are analyzed. (Apple)**
  + **Proposal 3: A similarity level of impulse response should be defined for using the same static channel, i.e., CDL model, to represent two physical locations of a route due to similar channel parameters in different physical locations. (Nokia)**
  + **Proposal 4: Using the static CDL models to represent a dynamic channel scenario, the order of CDL models can be randomly applied and no need to apply a CDL model twice during the OTA test. (Nokia)**
  + **Proposal 5:** **RAN4 to consider the following aspects regarding the dynamic OTA modelling: (Qualcomm)**
    - * **How to create a driving 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**
* Recommended WF
  + TBA

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

**Issue 4-2-1: Link adaption configuration for Dynamic FR1 MIMO OTA**

* Proposals
  + **Proposal 1: test equipment shall implement the mapping between MCS and CQI/rank according to Table A.4-2 and Table A.4-3 in the annex of TS 38.101-4 to ensure consistency in downlink resources allocations among test equipment vendors. (Huawei)**
  + **Proposal 2: use maximum of absolute differences in information bit payloads across all CQI/rank values between Table A.4-2 or Table A.4-3 in TS 38.101-4 and test equipment allocation as the validation metric. The pass/fail threshold is zero bit. (Huawei)**
  + **Proposal 3: take the mapping table between CQI and MCS used for demodulation in TS 38.101-4 as reference for dynamic MCS adaption. (Samsung)**
  + **Proposal 4: The mapping between CQI and MCS specified in section 5.2.2.1 of TS 38.124 and PMI codebook specified in section 5.2.2.2 of TS 38.124 should be used for link adaptation in FR1 dynamic OTA testing. (Qualcomm)**
* Recommended WF
  + TBA

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

* Proposals
  + **Proposal 1: TE directly follow the UE reported Rank Indicator (RI) for rank adaption in dynamic MIMO OTA testing. (Samsung)**
* Recommended WF
  + TBA

**Issue 4-2-3: interference-limited environment condition for FR1 dynamic MIMO OTA**

* Proposals
  + **Proposal 1: RAN4 should try to align FR1 dynamic OTA test methodology with CTIA. Therefore, RAN4 should consider using the interference-limited environment condition in RAN4 FR1 Dynamic MIMO OTA test method. (Qualcomm)**
* Recommended WF
  + TBA

**Issue 4-2-4: Test parameters for FR1 dynamic MIMO OTA**

* Proposals
  + **Proposal 1: set the maximum number of HARQ transmissions to [8] for all configurations, namely TDD, FDD, 2x2 and 4x4 MIMO. (Huawei)**
* Recommended WF
  + TBA

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

*Moderator: before measurement activity of UE, the channel model reference parameters, pass/fail limits, channel model validation results from test labs should be done.*

**Issue 4-3-1: UE measurement results collection**

* Proposals
  + **Proposal 1: RAN4 shall gather data adopting both FoM(s), i.e.: Throughput vs. Noise-limited and Throughput vs. Interference-limited environmental conditions. Thus, analysing measurement results to define the proper MIMO OTA radiated performance that corresponds to network deployment priority. (Apple)**
  + **Proposal 2: Perform a measurement campaign on both environmental conditions, to compare their effectiveness of distinguishing between different UE MIMO OTA performance. (CAICT)**
  + **Proposal 3: Collect measurement throughput data from different UEs during the measurement campaign to study and check the candidate device orientations (DMP, DML, DMSU) and rotations (0°, 90°, 180°, 270°). (CAICT)**
* Recommended WF
  + Collecting views.

# Topic #5: Rel-19 FR1 OTA requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2412060 | vivo | **Observation 1: For 1Tx requirements work, there is no need to perform further AC lab alignment testing in Rel-19.**  **Proposal 1:** **Feedback from interested companies is needed to check the number of available devices for different bands, then RAN4 can make reasonable decision on a smaller scope of 1st priority bands in Rel-19.**  **Proposal 2: AC lab alignment for non-coherent UL MIMO at n41/n78 should be done in Rel-19, the framework can be similar to Rel-18 [5], encourage test labs to join this activity.**  **Proposal 3: The Size 2 requirement can be specified based on an offset-based approach, rather than new measurement campaign.**  **Proposal 4: If the offset-based approach is agreed, RAN4 can also further discuss whether small number of measurements is needed for performance checking to confirm the offset value.**  **Proposal 5: For TRP TRS 1Tx requirements work and FR1 MIMO OTA requirements work, there is no need to perform further lab alignment testing in Rel-19.** |
|  |  |  |

## Open issues summary

### Sub-topic 5-1 FR1 TRP TRS requirements

**Issue 5-1-1: 1Tx requirements for TRP TRS**

* Proposals
  + **Proposal 1: no need to perform further lab alignment testing in Rel-19. (vivo)**
  + **Proposal 2: Feedback from interested companies is needed to check the number of available devices for different bands, then RAN4 can make reasonable decision on a smaller scope of 1st priority bands in Rel-19. (vivo)**
* Recommended WF
  + TBA

**Issue 5-1-2: 2Tx requirements for TRP TRS**

* Proposals
  + **Proposal 1: AC lab alignment for non-coherent UL MIMO at n41/n78 should be done in Rel-19, the framework can be similar to Rel-18 [5], encourage test labs to join this activity. (vivo)**
* Recommended WF
  + TBA

**Issue 5-1-3: Size 2 TRP TRS requirements (PDA hand)**

* Proposals
  + **Proposal 1: The Size 2 requirement can be specified based on an offset-based approach, rather than new measurement campaign. (vivo)**
  + **Proposal 2: If the offset-based approach is agreed, RAN4 can also further discuss whether small number of measurements is needed for performance checking to confirm the offset value. (vivo)**
* Recommended WF
  + TBA

### Sub-topic 5-2 FR1 MIMO OTA requirements

**Issue 5-2-1: FR1 MIMO OTA**

* Proposals
  + **Proposal 1: no need to perform static MPAC lab alignment activities in Rel-19. (vivo)**
* Recommended WF
  + TBA

**Issue 5-2-2: Bands for requirements**

* Proposals
  + **Proposal 1: Check and confirm the bands for Rel-19 FR1 MIMO OTA requirements. (moderator)**
* Recommended WF
  + TBA