**3GPP TSG-RAN WG4 Meeting # 104-Bis-e R4-221XXXX**

**Electronic Meeting, Oct. 2022**

**Agenda item:** 6.8.4

**Source:** Moderator (Qualcomm Incorporated)

**Title:** Email discussion summary for [104-bis-e][132] FR2\_multiRx\_UERF\_part1

**Document for:** Information

# Introduction

This document captures discussion for this meeting on the following agenda items:

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| 6.8 Requirement for NR FR2 multi-Rx chain DL reception6.8.1 General6.8.2.3 UE RF requirements |

Note that relevant proposals from documents submitted under 6.8.2.1 are also treated here.

Table to collect delegate contact information is included in the Annex.

# Topic #1: Requirement for NR FR2 multi-Rx chain DL reception

*AI 6.8.2, 6.8.2.3*

## Companies’ contributions summary

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| **T-doc number** | **T-doc name** | **Company** | **Proposals / Observations** |
| R4-2215581 | Proposal on spherical coverage requirements for FR2-1 multi-Rx chain DL reception | Nokia, Nokia Shanghai Bell | **Proposal 1:** At least the signal received from one of the two directions for FR2-1 multi-Rx chain DL reception shall maintain the legacy spherical coverage requirement for reception from a single direction. |
| R4-2215621 | RF requirement for NR FR2 multi-Rx chain DL reception | Apple | (not available ) |
| R4-2215781 | Discussion on UE RF requirements for simultaneous DL reception | LG Electronics | **Proposal 1:** Consider 2 panels as baseline for UE RF requirements for enhanced FR2-1 UEs.**Proposal 1-1:** Consider which placement can be baseline for UE RF requirements among {Back2Back, Orthogonal, In-line} placement**.****Proposal 2:** Do not define the concept of panel in UE RF core requirements.**Proposal 3:** Consider diversity gain of ‘0dB’ for EIS requirements of enhanced FR2-1 UEs.**Proposal 4:** Consider K sample(s) in the legacy spherical coverage of 50%-xile in one panel and all samples in other panel for evaluating CDF of multi-Rx.**Proposal 4-1:** Assume all K sample(s) to be selected at same point of CDF 50%-xile considering lowest received power. |
| R4-2216127 | Discussion on RF requirement for multi-Rx DL reception | vivo | **Observation 1:** UE cannot maintain 2-layer MIMO under large power imbalance and NW also not expect the UE work with MIMO under such situation.**Observation 2:** Using panel concept explicitly risks limiting UE design and UE behavior which is not expected.**Observation 3:** Define the peak EIS and 50% spherical coverage can not reflect the performance gain that bring from the multi-panel activated simultaneously. **Proposal 1:** The impact of power imbalance does not need to be considered in RF requirement and verification for multi-Rx DL reception.**Proposal 2:** A new RMC for 2-layer DL MIMO need to be defined for multi-Rx.**Proposal 3:** Do not use panel concept no matter in RF requirement or test configuration.**Proposal 4:** Define a EIS tolerance = max(∆EIS\_1, ∆EIS\_2) ≤ [TBD] dB to ensure the performance gain of the multi-Rx DL reception.  |
| R4-2216353 | Discussion on UE RF requirements supporting simultaneous DL reception | Xiaomi | **Proposal 1:** The EIS total spherical coverage requirement for the UE supporting simultaneous DL reception with two different QCL TypeD RSs on single component carrier should keep the same coverage N%-tile with the R-15 UE (N% = 50% for PC3).  |
| R4-2216786 | On UE RF requirements for 2AoA FR2 DL MIMO | Qualcomm Incorporated | On beam management:**Proposal 1:** The UE uses Rel-16 IEs *beamCorrespondenceSSB-based-r16* and *beamCorrespondenceCSI-RS-based-r16* to convey to the network what QCL-D reference signal it can support for the multi-chain Rx feature.**Proposal 2:** For this feature, the TE configures 2-port CSI-RS QCL-D reference signals from each TRP when CSI-RS is required by the UE for beam management.On the UE RF requirement:**Proposal 3:** The RF requirement for any AoA pair is defined with assumption that TRP1 uses  polarization when TRP2 uses  polarization and vice-versa ( and  are the angular coordinates of the test system grid).**Proposal 4:** The RMC used for the proposed UE RF requirement for the 2-AoA rank 2 DL is shared with the RMC referenced in clause 7.3.2.1 of TS38.101-2 (single CC REFSENS)**Proposal 5:** The nominal or 100% throughput condition for the proposed UE RF requirement for the 2-AoA rank 2 DL is twice the maximum throughput determined for the REFSENS requirement for the single CC case for that band.**Proposal 6:** For each test point (AoA pair), the individual DL powers from each TRP are set in a ratio that enables a balanced sensitivity condition, where ‘balance’ refers to equal SNR metrics per TRP.**Proposal 7:** For a balanced sensitivity condition, sensitivity is the linear sum (mW domain) of the DL power levels at the UE location.On UE capability pre-requisites:**Proposal 8:** Support for *simultaneousReceptionDiffTypeD-r16* and *singleDCI-SDM-scheme-r16,* along with support for 4L DL are pre-requisites for the UE to support ‘simultaneous DL reception with two different QCL TypeD RSs on single component carrier’. |
| R4-2216253 | Views on multi-Rx chain DL reception in FR2 | Sony, Ericsson | **Observation 1:** if the UE supports *simultaneousReceptionDiffTypeD-r16* and *singleDCI-SDM-scheme-r16* the test can be carried our with an RMC with different layers on the two probes, if the latter is not supported, the test is also possible by carried out with an RMC with one layer, the same on the two probes.**Observation 2:** full set of AoA1+ full set of AoA2 is not feasible from the testability aspect. However, it may still be used to derive the core requirement as it provides an overall assessment of device performance under arbitrary UE orientation and angle of incoming signals. However, a performance gap between the derived requirement and the actual test may appear. **Observation 3:** More than one AoA1 may need to be selected to ensure the device's performance in real life. In addition, testability issue may appear if one of the AoAs needs to have a fixed relative orientation towards the device while the device needs to be rotated. **Proposal 1:** The concept of antenna panel should not be explicitly used in core requirements.**Proposal 2:** RAN4 can discuss how to treat the UE which does not support *singleDCI-SDM-scheme-r16* in UE RF test. **Proposal 3:** If full set AoA1 + full set AoA2 is selected, the performance difference between the derived requirement and the actual test setup defined in the end needs further study.**Proposal 4:** the testability of having one of the AoA fixed relative to the DUT must be confirmed before selecting this method.**Proposal 5:** RAN4 shall define the EIS metric for measuring the DL spherical coverage with simultaneous reception under different AoAs setups. One possibility is to use the total EIS from the two directions. Alternatively, the EIS is fixed from one direction at the 50%-ile for the eisting EIS spherical coverage requirement while the EIS spherical coverage is measured on the other. |
| R4-2216589 | On UE RF requirement for FR2 multi-Rx chain DL reception | Huawei, HiSilicon | **Observation 1:** For the UE which is capable of worse spherical coverage capability, which could be reflected by the composite area, could have better DL receiving performance of the AoA pair with a small angular offset.**Observation 2:** The mTRP operation’s gain scenario should have the following characteristic:* The power imbalance between the two TRP-UE links is within an acceptable range.

**Observation 3:** The definition of the requirement for simultaneous DL reception from two AoAs is strongly related to the test design. For instance, if the new requirement is still for spherical coverage, then no new RF requirement or test cases need to be introduced. **Proposal 1:** The concept of panel should not be explicitly used in core requirements and test configurations.**Proposal 2:** Any type of panel equipment considering reasonable physical limitation on feasibility due to e.g. heat dissipation should not be precluded, as long as such kind of UE implementation can meet the requirement for this feature**.****Proposal 3:** The composite area can be introduce to distinguish the UE with different spherical coverage performance.* Within the composite area, when such UE is configured with simultaneous DL reception from 2 AoAs, shall achieve better EIS performance than the situation that it is not configured with this feature.
* The UE with wider composite area could has worse spherical coverage performance.

**Proposal 4:** Further consider how to accommodate the UE with different composite area for the derivation of RF requirements for simultaneous DL reception from two AoAs.**Proposal 5:** Identify the gain scenarios for m-TRP operation first, which is beneficial for multiple aspects like the discussion on RF/RRM/Demod requirements and the test design accordingly.**Proposal 6:** Consider the following two options to acquire the angular offset between two AoAs under the gain scenarios for m-TRP operation:* Alt. 1: Send an LS to RAN1 for asking more background info at least about:
	+ All necessary SLS assumptions to support m-TRP operation with up to 4 layers, like network topology, UE distribution and so on.
	+ The valid range of angular offset between 2 AoAs so that obvious gain can be observed for enabling multi-panel simultaneous reception from different QCL Type-D RS.
* Alt. 2: Align all necessary SLS assumptions within RAN4 to support m-TRP operation with up to 4 layers, like network topology, UE distribution and so on. Then find the valid range of angular offset between 2 AoAs so that obvious gain can be observed for enabling multi-panel simultaneous reception from different QCL Type-D RS.

**Proposal 7:** For the RF requirements to support simultaneous DL reception from two AoAs, the range of power imbalance between two TRP-UE links shall be considered as side condition and should be further discussed**.****Proposal 8:** Taking the current 50%-tile EIS spherical coverage requirement (for PC3) for single band as the baseline, the new spherical coverage requirement shall be further discussed at least considering the following system factors:* angular offset between two AoAs
* reception power imbalance of the DL signals between two TRP-UE links

**Proposal 9:** Clarify that the test design for verification of the RF requirement for simultaneous reception from 2 AoAs shall be based on single-layer reception for each DL direction with dual TCI configuration, i.e., total 2 layers for both directions.**Proposal 10:** Hold the discussion on test design in this WI and the SI for FR2 OTA before achieving concrete conclusion on RF requirement for setting UE RF requirement for simultaneous reception from 2 AoAs. |
| R4-2216875 | On Defining Coverage Requirements for Multi-Rx Chain Downlink Reception | Lenovo | **Proposal 1**: Define the complementary cumulative distribution function for simultaneous reception from *two randomly selected directions* aswhere reflects the area of the unit sphere corresponding to and This expression can be simplified as**Proposal 2**: In the case that the purpose of the measurement is only to verify that the requirement is met, the measurement can be simplified as where are the *M* elements of the set |

Submitted to [133] but relevant to UE RF requirements:

| **T-doc number** | **T-doc name** | **Company** | **Proposals / Observations** |
| --- | --- | --- | --- |
| R4-2215579 | Proposals on consideration of UE architecture for FR2-1 multi-Rx chain DL reception | Nokia, Nokia Shanghai Bell | **Proposal 1: Consider both single-beam and multi-beam operations on one or more panels in defining the RF requirements and test for FR2-1 UE multi-Rx chain DL reception.****Proposal 2: The concept of panel should not be explicitly used in core requirements and test configurations for FR2-1 UE multi-Rx chain DL reception.****Proposal 3: The single panel with single-beam operation or multi-beam operation should not be excluded for FR2-1 UE multi-Rx chain DL reception.** |
| R4-2215620 | UE implementation assumptions for NR FR2 multi-Rx chain DL reception | Apple | Proposal 1: For setting the UE RF requirement when the UE is configured with 2 active TCI states, single DCI scheme is adopted as a baseline, if the UE supports single DCI scheme. If the UE only support multi-DCI scheme, multi-DCI is used.Proposal 2: A panel is the hardware that consists of antenna array and the associated transceiver and BB unit that a UE uses to produce a TX/RX beam pointing to a particular direction in the spatial domain. From RX perspective, a panel is used to receive one and only one AoA or TCI state. Proposal 3: The concept of panel should not be explicitly used in core requirements and test configurations.Proposal 4: The scenario where a single panel is used to receive two AoAs should not be considered.Proposal 5: The following typical implementation options are considered in developing requirements:• Two panels having equal beamforming capabilities and non-overlapping scanning range• Two panels having unequal beamforming capabilities and non-overlapping scanning range• Two panels having equal beamforming capabilities and overlapping scanning range• Two panels having unequal beamforming capabilities and overlapping scanning range. |
| R4-2215701 | System assumption and UE assumption for FR2 simultaneous DL reception from different directions | Samsung | **Observation 1: FR2 multi-RX chain DL is featured as simultaneous DL reception from different TRPs in different directions****Observation 2: It is not typical scenario for FR2 4 layer MIMO if UE is very far from TRP1 and very close to TRP2 due to large PSD difference****Proposal 1: RAN4 to discuss “distance to TRPs” as one of system assumptions, and correspondingly a moderate PSD difference configuration in core requirement is expected.****Observation 3: “different direction” implicitly indicates that there should be an applicable angle separation****Observation 4: angle separation is needed to address not only core requirement issues but also testability issues****Proposal 2: RAN4 to discuss “angle separation” as one of system assumptions, and correspondingly the requirements for FR2 multi-RX chain DL do not apply when angle separation smaller than a minimum threshold.****Proposal 3: the concept of panel should not be explicitly used in core requirements and test configurations.****Proposal 4: single panel implementation should not be excluded.****Proposal 5: UE panel assumption should follow implementation agonistic manner.** |
| R4-2215778 | Discussion for FR2 multi-Rx chain DL reception | Murata Manufacturing Co Ltd. | Observation 1: There was no clear view how the single panel meets the requirement.Observation 2: In the WID in RAN plenary, multi-RX was assumed providing RF spherical coverage improvement.Proposal 1: We do not consider the single panel in the discussion.Observation 3: We do not have clear view for future technology, and we should not limit implementation by specifications.Proposal 2: We should not exclude single panel in the specification to not limit implementationObservation 4: There seems to be no limitation on relative position among antennas on UE and base stations, so it may be hard selecting some use cases under the implementation flexibility in reality.Observation 5: From the viewpoint of antenna, there may be four representative patterns between beam direction and radiation patterns on UE. The target signal is received at main lobe of antenna, and the non-target signal is received below patterns.* The non-target signal is shut out by the formfactor.
* The non-target signal is received at null point of antenna.
* The non-target signal is received at side lobe of antenna.
* The non-target signal is received at main lobe of antenna.

Observation 6: The multiplexing correction may make the EIS difference between the representative patterns smaller. This may relate to connection sequence because we need to estimate the channel matrix for this correction.Proposal 3: We suggest checking the difference of EIS between representative beam patterns with multiplexing correction. If we select beam pattern based on worst EIS case and make discussion, spherical coverage in the ordinary use case will be better than our assumption. |
| R4-2216125 | Discussion on UE implementation assumption of multi-Rx DL reception | vivo | **Observation 1:** The beam pattern will be distorted when multiple panels activated simultaneously. **Observation 2:** The antenna gain of multiple panels activaed simultaneously is not always better than multiple panel switching, no matter for peak or 50% sperhical coverage.  **Observation 3:** The mutual impact between panels is rely on the UE design, and it will significantly exacerbate the development overhead if we try to avoid it. **Proposal 1:** FFS whether the mutual impact between two panels need to be considered.**Proposal 2:** Single panel perform dual-polarized MIMO to receive 2-layer data from 2 AoAs is allowed.**Proposal 3:** Independent RF chain for each polarization should be the baseline for the multi-Rx RF requirement discussion. |
| R4-2216352 | Discussion on UE architecture to support simultaneous DL reception | Xiaomi | **Proposal 1: The UE RF requirements for the UE supporting simultaneous DL reception with two different QCL TypeD RSs should be UE implementation agnostic, the concept of panel should not be explicitly used in core requirements and test configuration.** |
| R4-2216445 | Considerations on the UE assumptions for FR2 multi-Rx chain DL reception | OPPO | **Observation 1: It is probably feasible for UE to simultaneously receive FR2 dual-polarized electromagnetic waves from two directions. The side condition for this RF capability is that the antenna elements in the FR2 RF panel can be treated as sub-group to perform phase shift operation for independent beamforming.****Proposal 1: The scenario of the single panel to receive the 4-layer DL MIMO should not be excluded when specifying the RF requirement.****Proposal 2: The small separation between AoAs should be considered in the scenario of 4-layer DL reception with one single panel.****Proposal 3: The minimum separation between the two AoAs for 4-layer DL reception should be specified to guarantee the two AoAs are workable for UE.****Proposal 4: The UE should not be required to disclose the work mode of one panel reception or two panel reception for 4-layer DL MIMO.** |

## Open issues summary

### ’Panel’ in core requirements

*Proposal for possible agreement in online GTW session:*

‘Panel’ is not referenced in the final UE RF requirements

*Moderator’s note: below is a composite of multiple similar proposals.*

Proposal: ‘Panel’ is not referenced in the final UE RF requirements. UE panel assumption should follow implementation agonistic manner. The UE should not be required to disclose the work mode of one panel reception or two panel reception for 4-layer DL MIMO, as long as such kind of UE implementation can meet the requirement for this feature .

*Suggested WF: Agree with proposal, or provide refinements below:*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | Support  |
| Verizon | We agree to adopt the definition of panel as used in RAN1 discussions, i.e., it is a radiating structure associated with one TCI-state’ |
| Huawei | We agree that panel shall not be explicitly defined. Besides the first two sentences should be enough to reflect the principle, thus our refinement is provided as below to make the proposal more general.Proposal-rev: ‘Panel’ is not referenced in the final UE RF requirements. UE panel assumption should follow implementation agonistic manner.  |
| LG Electronics | Support Moderator’s proposal. And fine with Huawei’s proposal-rev.  |
| Xiaomi | Support the proposal. |
| Murata | Support Moderator’s proposal. And fine with Huawei’s proposal-rev. |
| Nokia | Agree with the proposal. It is not the panel(s) that are defining the core requirements, but the UEs ability to create two simultaneous beams for multi-Rx DL reception from two AoAs. |
| Samsung | Support the proposal |
| Sony | Agree.  |
| Ericsson | We agree with the proposal |
| Qualcomm | It should be enough to agree that ‘‘Panel’ is not referenced in the final UE RF requirements’. Once this is agreed, the requirements would obviously be panel agnostic. |
| Intel | Overall, we agree with the proposal and second Qualcomm in that agreeing “panel” is not referenced in the requirements is sufficient. |

### ’Panel’ understanding in assumptions for deriving UE RF requirements

*Lower priority discussion for online GTW session: What is a* ‘Panel’ ? (no clear candidate in discussion thus far)

*Moderator’s note: an understanding of ‘panel’ may be required for discussion purposes even if the concept may not figure in the final requirement*

Proposal : A panel is the hardware that consists of antenna array and the associated transceiver and BB unit that a UE uses to produce a TX/RX beam pointing to a particular direction in the spatial domain. From RX perspective, a panel is used to receive one and only one AoA or TCI state [R4-2215620].

*Suggested WF: Agree with proposal, or provide refinements below:*

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| --- | --- |
| **Company** | **Comments** |
| vivo | Generally ok with the proposal, but a “panel” definition is also discussed in the thread [144] for STxMP, it is better to align the understanding between Rx and Tx. |
| Verizon | We are ok for this proposal! |
| Huawei | Not agree on the proposal. Because we think the explanation here is not necessary if the previous issue can be agreed within the group. |
| LG Electronics | For ‘From RX perspective, a panel is used to receive one and only one AoA or TCI state’, the followings are needed to be clarified. A), If V-pol and H-pol produce each beam pointing to different directions, is it considered as 2 panels? B), If V-pol and H-pol produce a beam pointing to same direction, is it considered as 1 panel?Based on WID, the legacy spherical coverage requirement should be kept.* + The legacy spherical coverage requirement for reception from a single direction will be kept

Both A & B can guarantee the legacy spherical coverage requirement from a single direction? For example, with the existing test procedure, in case that V & H between TE and UE are not aligned, A) may not meet the legacy requirement. |
| Xiaomi | Disagree the description for Rx perspective, according to RAN1’s spec, a UE beam can receive multiple AOAs or TCI states: |
| Nokia | Do not agree with the proposal.A general antenna model is described in TR 38.803 with specific details that define:* Antenna model
* Antenna panel
* Antenna elements
* Antenna panel has a polarization (single or dual)

Changes for the definition that includes panel must reflect prior agreements. Associations to transceivers, BB unit and Rx/Tx beam pointing to a particular direction shifts the definition of an antenna panel to include radio architectural aspects, which can go beyond the physical entity of the antenna panel and may become significantly limiting to the architectural progress of the antenna and its interfaces. |
| Samsung | We wonder why the panel definition has to consist of transceiver and BB unit. We are fine to understand the panel terminology as RAN1’s understanding, but the new panel definition should not limit one physical panel to support the multi-panel feature.With the panel definition in this proposal, we would like to get clarification for following case: for a physical panel with 4x1 array with dual polarization, in case its dual polarization could transmit/receive in different direction simultaneously, this 4x1 panel will be interpreted as two panel based on above definition?  |
| Sony | To our understanding, a physical antenna array may have one or more transceiver and BB, which can produce one or more analogy Tx/Rx beam that point to same or different direction. We would like to check for single physical antenna array with multiple beam and multiple transceiver/ BB, is it considered as multiple panels? |
| Ericsson | Not agreed, LGE provides a good counterexample. |
| Qualcomm | Agree with vivo comment. The RAN1 understanding of panel is perhaps more general. We have proposed elsewhere that RAN4 adopt RAN1 understanding (see R4-2216783):**‘Panel’ is defined as one or multiple as combination of below depending on different UE implementation:** 1. **Unit of antenna group to control beam independently**
	1. **Within a panel, one beam can be selected and used for UL transmission.**
	2. **Across different panels, multiple beams (each selected per panel) may be used for UL transmission**
	3. **‘Beam’ is assumed to mean spatial filter associated with transmission or reception**
2. **Unit of antenna group to control its transmission power**
3. **Unit of antenna group to have a common UL timing**
 |
| Intel | What a panel entails depends on the integration used and the specific components included in the packaging and design (i.e., implementation specific). Further discussion is needed for the definition.For clarification, how does “panel” differ from “module”? It seems the terms may be used interchangeably. |

### Panel to panel interaction in multi-panel UE

*Lower priority discussion for online GTW session: Do we want to first identify the mechanism behind the phenomenon that causes interference pattern before discussing whether it should be FFS?*

Proposal : FFS whether the mutual impact between two panels need to be considered [R4-2216125].



*Suggested WF: Agree with proposal, or provide refinements below:*

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| **Company** | **Comments** |
| vivo | Support, this impact appeared in our simulation when same polarization beam pair are activated. if this impact should be considered, then we can further discuss how to reflect it in RF requirement. If companies think this impact is invalid, we still need to discuss what is the “correct” way to do the evaluation. |
| Verizon | The concept is understandable. But, it is not sure if this mutual is common to the different logical abstractions of panel based on RAN1 panel definition.  |
| Huawei | From implementation perspective we understand this issue could exist. But please note that the implementation agnostic has never been violated as a principle since Rel-15, and the legacy RF requirements, like EIS spherical coverage, were defined as a trade-off among different types of implementation. If we will study this mutual impact issue in Rel-18, we would like to ask what the impact will be regarding the legacy RF requirements. For example, is there any degradation could be expected for EIS spherical coverage?  |
| LG Electronics | Support FFS on the mutual impact. However, we think the mutual impact can be reflected into CDF for spherical coverage. |
| Xiaomi | Support, if one panel means one analog beam, the impact of different beams should be considered  |
| Murata | We agree with proposal.We wonder whether mutual impact includes spatial correction by the channel matrix? |
| Nokia | Support to consider the mutual impact between the two receive beams, but avoid using the term panel. |
| Samsung | Thanks vivo for the simulation. We have a question, is the phase configuration the same for the two panels? For 2AoA reception, the phase control of the two panels are different to direct the beams pointing to different AoA, resulting in a spatial isolation. It seems that the simulation does not consider independent phase configuration for each panel? |
| Sony | Fine to FFS, the detail mechanism can be discussed once we have a high-level agreement with UE implementation assumption, e.g., how panel is assumed and how many panels should be assumed. |
| Ericsson | This can be FFS. |
| Qualcomm | We are not against FFS, but only after there is a clear understanding of the mechanism that is causing this interference effect. There seems to be an assumption that there is a fixed method of combining across the antenna modules. The interference pattern visible will not be visible if there is coherent combining across the modules, for example by using MRC. |
| Lenovo | We believe this issue can exist, but it should be reflected in the spherical coverage CDF. |
| Intel | Ok to further discuss along with the complete set of assumptions for the simulations. This issue may be captured as an additional “loss” but the extent of it has to do with the implementation used. As Lenovo noted, this would be seen in the spherical coverage CDF. |

### Study and identify AoA ranges where gains are expected in deployment

*Lower priority discussion for online GTW session: (not much support for either proposal)*

Proposal : Identify the gain scenarios for m-TRP operation first, which is beneficial for multiple aspects like the discussion on RF/RRM/Demod requirements and the test design accordingly [R4-2216589]:

1. Alt. 1: Send an LS to RAN1 for asking more background info at least about:
	1. All necessary SLS assumptions to support m-TRP operation with up to 4 layers, like network topology, UE distribution and so on.
	2. The valid range of angular offset between 2 AoAs so that obvious gain can be observed for enabling multi-panel simultaneous reception from different QCL Type-D RS.
2. Alt. 2: Align all necessary SLS assumptions within RAN4 to support m-TRP operation with up to 4 layers, like network topology, UE distribution and so on. Then find the valid range of angular offset between 2 AoAs so that obvious gain can be observed for enabling multi-panel simultaneous reception from different QCL Type-D RS.

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| **Company** | **Comments** |
| vivo | We doubt whether it is feasible to conclude the range of angular from SLS assumption. In the SLS, UE may access to any TRP only if the SINR is acceptable and UE may not access to the nearest TRP if the inference is severe. All these behaviors are dynamic and we cannot easily get a meaningful range from the static SLS assumption. |
| Verizon | Agree with Vivo! |
| Huawei | As the proponent, we prefer Alt 1, Rel-16/17 evaluation/analysis collection from RAN1 could be very useful. The Alt 2 is also acceptable, since both 2 alternatives are for the same purpose, which is to provide necessary inputs to other aspects of RAN4 discussion like AoA-pair angular offset range and test design. |
| Xiaomi | agree with vivo. |
| Nokia | Do not support sending the proposed LS because it indirectly implies agreements beyond the proposal above, we should come to a common agreement on the basics of multi-RX operation and requirements before we consider SLS assumptions. |
| Samsung | We share similar with vivo and Verizon, the SLS assumption may not consider small AoA impact fully. The small AoA impact should rely on RAN4 evaluation. Except SLS assumption, in general we think Alt.2 is good direction to go forward, i.e., to figure out the valid range of angular offset with in RAN4. |
| Sony | We don’t see the need to send LS to RAN1 right now. From RAN4 perspective, the most important thing is to identify the test setup from testability aspect. Once we select a most feasible AoA setup, we can further look into details.We also agree with vivo’s analysis.  |
| Ericsson | No need to send an LS to RAN1 at this point, although selection of relevant angular separations to mimic the intended deployment scenario in the test is important (a wide angular separation between TRPs appears to be among RAN1 objectives). The vivo analysis has got merits. |

### What should happen when same panel receives DL from multiple directions for UE RF requirement

*Discussion for possible agreement in online GTW session:*

The scenario where a single panel is used to receive two AoAs should not be excluded. Whether a UE with single panel can satisfy the requirement or not will be an implementation issue.

Proposal: The scenario where a single panel is used to receive two AoAs should not be considered

Options:

1. Should not be considered [R4-2215620]
2. Should not be excluded [R4-2216445] [R4-2216786]

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| --- | --- |
| **Company** | **Comments** |
| vivo | Option 2. The legacy UE already can perform polarized MIMO and it is straightforward to keep this behavior for multi-Rx. However, we can further discuss whether each polarization beam can point to a different AoA. |
| Verizon | We support Option 2!  |
| Huawei | We understand that a certain type of panel implementation could be used as discussion assumption, but from RF requirement perspective, we don’t think there will be different requirement for different type of implementation. Whether a UE with single panel can satisfy the requirement or not will be an implementation issue. |
| LG Electronics | It seems to be related to Issue 1.2.2. At first, the following needs be clarified.If the panel can receive 2 AoAs with V-pol and H-pol, is it a single panel or 2 panels? If a single panel, option 2 can be supported. However, as mentioned in 1.2.2, we need to check the panel which receive 2 AoAs with V-pol and H-pol can meet the legacy spherical coverage requirement for reception from a single direction. |
| Xiaomi | Option 2 |
| Murata | In requirement perspective, we have similar view with Huawei. |
| Nokia | Support option 2, as discussed in R4-2215579. |
| Samsung | Support option 2 if panel here means a physical panel. |
| Sony | Option 2.  |
| Ericsson | Option 2, could be the case for the intended deployment, |
| Qualcomm | Option 2, hopefully the ortho-pol 2 AoA DL signal used for UE RF requirement can alleviate concerns. |
| Lenovo | Option 2. |
| Keysight | If this is strictly for RF requirements purposes, we have no opinion. However, if the testing requirement includes a condition that a scenario where the UE receiving two AoAs with the same panel should be excluded, this information would have to be made available to the TE; for simplicity Option 2 would be preferred in that case.  |

### Small AoA separation condition

*Discussion for possible agreement in online GTW session: (some concern with companies)*

*Can option 1 be considered as not required for UE RF requirement which is agreed to be only rank 2? (concern was raised for 4L operation)*

*Can option 2 be used as a baseline, and use option 1 where there is a test method limitation?*

*Moderator’s note: The condition for ‘small AoA’ is adopted from R4-2216786:* A small angular separation represents the condition where the UE is not able to deploy beams towards each TRP that sufficiently suppress the signal from the other TRP.

Options:

1. the requirements for FR2 multi-RX chain DL do not apply when angle separation smaller than a minimum threshold [R4-2215701] [also, related to R4-2215620]
2. The RF requirement for any AoA pair is defined with assumption that TRP1 uses  polarization when TRP2 uses  polarization and vice-versa (and are the angular coordinates of the test system grid). [R4-2216786]

 

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| **Company** | **Comments** |
| vivo | Option 2. Option 1 means if both 2 AoAs fall into same panel coverage, the interference cannot be acoided and it will restrict the multi-Rx scenario significantly. |
| Verizon | Option 2. The concept of orthogonal theta and phi polarization can be useful for the angle separation as discussed by companies |
| Huawei | First we wonder is this only for requirement derivation or also can be applied for test design? If this issue is also related to the test design, whether there could be some testability issue or additional implementation complexity should reply on TE vendor inputs.From requirement perspective, we think it is necessary to preclude some scenarios where mTRP operation and DL-MIMO will not be configured by TRP (in this case, TRP can be aware of the poor channel condition by measurement).For Option 2, even orthogonality might be guaranteed at transmitter side, we wonder does it mean the orthogonality is also guaranteed at receiver side? Besides, we note that keep the principle of implementation agnostic might be the majority view, in this regard, some certain types of UE, e.g. two panels having non-overlapping scanning range, might have poor performance under this small AoA separation scenario. More prefer to Option 1 for now, but definitely it also needs more discussion.  |
| LG Electronics | Support Option 1. RF requirements need to be specified considering also both  & pol of TRPs. So, Option 2 can be considered in test set-up. |
| Xiaomi | support Option 2 |
| Nokia | Do not support the options proposed here but propose FFS on small AoA separation, since we don’t see the small AoA separation condition limited to the two options. Option 1 will restrict deployment scenario to the minimum threshold, while option 2 assume no inter-beam interference, both of which cannot reflect real-life operation. In addition, we would like to highlight that the activities in the OTA track are of great interest, otherwise we may reach agreements on AoA separation requirements that cannot be supported through reasonable test systems (time, money, space etc).  |
| Samsung | Option 1 and option 2 are not contradicted. We are okay with both option 1 and option 2.Even option 2 is adopted, option 1 is still needed to guarantee the spherical coverage derived by RF requirements will work well for 4x4 reception. |
| Rohde & Schwarz | As highlighted by Huawei, the determination of min (and also max) AoA separation has a major impact on the test method design. Therefore, we prefer option 1 which implies that a minimum separation is ensured for testing.Option 2, somehow imposes a major change in current approach for spherical measurements (e.g. spherical coverage and beam peak search) where both DL polarizations are tested sequentially for each grid point. |
| Sony | Option 2. Moreover, if fixed offset AoA setup is adopted, such an issue can be avoided from the beginning. We would like to focus on the feasible test method first and then look into the detail issue.  |
| Ericsson | Option 2 possible for small angular separation. |
| Qualcomm | Agree with Samsung comment, option 2 could be a baseline, and option 1 can be considered for test set up limitations.To R+S: In the 2 AoA set up, there have to be 2 active DLs simultaneously. That is a major change, but hopefully not a surprise. Here, at any given time, each antenna would only transmit DL in one polarization, then switch pols at both antennae and repeat the measurement. In that sense there is no major change, other than duplication of the number of DL sources.To Huawei: the intent is to make the tough case of ‘narrow separation’ look like pol. MIMO (legacy rel-15 behavior). Your question would seem to apply to a legacy single AoA 2L DL case also: ‘even orthogonality might be guaranteed at transmitter side, we wonder does it mean the orthogonality is also guaranteed at receiver side?’ |
| Lenovo | Option 1 for 4x4.For Option 2, it is not clear that TRP polarizations can be assumed to be aligned at the UE. |
| Intel | Either option may work, but both need further discussion (considering small AoA separation and testability implications) |
| Keysight  | The assumption here is that these options translate directly to testing requirements. Hence, option 2 is preferred to reduce testing efforts and test time. Minimum angular separations between AoAs for various test system options are discussed in SI agenda, specifically R4-2215540, i.e., ~5° angular separation between two neighboring DFF probes and ~30° angular separation between two neighboring IFF probes.  |

### DL power imbalance from the 2 TRPs for sensitivity condition

*Discussion in online GTW session: (no clear candidate)*

It is proposed that this aspect be discussed jointly with 1.2.8

Proposal: For the RF requirements to support simultaneous DL reception from two AoAs, the range of power imbalance between two TRP-UE links shall be considered as side condition and should be further discussed [R4-2216589]

Options:

1. PSD difference is ‘none to low’ in radiated domain [R4-2216127] [R4-2215701]
2. PSD difference is determined by equalizing SNR metrics per TRP [R4-2216786]
3. EIS is fixed from one direction at the 50%-ile for the existing EIS spherical coverage requirement while the EIS spherical coverage is measured on the other. [R4-2216253]

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| **Company** | **Comments** |
| vivo | Both option 1 and option 2 can be considered. We agreed that the RF requirement is defined based on 2-layer MIMO case and if the power imbalance is large, the UE cannot maintain the 2-layer and NW also not expect the UE work with MIMO operation, so at least the PSD imbalance is not needed to be considered for both RF requirement and verification. We can further discuss how to achieve this in the test.  |
| Verizon | Preferred Option 2, but would see more from Option 1.  |
| Huawei | We think both options are valuable and worth further discussion, initially we have the following questions for Option 2:We note that in R4-2216786 a so called “power compensation for the imbalance link“ approach has been proposed. We wonder how serious will the time cost be if this procedure should be conduct for each test point. Besides, for a UE which could have any kind of implementation, there must be a portion of test points that not need too much compensation, then how should we treat the EIS measurement results regarding these points comparing to the other test points which need more compensation? |
| Xiaomi | We are OK for Option 1 and Option 2. |
| Nokia | Do not support the options proposed here but propose FFS on PSD difference, since we do not see power imbalance defining the RF requirements for multi-RX operation. The capability to maneuver signals of different signal strength is an aspect of Demod. |
| Samsung | Both option 1 and option 2 can be further discussed. For option 2, in general we think it is a good idea, besides it brings a little complication to test, the UE measurement accuracy impact should be evaluated, if the SNR or RSRP measurement accuracy is not good, the final results will be greatly influenced. |
| Sony | We are open to all the possible solutions. However, just want to point out that for the equal SNR metric, it may relays on UE report SNR level as Samsung commented. As far as we can recall, similar discussion happened in Rel-16 for CSI-RS only BC, for the purpose of setting a fixed SNR difference between SSB and CSI-RS.  |
| Ericsson | The test metric should be agreed before we decide on the PSD levels. Option 3 (a Sony-Ericsson proposal) is similar to the ‘non-collocated’ DL CA cases discussed: the roles of the probes are swapped in the test (not included above) such that both directions are measured. This can also mimic the case with different EIS on the two beams, which is a likely case in a deployment where the TRPs are ‘widely separated’..We assume that the spherical coverage will be measured with an RMC with a CW and one layer per beam. For the demod requirements with more than one layer the metric is effectively the sum of the EIS. |
| Qualcomm | We are proponents of option 2. To Huawei and others: The test complication of option 2 is that it comprises the additional step to provide the UE with the appropriate measurement resources and get the UE to report the SNR metric for the relative power adjustment. The downside of not doing this step is to have no guarantee that the UE is running at sensitivity condition. For example half the bits received in the TB could have very good SNR and half the bits could have poor SNR.To Nokia: In our this sensitivity test is about determining the minimum DL power to achieve a certain throughput condition. This does have the effect of equalizing the SNRs for both layers which can have the effect of minimizing PSD difference inside the UE. |
| Lenovo | We prefer Option 1 as it is simpler than Option 2. The correct approach will depend on how the spherical coverage requirement is defined. |

### How to determine EIS for a test AoA pair

*Discussion in online GTW session: (no clear candidate)*

*It was pointed out that EIS should not be reused for this parameter. For the GTW discussion, it is proposed to use ‘combined sensitivity’ for this parameter.*

*There is a view that ‘requirement concept’ should be defined first, but there is also a view that we need to define the parameter on which a requirement has to be formulated.*

*Moderator’s note: This topic is related to choice made for ‘PSD difference’*. Options:

1. Sensitivity is the linear sum (mW domain) of the DL power levels at the UE location. [R4-2216253] [R4-2216786]
2. EIS is fixed from one direction at the 50%-ile for the existing EIS spherical coverage requirement while the EIS spherical coverage is measured on the other. [R4-2216253]

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| **Company** | **Comments** |
| vivo | Neither for now. Option 2 is not preferred as we comment in 1.2.7, and for option 1, any further calculation will dilute the physical meaning of EIS which is not expected. It is better to conclude the RF requirement concept first, then we can discuss whether such calculation is still needed or meaningful. |
| Verizon | Option 1 seems an option based on the the DL power levels of UE  |
| Huawei | From our understanding, Option 1 is for post-processing after getting the EIS, while Option 2 is about how to get the EIS. Anyway, as mentioned in the Moderator’s note, this issue shall be discussed after we can get conclusion for the previous issue. |
| LG Electronics | Support Option 1.Considering two AoAs, EIS needs to be determined with linear sum at a direction.  |
| Xiaomi | Prefer to FFS. |
| Nokia | Do not support the options proposed here but propose FFS, since we need to agree if the sensitivity for AoA1 and AoA2 should be tested simultaneously or separately. |
| Samsung | Agree with vivo and Nokia, neither for now.For option 1, the sum power will lead to the EIS is dominated by only one AOA and another AoA performance is almost neglected.For option 2, it is overlapped with issue 1.2.7 on PSD difference?In our view we think it is better to measure EIS per AoA, i.e., to obtain EIS1 for AoA1 and EIS2 for AoA2, though maybe only EIS1 is necessary if AoA2 is as anchor only. |
| Rohde & Schwarz | In our understanding, Option 1 is a misinterpretation of the EIS/Sensitivity concept which is formally defined per test direction in OTA, and thus we think it is better to define metrics based on the individual results per test direction. |
| Sony | we are fine with considering all the possible proposals. |
| Ericsson | Both can be considered. Option 2 (a Sony-Ericsson proposal) is similar to the ‘non-collocated’ DL CA cases discussed: the roles of the probes are swapped in the test (not included above) such that both directions are measured. |
| Qualcomm | Option 1. We however agree that it would depend on the test methodology (‘PSD imbalance’). For example option 2 here would go along with 1.2.7 option 3 (anchor approach).  |
| Lenovo | Prefer neither for now. Agree with Vivo that it is better to define RF requirement first. |
| Intel | Need to address requirement concept and test method before agreeing on this |
| Keysight | Share similar view as R&S in that we might want to define a new label/metric as EIS is generally defined for 1 AoA. It would be desirable to stick with Option 1 |

### DL RMC for sensitivity condition

*Proposal for possible agreement in online GTW session:*

A new RMC for 2-layer DL MIMO needs to be defined for multi-Rx

Proposal: A new RMC for 2-layer DL MIMO need to be defined for multi-Rx. [R4-2216127]

*Moderator’s note: A proposal from R4-2216786 to retain RMC from legacy 1L DL is withdrawn. 1L RMC cannot be retained for 2L.*

*Suggested WF: Agree with proposal, or provide refinements below:*

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| **Company** | **Comments** |
| vivo | Support, the single DCI imply that the 2-layer data are from same TB, and we cannot get the throughput for each layer, so a new RMC seems the only choice. |
| Huawei | This can be reviewed if more details on the 2-layer RRC can be provided. |
| Xaiomi | Support. |
| Nokia | This depends on the decision on issue 1.2.8. |
| Samsung | If the proposal in intended to enable throughput for each layer, we support the proposal and refinement is need to capture this purpose. |
| Sony | Fine to introduce a new RMC for 2L DL MIMO.  |
| Ericsson | A new RMC needed, we agree with the proposal. |
| Qualcomm | Support the new RMC proposal. To interested companies, we have uploaded a proposal for consideration for the next meeting. [.....Rnd1/draft\_2LRMC\_120KHz.docx](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_104bis-e/Inbox/Drafts/%5B104-bis-e%5D%5B132%5D%20FR2_multiRx_UERF_part1/Rnd1/draft_2LRMC_120KHz.docx) |

### Proposals for the EIS spherical coverage requirement

*Lower priority discussion in online GTW session: (no clear candidate)*

*Options below are not mutually exclusive, please comment on multiple if necessary.*

Options:

1. At least the signal received from one of the two directions for FR2-1 multi-Rx chain DL reception shall maintain the legacy spherical coverage requirement for reception from a single direction. [R4-2215581]
2. Consider K sample(s) in the legacy spherical coverage of 50%-xile in one panel and all samples in other panel for evaluating CDF of multi-Rx. Assume all K sample(s) to be selected at same point of CDF 50%-xile considering lowest received power [R4-2215781]
3. The EIS total spherical coverage requirement for the UE supporting simultaneous DL reception with two different QCL TypeD RSs on single component carrier should keep the same coverage N%-tile with the R-15 UE (N% = 50% for PC3). [R4-2216353]
4. Define a CCDF as [R4-2216875]:
5. Use the concept of ‘composite area’ to distinguish the UE with different spherical coverage performance. [R4-2216589]
	1. Within the composite area, when such UE is configured with simultaneous DL reception from 2 AoAs, shall achieve better EIS performance than the situation that it is not configured with this feature.
	2. The UE with wider composite area could has worse spherical coverage performance.



1. Define a EIS tolerance = max(∆EIS\_1, ∆EIS\_2) ≤ [TBD] dB to ensure the performance gain of the multi-Rx DL reception. [R4-2216127]
	1. Step-1: Perform the single carrier spherical coverage test, get the EIS\_0 which is the top 50% EIS of the whole sphere.
	2. Step-2: Perform multi-Rx spherical coverage test and only verify the top 50% regien of single carrier, then get EIS\_1 from AoA1 and EIS\_2 from AoA2, detail of the test setup can be further discussed
	3. Step-3: Calculate the difference in same direction ∆EIS\_1 = EIS\_0AoA1 – EIS\_1 and ∆EIS\_2 = EIS\_0AoA2 – EIS\_2
	4. Step-4: Reselect the AoA1 and AoA2, get a set of ∆EIS\_1 and ∆EIS\_2.
	5. Step-5: EIS tolerance = max(∆EIS\_1, ∆EIS\_2) ≤ [TBD] dB

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| **Company** | **Comments** |
| vivo | As the proponent for option 6, we can further explain why we try to introduce such tolerance requirement. Currently, the typical mmwave UE already equipped with multiple panels but only one panel can be activated. In our simulation [R4-2216125], we find that when multiple panels are activated simultaneously, the coverage performance may be worse than one panel switching case, and if we consider single panel receive 2 AoAs simultaneously case, the coverage also be worse due to lose the polarization gain for each AoA. All these facts imply that the coverage performance of multi-Rx is not definitely better than single panel operation and the traditional CDF method can not verify the actual gain for multi-Rx. So based on the agreed RF requirement assumption (i.e., receive 2-layer from different AoA), we think the key performance gain for multi-Rx should be “simultaneous reception” rather than “coverage enhancement”, and the ideal case is that each layer can perform like single carrier and the throughput can be “doubled”. The option 6 try to compare the performance between single carrier and multi-Rx reception in each test point, and if the all degradations are within an acceptable range, we can consider the UE pass the test. The option 3 is also reflected in option 6 because only top 50% (for PC3) is verified.For option 2 and option 5, we think the problem is that these 2 options need to verify each panel one by one and it has the risk of revealing the UE implementation details, in addition, if UE equip with more than 2 panel (actually many mmwave UEs already equip with 3 panels now), the verification will be more complicated, we may need to discuss the principle of mapping relationship between multiple panels and 2 AoAs, and this may also restrict the UE behavior. |
| LG Electronics | Support Option 2.Based on WID, legacy spherical coverage requirement should be kept.* + The legacy spherical coverage requirement for reception from a single direction will be kept

So, for PC3, spherical coverage requirement of 50%-tile should be kept for single direction. Option 2 can guarantee it. Because K samples are selected from the legacy spherical coverage requirement. And, based on K sample(s) + Full Set, CDF for EIS spherical coverage of multi-Rx can be simply investigated. Also it can reduce additional test time up to K times comparing to Full Set + Full Set. For Option 1,- Generally ok, however, it can limit UE implementations.For example, in case of implementation that V-pol and H-pol produce each beam pointing to different directions, it cannot guarantee the legacy spherical coverage requirement from a single direction with the existing test procedure.For Option 3,- EIS total spherical coverage requirement needs to be specified based on evaluation. As starting point, we can support keeping the same coverage N%-tile in the existing requirements.For Option 4,- Formula can be considered for discussion. However, it is not necessary to be defined in RF requirements.For Option 5,- It’s a new concept of ‘composite area’. The concept can be considered for discussion. However, it is not necessary to be defined in RF requirements. Spherical coverage requirement needs to be defined considering different implementations.For Option 6,- We would like to keep same/similar concept rather than new concept for spherical coverage requirements. For EIS tolerance, test time seems to be tremendous.. |
| Xiaomi | Support Option 3, using the same coverage N%-tile in the existing requirements as baseline, whether to relax the requirements need further study. For Option 1, it also depends on the mutual impact between different panels or beams. |
| Nokia | Propose option 1.For proposal 2, what is the reason to select K samples at same point of CDF 50%-xile, can we have different samples at different CDF %-xile?Ok with proposal 3.For proposal 4, not clear how the equations can be used to define the requirements.For proposal 5, so UE have to declare its composite area for the requirements and test?For proposal 6, so there are no absolute requirements on EIS\_0 for AoA1 and AoA2 themselves? |
| Samsung | For option 1, it seems better to discuss detailed requirements after requirement framework is agreed;For option 2, we think it is good candidate in principle but further clarification needed for how K samples selected. Finally only one of the K is used if understanding is correct.For option 3, we support to maintain 50% for PC3For option 4, the equation involves almost all permutation of AoA pair which may not be practical to measure.For option 5, in our view implementation agnostic is preferred, the requirements should be inclusive to either UE with overlapped coverage or not.For option 6 we wonder if top50% will always work. It is possible that the top50% coverage is contributed by a single panel. |
| Sony | 1. In our view, to make the requirement being meaningful, it is important the total sensitivity level from two different direction is better than single AoA case, otherwise, there is no point for the network to configure the UE with mTRP. However, it is questionable if we need to mandate one of the Rx chain can always reach the single AoA requirement, this needs to be further studied.
2. This proposal to our understanding is related to test reduction. In our view, this can be discussed in later stage.
3. It is hard to agree with this proposal without clear definition of two AoA EIS and two AoA spherical coverage.
4. We agree with the math, the main thing need to be discussed and agreed by the group is that condition for a test point pass the EIS test:
5. It is unclear why we need such a concept.
6. We appreciate the further clarification from vivo. However, Since EIS from each AoA would be tested anyway here, we think it is sufficient to set absolute requirement and it is not necessary to set the additional tolerance requirement.
 |
| Ericsson | It is not entirely clear what the test is going to verify. Presumably that performance of 2L (and 4L) DL-MIMO can be improved with SDM-capable UE?Suppose that two probes with fixed angular separation provides a specific EIS, equal from the probes, such that the BLER is met. The DUT is rotated, and the spherical coverage measured, then pass for each position of the DUT at which the BLER is met? This would be somewhat similar to FR1 REFSENS test. Then the metric in (4) could be used for the CCDF.Alternatively, fix one of the EIS levels of one of the probes to the 50%-ile of the existing EIS spherical coverage requirement and adjust the EIS of the other like in the standard EIS test. Swap the roles and look at a common spherical coverage area. The layers can be transmitted with different polarization.The test should also make sure that both panels are used.UEs only capable of simultaneousReceptionDiffTypeD-r16 could also be verified but with the same L transmitted from each port (different RMC). |
| Qualcomm | In our view it is important to first agree on the parameter that we are going to create the requirement on. This is good discussion, but we first need to understand what is meant by sensitivity. |
| Lenovo | 1. Does this mean that if UE passes EIS with single TRP at then it also passes EIS at when a second TRP is added at , regardless of the angular separation of and and any PSD difference?
2. We think this is a good candidate, but would like to understand how it relates to a spherical coverage requirement.
3. The meaning of this proposal is not clear to us. Is this similar to Proposal 1?
4. We support as proponent. Also, we appreciate the comment from Sony. In our paper, we look at the CDF that the EIS for a first TRP at and the EIS for second TRP at are both less than when measured simultaneously. Thus we propose defining coverage in terms of the pairs such that

Even if this set definition is not acceptable, we think some similar definition of spherical coverage is needed before testing can be defined.1. It is not clear to us why this definition is needed unless it is used to indicate that there are multiple Rx resources in the overlap region (at least one from each panel).
2. Is the purpose of limiting ∆EIS\_1 = EIS\_0AoA1 - EIS\_1 to limit the maximum desense from the second TRP? Does this matter if EIS\_1 is still acceptable?
 |
| Intel | Similar view as Qualcomm, we should agree on the requirement definition first |

## Companies views’ collection for 1st round

### Open issues

See previous subsection 1.2

### CRs/TPs comments collection

N/A

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | **Status summary**  |
| **Sub-topic#1** | *Tentative agreements:**Candidate options:**Recommendations for 2nd round:* |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

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| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on … | YYY |  |
| LS on … | ZZZ | To: RAN\_X; Cc: RAN\_Y |
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**Existing tdocs**

|  |  |  |  |  |
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| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
|  |  |  | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
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Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-211xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-211xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-211xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
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Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
	1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
	2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

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|  |  |  |
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Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)