**3GPP TSG-RAN WG4 Meeting # 97-e R4-2017631**

**Electronic Meeting, November 2 – 13, 2020**

**Agenda item:** 13.1

**Source:** Moderator (Apple Inc.)

**Title:** Email discussion summary for [97e][331] FS\_FR2\_enhTestMethods

**Document for:** Information

# Introduction

*The email discussion on FS\_FR2\_enhTestMethods is organized into the following topics:*

* Topic #1: Test methodology for high DL power and low UL power test cases
* Topic #2: Solutions to minimize the impact of polarization basis mismatch between the TE and DUT on the RF testing
* Topic #3: Testability enhancements to support the verification of RF requirements for inter-band (FR2+FR2) CA
* Topic #4: Extreme temperature conditions for all applicable FR2 UE RF test cases
* Topic #5: Testability enhancements to support the verification of RF requirements for FR2 DL 256QAM
* Topic #6: Testability enhancements to reduce test time
* Topic #7: Testability aspects for the introduction of the new band n262
* Topic #8: Rapporteur input

We note that Topic #5 did not receive any contributions during this meeting.

# Topic #1: Test methodology for high DL power and low UL power test cases

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2014267](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014267.zip) | Qualcomm Incorporated | **Impact on beam management due to spherical wavefront in DL**  Observation 1: Impact of non-spherical WF of the DL reference signal requires further study before general conclusions can be drawn for all power classes, and all reasonable packaging variants for each power class. |
| [R4-2014919](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014919.zip) | Apple Inc. | **TP to TR38.884 on High DL and Low UL power test cases**  Proposal 1: It is proposed to approve the text proposal related to the high DL and low UL power test cases objective. |
| [R4-2015319](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2015319.zip) | CAICT | **Test methodology for high DL power and low UL power test cases**  Observation 1: The path loss is about 18dB lower than IFF/DFF method at the same range length 1.35m.  Observation 2: The path loss is about 3dB lower than traditional NF method at 0.22m range length. It means the measurement dynamic range and signal-to-noise ratio will be improved.  Observation 3: The method based on the coaxial cone TEM cell does not rely on the test antenna. It realizes the combination function of anechoic chamber and antenna.  Observation 4: The equivalent quiet zone is the area close to the outer conductor. Accordingly, the larger the cavity of the coaxial cone TEM cell, the larger the equivalent quiet zone.  Proposal 1: The method based on coaxial cone TEM cell could be used as one of the UE RF testing methods.  NOTE: late contribution |
| [R4-2016213](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2016213.zip) | Keysight Technologies | **On Test methodology for high DL power and low UL power test cases**  Observation 1: White box testing generally requires the declaration by the manufacturer which antenna panel is active in any UL/DL test direction and the detailed locations of the panels within the DUT for full test case coverage  Observation 2: If white box test approach is selected for an enhanced NF test methodology supporting all conformance test cases, a vendor declaration is required which antenna panel is active in any UL/DL test direction and the detailed locations of the panels within the DUT.  Observation 3: If white box test approach is selected for an enhanced NF test methodology meant to provide full conformance test case coverage, x-y-z positioning systems to fully automate test cases will likely affect the Quality of QZ MU and increase test system complexity as well as test time.  Observation 4: If white box test approach is selected for an enhanced NF test methodology meant to provide coverage for the low UL/high DL power test cases only, a limited vendor declaration is needed, i.e., the phase centre offset of the panel yielding TX/RX beam peak radiation.  Observation 5: Feedback whether enhanced testability methods need to perform beam peak searches and spherical coverage tests was inconclusive.  Observation 6: For CATR test systems based on IFF test methodology white box vs black box testing makes little difference  Observation 7: For DFF and DNF systems, white box testing could eliminate the offset MU and potentially yield quality of quiet zone MUs for DFF and DNF based test systems similar to those of CATR based test systems  Observation 8: For white box testing, the min. range lengths for NF systems capable of single direction, TRP, and spherical coverage test cases is larger than for black box testing  Observation 9: The reduction in pathloss for NF systems is about 13dB (11dB) for black (white) box testing when compared to IFF.  Observation 10: The NF interface distances of 4x1 and 8x2 antenna arrays are in the FF of the single element.  Observation 11: The 50%-ile EIRP is approximated within ~1dB with the direct NF methodology  Observation 12: The EIRP beam peak (100%-ile EIRP) and direction cannot be measured accurately with the direct NF methodology.  Observation 13: Performing black-box DNF measurements with a UE and offset antennas in the known beam peak direction can yield incorrect EIRP/EIS measurements  Observation 14: Performing accurate black-box NF measurements with a UE and offset antennas requires local searches around the known beam peak direction to improve EIRP/EIS measurements.  Observation 15: When performing NF measurements of NR FR2 devices utilizing beam forming, the beam forming of the UE towards the NF measurement probe could result in measurements of undesired beams and incorrect EIRP/EIS beam peak measurements  Observation 16: Very large near-field path loss differences can be observed for NF testing methodology without any transform.  Observation 17: The novel NF testing approach with Transform shows very promising measurement accuracies for NF EIRP measurements utilizing the black-box approach  Observation 18: The novel NF testing approach with Transform can accurately predict the offset of the antenna array from the centre of QZ.  Observation 19: The black&white box approach (white: phase centre offset of active panel is declared; black: geometric centre of DUT is aligned with centre of QZ) does not require a FF probe to steer and lock the antenna beam towards the FF beam peak direction and has the same advantages as the black-box approach over the white-box approach.  Observation 20: The novel NF testing approach with Transform yields similar measurement accuracies for NF EIRP measurements utilizing the white&black-box approach when compared to the black-box approach  Observation 21: Large uncertainties can be observed for TRP for measurements performed in the NF utilizing the black back box approach.  Observation 22: With the offset of the antenna array known, e.g., estimated with the enhanced NF methodology introduced in this contribution, very accurate TRP measurements in the NF can be made with a TRP offset compensation approach  Proposal 1: Keep the black box test approach for NR FR2 conformance testing  Proposal 2: Adopt the effective antenna aperture approach, i.e., taking into account the frequency dependence of the max antenna array aperture, for NF range length determinations  Proposal 3: Do not consider the Direct NF methodology as enhanced methodology for conformance test cases.  Proposal 4: For black-box approach applied to NF measurements, NF systems to utilize a FF probe and UBF activation that allows the UE to select the intended beam.  Proposal 5: The NF testing methodology utilizing black-box approach without any transform cannot be considered for NR FR2 testing for EIRP/EIS based metrics.  Proposal 6: Feedback from industry is requested whether to continue efforts in terms of simulations and empirical investigations on this enhanced NF methodology with transform utilizing black-box approach  Proposal 7: Feedback from industry is requested whether to continue efforts in terms of simulations and empirical investigations on this enhanced NF methodology with transform utilizing the white&black-box approach  Proposal 8: Feedback from industry is requested whether the combination of black and white&black box approaches is acceptable to avoid the need for a vendor declaration.  Proposal 9: When performing TRP measurements in the NF, the offsets should be compensated to improve the measurement uncertainty. |
| [R4-2016377](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2016377.zip) | MVG Industries, Sony | **Impact of phase variation**  Observation 1: At distances less than classical FF (ideal case) distance, the selected beams are different with respect to the FF case.  Observation 2: Figure of merits such as EIRP, TRP, and Spherical Coverage are not influenced dramatically from range length. This is valid in both static beam and dynamic beam scenarios |
| [R4-2016562](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2016562.zip) | Rohde & Schwarz | **Views on test methods for high DL power and low UL power TCs**  Observation 1: Current permitted methods can be enhanced without any impact on test time or measurement uncertainty.  Observation 2: TRP measurements can be performed at Derat distance without impact on the MU.  Observation 3: FSPL improves by ~7dB for Direct Near Field measurements at Derat distance compared to IFF/DFF.  Observation 4: Displacement correction for TRP measurements based on manufacturer declaration will reduce MU for DNF systems.  Proposal 1: Non-permitted methods should be only considered if the improvement is better than the performance shown in table 3-1.  Proposal 2: Focus on the definition of DNF methodology based on Derat distance and the displacement correction based on manufacturer declaration. |

## Open issues summary

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

*NOTE:* [R4-2015319](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2015319.zip) *was submitted late, and the proposal is not included in the moderator summary. However, if consensus could be reached based on the proposal, then it could be included in the WF emerging from Round 1 discussions.*

### Sub-topic 1-1: Beam management sensitivity of NF based solutions

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 1-1-1: Simulation assumptions for beam management sensitivity of NF based solutions**

*Based on the agreed WF from the last meeting [R4-2012713], the agreed simulation assumptions can be captured in the following table:*

|  |  |  |
| --- | --- | --- |
| Parameter | Value | Notes |
| Spherical coverage Measurement Grids baseline assumption | Annex G.1.1 in TR38.810 |  |
| Antenna array | 8x2 and 4x1 | Element near-field assumption is implementation specific |
| Simulated DUT | Two antenna arrays are integrated in the UE for the spherical coverage analyses  - Antenna panels are studied with Nz x Ny with Nz>Ny, e.g., 8x2 corresponds to Nz = 8 and Ny = 2  - The implementation loss for the antenna near the front is 0dB less than that for the antenna near the back  - The antenna in the back is on the opposite side of the UE (mirrored around (0,0,0)). | See Figure 5.1.2-1 for example positions of two antenna arrays |
| Beam steering | - In the xy plane, assume 45o beam steering granularity (AZ from -45o to +45o)  - In the xz plane, assume 22.5o beam steering granularity (EL from -90o to 90o) |  |
| Offsets | - Various antenna offsets (yoffset, zoffset) beyond 7.5cm in radius (12.5cm max) | Offset is defined with respect to the center of antenna array |
| Range Lengths | - 30cm, 20m (more range lengths are not precluded)  - Goal is to eventually determine min. range length and MU for performing spherical coverage tests in DNF | Defined as distance between centre of QZ/positioning axes and measurement probe |
| Test methodology | DNF (while taking path loss offsets into account) |  |
| Sampling grid | Study finer than 7.5deg step size for constant-step size grids | Parametric studies to show convergence for the selected assumption |

*The intention of this Issue is to collect company views on further improvements of the simulation assumptions*

* Proposal:
  + Alt 1-1-1-1: Include additional simulation assumptions according to [R4-2014267](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014267.zip):
    - Antenna element beams: Half power beam widths reduced from 260/130 to 90/90 (deg); Field was assumed to hold in array configuration in presence of other elements
    - Antenna array: 8x2 array, 3x5 beam positions; 2 equally competent arrays on opposite faces of a 6- sided box that is the UE
    - Field perturbation due to near field probe neglected; Field perturbation due to DUT fixturing neglected
  + Alt 1-1-1-2: Include the following simulation assumptions for TRP analysis according to [R4-2016213](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2016213.zip):
    - Uniform distribution of offsets within the QZ; see contribution for histograms of each parameter, theta, phi, offset radius, x, y, and z.

**Issue 1-1-2: Results collection for beam management sensitivity of NF based solutions**

*Simulation results were provided in* [R4-2014267](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014267.zip)*,* [R4-2016213](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2016213.zip)*, and* [R4-2016377](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2016377.zip)*. The intention is to summarize the available results during the meeting. Preliminary tables are proposed below, and feedback on the table format (i.e. which metrics are useful to summarize) as well as the data is requested.*

*The table below summarizes the results from simulations of beam management sensitivity of DNF (i.e. beam peak search is performed in the NF)*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Company and reference | Swept parameters | Beam management performance maximum ∆ relative to reference (dB) | | | Notes |
| Beam peak | 50% CDF | TRP |
| Company A [R4-2014267] | Array: 8x2  Range: {0.2, 0.4, 0.8} m  Offset: {0, 0.05, 0.10} m | [0] ?? | FFS | Not analyzed | For PC3 UEs, there seems to only be mild perturbation of the spherical coverage CDF despite the dire beam choice predictions made in the study. This aspect needs to be studied further, as well as how to resolve for other power classes |
| Company B [R4-2016213] | Array: 8x2, 4x1  Range: {0.25, 0.3, 0.45, 20} m  Offset: {0.125 in y, 0.125 in z, 0.09 in y & z} m | 7.0 | 1.0 | TRP analyzed separately | The EIRP beam peak (100%-ile EIRP) and direction cannot be measured accurately with the direct NF methodology |
| Company B [R4-2016213] | Array: 8x2  Range: 0.2 m  Offset: 0.15 m in x, y, z |  |  | 0.66 dB systematic  0.46 dB RSS’ed | Large uncertainties can be observed for TRP for measurements performed in the NF utilizing the black back box approach |
| Company C [R4-2016377] | Array: 4x1  Range: {100, 4.2, 0.9, 0.45, 0.3} m  Offsets: not specified | 0.3 | [0] ?? | 0.1 | Figure of merits such as EIRP, TRP, and Spherical Coverage are not influenced dramatically from range length |

*The table below summarizes the results from simulations of beam management sensitivity of NF (i.e. beam peak search is first performed in the FF/IFF and test case is executed in the NF)*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Company and reference | Swept parameters | Beam management performance maximum ∆ relative to reference (dB) | | | Notes |
| Beam peak | 50% CDF | TRP |
| Company B [R4-2016213] (“Black box with transform approach”) | Array: 8x2, 4x1  Range: {0.22 – 0.30} m  Offset: {0, 0.50, 0.10, 0.125} m | Max µ = 0.2  Max σ = 0.3  Worst case with 99% confidence: 1.1 | Not analyzed | Not analyzed | Feedback from industry is requested whether to continue efforts in terms of simulations and empirical investigations on this enhanced NF methodology with transform utilizing black-box approach |
| Company B [R4-2016213] (“White box with transform approach”) | Array: 8x2, 4x1  Range: {0.22 – 0.30} m  Offset: {0, 0.50, 0.10, 0.125} m | Max µ = [0.1] ??  Max σ = [0.3] ??  Worst case with 99% confidence: 1.0 | Not analyzed | TRP analyzed separately | Feedback from industry is requested whether to continue efforts in terms of simulations and empirical investigations on this enhanced NF methodology with transform utilizing the white&black-box approach |
| Company B [R4-2016213] (“TRP with compensation for antenna offset”) | Array: 8x2  Range: 0.2 m  Offset: 0.15 m in x, y, z |  |  | 0.02 dB systematic  0.21 dB RSS’ed | With the offset of the antenna array known, e.g., estimated with the enhanced NF methodology introduced in this contribution, very accurate TRP measurements in the NF can be made with a TRP offset compensation approach |
| Company C [R4-2016377] | Array: 4x1  Range: {100, 4.2, 0.9, 0.45, 0.3} m  Offsets: not specified | 0.3 | [1.0] ?? | 0.8 | Figure of merits such as EIRP, TRP, and Spherical Coverage are not influenced dramatically from range length |

*The intention of this Issue is to collect company results available so far and to stabilize the format of the table so that additional results can be provided in the next meeting.*

* Proposal: Companies are encouraged to provide feedback on the table format, values in the table, and to share any other results that might have been missed in the summary

### Sub-topic 1-2: NF based solutions and test setup descriptions

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-2-1: Which NF based solutions are in scope of the SI?**

* Proposals
  + Alt 1-2-1-1: Direct near-field (DNF)
  + Alt 1-2-1-2: Near-field with assistance (NFA) of beam peak search in an FF/IFF system
  + Alt 1-2-1-3: Others?
* Recommended WF
  + It is recommended to finalize the list of applicable NF based solutions in order to enable the collection of test method setup descriptions for the next RAN4 meeting

**Issue 1-2-2: For NF based solutions what manufacturer declarations should be considered in scope of the SI?**

* Proposals
  + Alt 1-2-1-1: Only as agreed in WF [R4-2012713, slide #4]
  + Alt 1-2-1-2: Additional declarations are needed (companies are encouraged to identify these in their comments)

### Sub-topic 1-3: Enhancement of permitted methods

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-3-1: Summary of potential improvements of permitted methods**

*Based on the analysis provided in* [R4-2016562](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2016562.zip)*, a preliminary table of potential improvement of permitted methods is provided below. The intention of this Issue is to collect company views on the feasibility of the proposed potential improvements of permitted methods.*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Test Case** | **Test Metric** | **Regulatory related** | **TS 38.521-2 Test Requirements** | **Potential improvement** |
| 7.4 Maximum input level | EIS | No | 26dB relaxation for 24.25 ~ 29.5 GHz and 34 dB relaxation for 37 ~ 40 GHz with respect to minimun requirements. | ~ 6dB for FR2a  ~10dB for FR2b |
| 7.5 Adjacent channel selectivity | EIS | Yes, for case 1. | Added relaxations for ACS Case 1:   * 50MHz: 1.8dB relaxation for power in transmission BW and interferer for band n260. * 100MHz: 4.8dB relaxation for power in transmission BW and interferer for band n260. * 200MHz and 400MHz are deemed not testable.   Decision not test ACS case 2. | Similar improvements as for TC 7.4  All single carrier bandwidth could be testable 400 MHz, without relaxations up to 200 MHz |
| 6.3.2 Transmit OFF power | TRP | Yes | Relaxations for n257: 21.4dB @ 50MHz, 24.4dB @ 100MHz, 27.4dB @ 200MHz and 30.4dB @ 400MHz.  Relaxations for other bands are still TBD. | ~ 10dB for FR2a and FR2b |
| 6.5.2.3 Adjacent channel leakage ratio | EIRP | Yes | Relaxation for n257, n258 and n261: 0dB, except for 200Mhz (0.5dB in one test ID) and 400MHz (between 1.5 and 3.5dB) | Improvements remove required relaxations from TC |
| 6.3.1 Minimum output power | EIRP | No | No relaxation for PC1. For other power classes, relaxation varies from 0dB to 13.5dB depending on the operating band and channel bandwidth. | ~ 10dB for FR2a and FR2b  FR2a requirements testable without relaxations |

* Proposal: Companies are encouraged to provide feedback on the table format, values in the table, and to share any other results that might have been missed in the summary

**Issue 1-3-2: Criteria for consideration of non-permitted methods**

* Proposal: For a given test case, non-permitted methods should be only considered if the improvement is better than the potential improvement of the permitted method.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Issue** | **Company Comments** |
| Issue 1-1-1: Simulation assumptions for beam management sensitivity of NF based solutions | MVG: Based on the simulation results from R4-2014267, R4-2016213, and R4-2016377, we can clearly say the results are DUT dependent. DUT’s beams patterns are affecting the simulation results. Specifically, we ran some further simulation to compare the figure of merits when considering FS arrays and arrays on a phone size ground plane. New results are reported under issue 1-1-2 as a comment to KS contribution R4-2016213.  Keysight: We are open to considering alternate assumptions even though the antenna element and HPBW assumptions were clearly agreed in the WF (“simulation assumptions are the same as outlined in Annex G.1.1 in TR38.810”). The simulations for testability aspects have always been assuming a FS configuration while the simulations related to performance requirements assumed full phone model; this SI is not related to requirements discussions but testability.  MVG: It looks simulation results are DUT dependent. It means conclusions could potentially be DUT dependent. If with the arrays used for testability (FS) we found 3dB delta for EIRP max and with the arrays (phone model) used for performance requirements the error is only 0.5dB why we should drop DNF? Certainly, MVG can simulate an 8x2 antenna arrays implementation in FS and on phone size ground plane. |
| Issue 1-1-2: Results collection for beam management sensitivity of NF based solutions | MVG: Comment to KS contribution R4-2016213.  We have been trying to address some of the difference seen between our results and KS’s ones. Specifically, we focused on the 4x1 linear array. In our simulation a full phone model (including the PCB and phone house) has been considered. This is in line with the simulation setup for UE spherical coverage discussion in FR2 (38.101-2). In order to see whether the simulation results are affected by the DUT beams patterns, we also simulated two FS arrays with using the same y and z offset. EIRP peak error and CDF curves have been then compared for the two scenarios. Here is a summary of our results:    Differences can be observed between Ground plane and FS. Our FS results are in better agreement with KS. It looks KS is simulating a FS arrays. Here is also a CDF curves comparison:  Chart, line chart  Description automatically generated  Due to the fact EIRP max error is seen in the direction of the beam, we ran some simulations to understand the direction of the beam for the arrays simulated by KS and MVG. Results are also reported in summary table above. Looking at those results can be observed that for the MVG case (Free space) the error is worse for z-offset than y-offset because the antenna has a narrower pattern in elevation while KS sees higher error with the y-offset. However. MVG and KS results with z-offset compares better than the y-offset.  On the other hand, we were observing good agreement between our simulation results (R4-2016377) and simulation results in R4-2014267). Both beam selection error study and spherical coverage curves at different distances seem to be consistent between the two contributions.  R&S: based on the results provided by MVG in R4-2016377, table 1, it seems that the 0.1dB error on TRP is not defined properly since it assumes that the Beam Peak direction is selected also using the NF antenna (i.e. Dynamic Beam scenario) while it should be compared with the case where the beam is selected with a FF method (i.e. Static Beam scenario). In other words, the 0.1dB error should be added to the error in the Beam Peak search in the NF.  We support the proposal to extend the simulation study to further tune the results but, looking at the results presented to this meeting, the usage of a DNF method in combination with a IFF test system is the optimal approach.  Keysight: we would encourage MVG/Sony to consider the 8x2 antenna array as well as it allows beam steering in two and not just one direction. We ran additional simulations further reducing the HPBW of the single-element antenna arrays to 90o/90o which drastically reduces the beam towards the back and therefore mimics MVG’s simulations with a ground plane. The results are summarized in the following table   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | **Antenna Array Assumption** | **Offset [cm]** | | **Peak EIRP Delta at 25cm - NF Beam Peak Direction-** | | **Peak EIRP Delta at 25cm - FF Beam Peak Direction (90o,0o)-** | **Did UE select different beam between NF beam peak direction and FF beam peak direction?** | | **in y** | **in z** | **EIRPNF -EIRPFF [dBm]** | **(,) [o]** | **EIRPNF -EIRPFF [dBm]** | | **8x2** | **9** | **9** | **1.89** | **(50,32)** | **-4.23** | **yes** | | **12.5** | **0** | **1.74** | **(90,60)** | **-2.86** | **yes** | | **0** | **12.5** | **2.24** | **(40,0)** | **-2.98** | **yes** | | **4x1** | **9** | **9** | **2.4** | **(90,52)** | **-2.31** | **yes** | | **12.5** | **0** | **2.46** | **(53,44)** | **-1.9** | **yes** | | **0** | **12.5** | **2.39** | **(40,0)** | **-2.24** | **yes** |   Clearly, even these simulations show the concerns with DNF outlined in R4-2016213.  Additionally, sample CDF curves and patterns for the (9cm/9cm) offsets are enclosed as well.  4x1 Antenna Array      8x2 Antenna Array:      These results clearly indicate that the DNF methodology should not be considered further as part of this SI.  Additional TRP simulations are ongoing and will be provided shortly.  MVG:  To KS:  We have two set of simulation results on the table that don’t match. We have also a third set of simulations which in terms of CDF curves and beam selection error go in the direction of MVG’s simulation. We cannot drop the DNF solution just looking at results from one company. Moreover, we shouldn’t look at results for only 25cm range length. We think that at the end one of our goal is to find a minimum distance for DNF. Offset is another issue here. What we agreed in the WF is that the offset is “Various antenna offsets (*y*offset, *z*offset) beyond 7.5cm in radius (12.5cm max)”, which means the 7.5 cm<=offset <= 12.5 cm are all meaningful results. The results from KS are only based on 12.5 cm, which stands for the worst case.  Our view is that even if the DNF cannot support an offset as large as 12.5cm, it is still meaningful to understand the maximum offset it can support, specifically for a smartphone, which typically has a smaller offset. Can KS provide results for Peak EIRP error and CDF curves when considering 4x1 arrays at (0,3.5,7.5) cm offset? This is what we simulated at the end. Even though DUT is not the same, offset and arrays dimension are the same.  To R&S:  We didn’t quite understand your comment above table 1. When estimating the TRP error, we have been considering always TRP in FF (computed on the FF beam) as the reference. This is the same for both static and dynamic beam scenarios. For the static case, beam ID is the same between FF and at distance R. It is only the beam pattern difference that affect the error. For the dynamic case, there are two errors affecting TRP, the beam ID which is different between FF and at distance R and the beam pattern error at distance R.  Qualcomm:  We commented in our paper (R4-2014267) that ‘*there seems to only be mild perturbation of the spherical coverage CDF despite the dire beam choice predictions made in the study*’. On further analysis we uncovered some book-keeping errors in the simulation code. We have since corrected those and would like to update our prediction of spherical coverage CDF based on a UE with module offset (0, 5cm, 10cm), same as that considered in the paper.    There is approximately 2.5 dB of BP error when range length is reduced to 0.2m in presence of the module offset mentioned above. There is also significant perturbation of the CDF curve. CDF statistics start to converge when the range length is at least 4 times the offset.  MVG: It looks QC focused on 20cm range length to draw their conclusion (BP EIRP error). Looking at the CDF curves (as QC confirmed), there is convergence at range length in between 0.3m and 0.4m. It is not also clear what offset was used for simulating the CDF curves. As far as we have understood three offsets, 0cm (white box approach), 5cm and 10cm have been simulated. Which offsets set the CDF curves are referring to?  As a general comment, in R4-2012713 (WF from RAN4#e-96 was stated: Range Lengths (distance between centre of QZ/positioning axes and measurement probe):   * + 30cm, 20m (more range lengths are not precluded)   + Goal is to eventually determine min. range length and MU for performing spherical coverage tests in DNF   We think we made good progress eventually to address bullet 2 above. We think we might concentrate on simulating range length ≥30cm.  R&S  Response to MVG: our comment is precisely related to what you point out: “For the dynamic case, there are two errors affecting TRP, the beam ID which is different between FF and at distance R and the beam pattern error at distance R.”. Therefore, the 0.1dB error for the TRP result in the dynamic case is assuming the measured beam is different from the actual Beam Peak in FF and thus it should not be used as the value for comparison.  Response to KS: in all these simulations, the range length for DNF is assumed to be the boundary between reactive and radiative near-field, while in our contribution we presented a different definition for the range length calculation that makes all metrics (directional or TRP) still valid when tested in combination with a FF method that sets the beam under test.  The simulation agreed for this meeting was meant to assess the beam sensitivity due to NF, but it does not preclude the use of DNF when used in combination with a FF method as shown in our contribution.  MVG:  Response to R&S: We have found (reported on our contribution) that for the dynamic beam scenario, the two errors are compensating each other. This is why the TRP error is less than for static beam scenario. As we said, the reference is always the TRP measured in FF with its on beam selection.  Keysight:  As requested by MVG, we ran additional analyses with smaller offsets. Here, offsets of 7.5cm in x (not previously presented/considered), y, and z, as well as offsets of 5.3cm in y and z were considered for the 8x2 and 4x1 antenna array. While for these cases, the UE select the same beam in the NF as in the FF more often, we still see concerning trends with the peak EIRP deltas.   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **Antenna Array Assumption** | **Offset [cm]** | | | **Peak EIRP Delta at 25cm - NF Beam Peak Direction-** | | **Peak EIRP Delta at 25cm - FF Beam Peak Direction (90o,0o)-** | **Did UE select different beam between NF beam peak direction and FF beam peak direction?** | | **in x** | **in y** | **in z** | **EIRPNF -EIRPFF [dBm]** | **(,) [o]** | **EIRPNF - EIRPFF  [dBm]** | | **8x2** | 0 | 5.3 | 5.3 | 0.32 | (78,16) | -10.41 | no | | 7.5 | 0 | 0 | 2.81 | (90,0) | 2.81 | no | | 0 | 7.5 | 0 | 0.38 | (90,22) | -1.82 | no | | 0 | 0 | 7.5 | 0.56 | (52,0) | -3.07 | yes | | **4x1** | 0 | 5.3 | 5.3 | 0.6 | (77,23) | -2.61 | no | | 7.5 | 0 | 0 | 3.05 | (90,0) | 3.05 | no | | 0 | 7.5 | 0 | 0.77 | (90,30) | -0.8 | no | | 0 | 0 | 7.5 | 0.7 | (52,0) | -1.29 | yes |   Some sample CDF curves below:      Additionally, the scenario that QC simulated in their contribution with two 8x2 antenna arrays offset by (0,5cm,10cm) was simulated. These results show very similar beam peak differences, e.g., the 20cm range length yield ~2.5dB higher EIRP than in the FF which is exactly what QC is claiming in their revised plots. At this point, it seems our simulations are aligned with those from another company. I hope that MVG could provide simulations for the 8x2 antenna array show similar behaviour. It would be good if MVG could confirm that they are seeing that the DNF approach often makes the UE pick a beam different than if the probe was in the FF.    We cannot agree with MVG’s approach to define scenarios where the DNF approach is applicable while avoiding scenarios we agreed to consider. The results with small offsets and the 4x1 antenna arrays might show favourable arguments for the applicability of DNF for CDF curves. However, only because the CDF curves align does not necessarily mean that we can measure EIRP reliably. More importantly, we need to consider the simulation assumptions we agreed on, i.e., “offsets beyond 7.5cm in radium (12.cm max)” as well the 8x2 antenna array; unfortunately, MVG chose to pick simulation assumptions that were not in line with what we agreed and skipped important assumptions necessary to get a full picture on DNF. Based on the results presented in this summary and our contribution, these results clearly show that DNF is not universally applicable for the traditional NF distance for PC3 devices within a 30cm QZ.  Additionally, additional TRP MU (mean error and std. dev.) simulations are presented below for the 8x2 antenna randomly offset from the centre of QZ by up to 12.5cm; the measurement grid is a constant-step size grid with 10o step size. TRP was calculated with and without compensating the offset. The offset could be known either via a vendor declaration or the novel NF approach with Transform as outlined in R4-2016213. The results clearly show that TRP MUs can be improved by compensating the offset and a range length of 20cm is sufficient. Without compensating the offset, a range length of 25-28cm seems suitable with acceptable MUs; this MU might further increase once a direction probe antenna is considered (currently used to be isotropic).   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Range Length [cm] | With Offset  Correction | | Without Offset Correction | | | Mean TRP Error [dB] | TRP Std. Dev. [dB] | Mean TRP Error [dB] | TRP Std. Dev. [dB] | | 20 | 0.02 | 0.13 | 0.40 | 0.26 | | 25 | 0.03 | 0.06 | 0.24 | 0.15 | | 28 | 0.03 | 0.04 | 0.19 | 0.11 | | 32 | In progress | | 0.14 | 0.08 | | 43 | 0.08 | 0.04 | | 100 | 0.01 | 0.01 |   *Response to R&S regarding (“in our contribution we presented a different definition for the range length calculation that makes all metrics (directional or TRP) still valid when tested in combination with a FF method that sets the beam under test.”):* We believe additional analyses are needed on the accuracy/MU of EIRP measurements with offsets discussed here; additionally, beam steering assumptions need to be included which I believe have not been considered in R&S analyses, specifically whether at that range length the correct beam (same as FF) is chosen reliably. |
| Issue 1-2-1: Which NF based solutions are in scope of the SI? | MVG: Only support Alt 1-2-1-1: Direct near-field (DNF). We have to be careful with regard to Alt 1-2-1-2. Basically, this is a new setup where we do introduce a NF probe in a well-defined geometry of the CATR. Is the NF probe in when doing beam search? CATR is not so flexible as a testing solution. Its performances are determined essentially by the geometry (optic) of the setup. What is the sensitivity of the CATR performances w.r.t the NF probe?  vivo: we support to keep both Alt 1-2-1-1 DNF and Alt 1-2-1-2 Novel NF method. For DNF method, we can also do small-area local searching to find a better EIRP.  R&S: Direct Near Field (as defined in R4-2016562) with the assistance of a FF system is the optimal approach.  To MVG’s comment, the DNF probe can be carefully placed in such a way that it does not affect the performance of the IFF part of the system (i.e. CATR). DNF probe may be in the system while the Beam Peak search (or any other test case) is performed using IFF.  KS:   * Alt 1-2-1-1 (DNF): the DNF methodology, i.e., NF without a transform, does not seem feasible in our opinion due to the large BP search result differences (Figure 15-18 in 6213 and comments in Issue 1-1-2), due to the potential to measure vastly different EIRPs without any transform (Figure 30 in 6213), especially for antennas offset in x, and the fact that DNF measures the incorrect beam when compared to a FF methodology (as highlighted by QC as well). * Alt 1-2-1-1 (hybrid NF and FF): this seems the most suitable approach to allow re-use of existing status-quo IFF based systems and integration of NF methodology into the same system without the need for additional test systems, floor space, etc. With regards to MVG comment, the NF probe would not be present in the CATR during the IFF measurements. How the probe is introduced in the CATR for the NF measurements is up to the vendors and there should be various ways to introduce and remove the probe. * Alt 1-2-1-3: regarding the coaxial Cone TEM cell approach. It seems, if the UE has to be placed in between the inner and outer conductor, as outlined in Figure 3 of 5319, the total size of the TEM cell to support a 30cm QZ including 3D positioner would have to be quite significant. Additionally, we believe that it will be very challenging to guarantee to keep the EM distribution to only TEM mode. We are concerned that the modes with higher orders will deteriorate the accuracy of the test results. Especially introducing a positioning system between the conductors could act as stirrer (similar to reverberation chambers) and thus further lead to higher order modes. Below some preliminary simulations we performed.   MVG: We have two set of simulation results on the table that don’t match. We have also a third set of simulations (from QC) which in terms of CDF curves and beam selection error go in the direction of MVG’s simulations. MVG did also clearly show the limitation of the DNF for beam selection (NF beam ID is different than FF beam ID). Anyway, CDF curves and EIRP error are relative small. We think we should have time to reproduce the EIRP error KS is showing for the mentioned 8x2 antenna arrays setup. We cannot drop a testing methodology just because one company is reporting big error on the figure of merits.  CAICT:  Based on path losses for DFF and NF systems in Table 4, the reduction in pathloss for NF systems is about 13dB (11dB) for black (white) box testing when compared to IFF. For coaxial cone TEM cell method (R4-2015319), the path loss can be smaller. It is about 18dB lower than IFF/DFF method at the same range length 1.35m and 3dB lower than traditional NF method at 0.22m range length. It means the measurement dynamic range and signal-to-noise ratio will be improved. In addition, the method based on the coaxial cone TEM cell does not rely on the test antenna. It realizes the combination function of anechoic chamber and antenna. And the space, testing time and cost will be greatly reduced.  Table 1: Path losses for DFF system, traditional NF system, and coaxial cone TEM cell   |  |  |  |  | | --- | --- | --- | --- | | ***f* [GHz]** | **PC3 Devices: D=5cm** | | | | **IFF/DFF** | **Traditional NF** | **Coaxial cone TEM cell** | | **Path Loss with 1m range length** | **Path Loss with 0.22m range length** | **Path Loss with 1.35m range length** | | **24.25** | **60.16** | **46.86** | **43.87** | | **30** | **62.01** | **48.71** | **45.72** | | **40** | **64.51** | **51.21** | **48.21** | | **43.5** | **65.24** | **51.94** | **48.94** | | **52.6** | **66.89** | **53.59** | **50.59** |   Response to KS:   * Yes, the total size of the TEM cell to support a 30cm QZ including 3D positioner would have to be quite significant. In order to support a 30cm QZ, it needs a higher and larger coaxial cone TEM cell. Technically it is also achievable, the path loss for 30cm QZ coaxial cone TEM cell is about 5dB lower than IFF/DFF method while the testing time is significantly reduced, so we think this method is feasible. * Yes, it is important to keep the EM distribution to only TEM mode. In fact, by testing VSWR, it is found that it is less than 1.5 at most frequency points. Since the absorber including the load is placed on the coaxial cone TEM cell, and the DUT is placed near to the absorber, it can absorb most high-order modes. We did an experiment and placed the 3D positioner in the coaxial cone TEM cell, which has no significant effect on VSWR. In addition, whether it is the FF or the NF, the positioning system will disturb the field, and the effect is common.   Sony: Support Alt 1-2-1-1 DNF.  R&S: to Keysight’s comment, we share the view that a hybrid/combined system between FF and NF is the optimal approach. Whether the NF measurement is implemented as DNF (with the test range length defined as per R4-2016562) or NF with transform is still FFS.  We do not agree with the comment showing the need to remove/introduce the NF antenna in this hybrid/combined system. As far as the NF probe is present during QoQZ measurements for the FF method we don’t see the need to remove or hide it during FF measurement.  Keysight:  On the TEM cell, we believe more analyses are needed before we can further consider this approach. While the path loss results are promising, there might be various other items that need further work  As mentioned earlier, we cannot agree Alt 1-2-1-1 as we do not believe DNF is universally applicable to PC3 devices in a 30cm.  How the NF antenna is introduced in a hybrid NF/IFF system is up to the system vendor. |
| Issue 1-2-2: For NF based solutions what manufacturer declarations should be considered in scope of the SI? | Samsung: we’d like to clarify that the manufacturer declarations listed in WF [R4-2012713, slide #4] are only “potential candidate” declaration, those are not agreed ones. Based on previous discussion and contributions to this meeting, white-box approach does not show significant benefits, if a conclusion has to be made, black-box approach is preferred and no manufacturer declaration is needed.  vivo: we also prefer to keep Black box approach. However, if the group thinks white box is the key to enhance the test methodology, especially for DNF, we think only location of the active panels that yields the TX and RX beam peaks should be declared.  R&S: as described in some of the contributions to this meeting, the accuracy of TRP measurements in the DNF can be improved by correcting the displacement of the radiating source from the axis of the coordinate system. Assuming a combined system DNF+FF assistance, the easiest way to implement this displacement correction is to use a manufacturer declaration of this offset for the panel yielding the Tx/Rx beam peak.  KS: The need and level of vendor declaration essentially comes down to whether the white or white&black box approach is endorsed (KS proposal is to focus on black box approach which does not require any vendor declarations)   * Extensive manufacturer declaration is required if NF methodology needs to perform beam peak searches and spherical coverage, e.g., Table 1 of 6213  |  |  |  | | --- | --- | --- | | **Number of Antenna  Panels in DUT** | # | | | **Antenna Panel #** | **Phase-centre offset from geometric centre of DUT:** | **Range of Angles covered by Antenna Panel** | | 1 | (*x*off1, *y*off1, *z*off1) | (start1 to end1,start1 to end1) | | 2 | (*x*off2, *y*off2, *z*off2) | (start2 to end2,start2 to end2) | | … | … | … | | N | (*x*offN, *y*offN, *z*offN) | (startN to endN,startN to endN) |  * Simple manufacturer declaration is required if NF methodology does not need to perform beam peak searches and spherical coverage, e.g., Table 2 of 6213  |  |  | | --- | --- | | **Antenna Panel (yielding TX beam peak radiation** | **Phase-centre offset from geometric centre of DUT:** | |  | (*x*off, *y*off, *z*off) |   Since the offset of the antenna array can be estimated using the NF approach with transform (using black box), the TRP MUs can be further improved (TRP simulations with and without compensating offsets are in process)  Sony: We think the black box method should still be adopted as a baseline. Based on the simulation results have been provided to this meeting, the DNF can provide promising results with antenna offset. Therefore, it is preferred to have no addition manufacturer declaration. |
| Issue 1-3-1: Summary of potential improvements of permitted methods | Anritsu: We need more time to review if we will be able to obtain a similar performance with the reported values in R4-2016562.  vivo: very inspiring feedback, significant improvements to the current permitted test methodology has been made. Based on this information, we believe very promising improvements could be achieved for enhanced test systems.  Keysight: while we agree that some improvements with signal condition can be made, we believe the expected improvements are not as high as outlined in the table. Additionally, the integrated components are likely limited in terms of bandwidth and do not support FR2 completely. It should be highlighted that the improvements stated in the table would be applicable to NF as well on top of the improvements due to shorter range length.  R&S: to Keysight’s comment, would you mind to clarify what “the integrated components are likely limited in terms of bandwidth and do not support FR2 completely” means? If we consider the full FR2 frequency range (i.e. 24.25GHz to 52.6GHz), discrete components suffer from the same limitation in terms of bandwidth.  The improvements shown in R4-2016562 are valid for test cases and the range of frequencies RAN5 have analyzed so far (i.e. for FR2 bands up to 43.5GHz).  KS: our point is that the improvement due to signal conditioning are applicable to a limited range of FR2.  Apple: we consider this table a helpful starting point |
| Issue 1-3-2: Criteria for consideration of non-permitted methods | vivo: we support the proposal. In addition, several aspects should also be considered, e.g. testing time, complexity of test system/procedure, and measurement uncertainty.  Keysight: the improvements due to improved signal conditioning apply to NF methodologies just as they would apply to existing IFF methodologies. Hence, the NF methodologies generally yield an improvement on top of the existing permitted methodologies.  MediaTek: Conceptually, we think the criteria is “while all permitted methods with improvement and/or extra relaxation are not feasible/acceptable”  CAICT: Potential improvement of dynamic range is a good indicator but should not be the only one when comparing permitted and non-permitted methods. As pointed out by vivo, factors such as testing time and complexity should also be considered.  R&S: the listed improvements could be used eventually for NF methodologies, but we think is more efficient to focus the effort on NF methodologies for those test cases where relaxations are still required for IFF. Following this rationale, ACS, ACLR and Minimum output power can be removed from the list of Test Cases for NF methods.  Keysight: we cannot agree to remove any test cases for NF methods at this time.  Apple: we agree with this approach |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [R4-2014919](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014919.zip) | Samsung: we are generally fine with this TP but have some comment to clause “5.1.3 Manufacturer declarations”. Table 5.1.3-1 shows that white-box approach shows no much benefits, we’d like to go with a conclusion added that white-box approach is not considered and manufacturer declaration is not necessary, or we can keep clause 5.1.3 as “Reserved” until there is final conclusion. |
| R&S   * In order to improve clarity, in table 5.1.1-1 another column should be added to reflect the test metric (e.g. EIRP, TRP, EIS…) and measurement/link directions. * Clause *5.1.3 Manufacturer declarations* should reflect the outcome from this meeting, but it seems clear that “pure” white-box approach does not bring much improvement compared to black-box approaches (black-box understood as center of the DUT aligned with the coordinate system). It is proposed to use this section to better define the so called “Black&White-box” approach. |
| Keysight: the summary of test cases is missing the min. output power test case; it would be preferred to include portion of the vendor declaration write-up from 6213 in 5.1.3 and reflect the decision on white vs black vs black&white approach. |
| Apple: we would like to revise the TP in order to capture updates based on company comments to this topic |
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## 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:* |
| Issue 1-1-1: Simulation assumptions for beam management sensitivity of NF based solutions | *Take company inputs into account by revising the simulation assumptions to be captured in the TP. Discuss this issue as part of the TP discussion in the 2nd round.* |
| Issue 1-1-2: Results collection for beam management sensitivity of NF based solutions | *Take company inputs into account by updating the simulation results in the TP. Discuss this issue as part of the TP discussion in the 2nd round.* |
| Issue 1-2-1: Which NF based solutions are in scope of the SI? | *A list of NF based solutions is needed to help guide discussions next meeting, such that a TP with solution descriptions & diagrams can be prepared. Discuss this issue as part of the WF discussion in the 2nd round.* |
| Issue 1-2-2: For NF based solutions what manufacturer declarations should be considered in scope of the SI? | *Take company inputs into account by revising the manufacturer declaration section to be captured in the TP. Also clarify that these potential declarations, as commented by Samsung. Discuss this issue as part of the TP discussion in the 2nd round.* |
| Issue 1-3-1: Summary of potential improvements of permitted methods | *Take company inputs into account and include this summary in the TP, while labeling it as a starting point and not necessaritly the conclusion. Discuss this issue as part of the TP discussion in the 2nd round.* |
| Issue 1-3-2: Criteria for consideration of non-permitted methods | *Criteria for deciding whether enhancements for permitted methods or new non-permitted methods can map to conclusions of the study are helpful ways to drive toward the conclusion of the SI. Discuss this issue as part of the WF discussion in the 2nd round.* |

*Recommendations on WF/LS assignment*

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|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on remaining open issues with the test methodology for high DL power and low UL power test cases | Apple |

*Scope of the WF:*

* *Issue 1-2-1: Which NF based solutions are in scope of the SI?*
* *Issue 1-3-2: Criteria for consideration of non-permitted methods*
* *Remaining open issues with beam management sensitivity of NF based solutions*
* *Remaining open issues with enhancement of permitted methods*
* *If companies are not opposed to the late submission, whether coaxial cone TEM method (*[R4-2015319](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2015319.zip)*) can be considered in the scope of this study*

### CRs/TPs

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

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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”* |
| [R4-2014919](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014919.zip) | *A revision is recommended to capture the following aspects:*   * *Include conclusion on manufacturer declaration (white box) aspect, as commented by companies (Issue 1-2-2 and comments to the originally submitted TP)* * *Include DUT dependency aspect into simulation assumptions (Issue 1-1-1)* * *Include updated simulation results (Issue 1-1-2)* * *Improvement of permitted methods (Issue 1-3-1)* |

## Discussion on 2nd round (if applicable)

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| **Issue or WF** | **Company comments** |
| Revised TP (R4-2017598) | Samsung: thanks Apple for the good TP. We support this revised TP, and just have some comments for better understanding which may be helpful for following work. About “black box” and “black & white box” approaches, there a good comparison table given. We are not clear the reason why “black box” requires measurements at 3 different radii while “black & white box” require measurement only at 2 different radii. Besides “black box” approach and “black & white box” approach, a combined “black box” and “black & white box” approach is also proposed in contribution which could also be considered.  MVG: thanks for the TP to TR. As commented by Samsung above, we would like KS to clarify why for the white&black box approach there is the need to measure at two different radii in the BP direction.  As we have understood, antenna array offset declaration (white box) would be needed to determine the EIRP, EIS compensation while the knowledge of the offset and NF probe pattern would allow the calculation of the optimized DUT orientation so that the same beam as FF beam is selected in NF. Why the two radii then?  Apple: Many thanks to all of the companies who contributed to this TP. We just want to highlight the following aspects, which we hope to resolve next meeting: conclusions of the beam management impact study (TBD in clause 5.1.2.2), selection of “black box” or “black & white box” baseline (clause 5.1.3), and extension of summary of potential improvement of permitted methods up to 49 GHz (clause 5.1.4).  R&S: we share similar view to Samsung and MVG. The displacement correction can be based on manufacturer declaration, what removes the need of measurements at different distances and the additional burden (test time, validation, MU…) associated with such measurements, assuming the NF method is used as part of the CFFNF method.  In addition, we propose some modifications to the TP to reflect this option.  Keysight:  Our investigations with a single radius yield uncertainties larger than those presented in R4-2016213 with two radii for the “black&white” box which is why our proposal was to leverage the transform based approach.  MVG: it is not clear to us yet what mechanism is behind the two radii measurements in the BP direction. We think all the compensation are done in case the antenna offset is declared. Could you please provide some clarification to that? we could suggest to put [..] for both measurement at different radii and test time impact for white&black box approach at this stage. [..] can be removed in the next 3GPP RAN4 meeting since conclusions on DNF shall be drawn.  Keysight:  We cannot agree to put [] for our simulation results; we are more than happy to provide additional background of analyses and results based on single-radius the next meeting so that we can augment the tables with the white&black box approach using just a single radius. |
| WF on remaining open issues with the test methodology for high DL power and low UL power test cases (R4-2017593) | Keysight:  Maybe the following information on TRP MUs with and without offset could be added to the TP? The assumptions were explained in the discussion of round 1 but simulation did not complete in time.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | Range Length [cm] | With Offset  Correction | | Without Offset Correction | | | Mean TRP Error [dB] | TRP Std. Dev. [dB] | Mean TRP Error [dB] | TRP Std. Dev. [dB] | | 20 | 0.02 | 0.13 | 0.40 | 0.26 | | 25 | 0.03 | 0.06 | 0.24 | 0.15 | | 28 | 0.03 | 0.04 | 0.19 | 0.11 | | 32 | 0.03 | 0.02 | 0.14 | 0.08 | | 43 | 0.03 | 0.02 | 0.08 | 0.04 | | 100 | 0.04 | 0.02 | 0.01 | 0.01 |   Additionally, CDF curves for the various simulation results are presented below |
| CAICT | [pasted comment from email thread]  Regarding the two issues of coaxial cone TEM cell list in the WF:  We did some simple experiments about the stirring issue, the measurement results shows that there is no significant effect on VSWR. We will do some more detail analysis including simulations and experiments to study the EM field distribution and impact of stirring effects, and present results at the next meeting.  Regarding the second issue, as the direction of wave and polarization in the cone are clear, the beam peak search can be performed. We can provide more results at the next meeting as well.  We hope this approach can be considered in the scope of the SI if we can resolve companies' concerns.  Thus, I would appreciate if you can consider the following edits for the WF:  •The following aspects related to the coaxial cone TEM cell approach are FFS:~~.~~ This approach can be considered in scope of the SI if the following issues are solved.  •EM field distribution and impact of stirring effects  •Whether an analysis of beam management sensitivity is needed  Keysight:  We are not objecting to consider this approach at a later time; however, given the late contribution, more work is needed from our side to further investigate the feasibility. As such, we cannot agree at the moment that only the above two issues need to be addressed before this methodology can be included as permitted method as there might be additional topics that need to be addressed.  MVG: we do agree with KS. Generally speaking, we are ok to consider this approach. We would like to further investigate this methodology with the aim of understanding whether other issues than the one above must be addressed. |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: Solutions to minimize the impact of polarization basis mismatch between the TE and DUT on the RF testing

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

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2014266](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014266.zip) | Qualcomm Incorporated | **FR2 testability enhancement for polarization mismatch**  Observation 1: TPMI side condition method (option 1 in WF R4-2012714) to enhance UE EIRP measurement has been adopted by the standard.  Observation 2: The DL pol. scan method (option 2 in WF R4-2012714) is not a valid method to enhance UE EIRP measurement.  Observation 3: In addition to enhancing TE with dual pol coherent receivers, dual TE transmitter chains to support 2-layer CSIRS may be a future enhancement avenue to optimize the UEâ€™s beam choice. |
| [R4-2014725](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014725.zip) | Samsung | **Discussion on FR2 EIRP measurement enhancement**  Observation 1: TPMI side condition method is only applicable for EIRP measurement of UL MIMO operation including â€˜full power transmissionâ€™  Observation 2: TPMI side condition method is only applicable for partial Rel-16 and beyond UEs  Observation 3: TPMI is controlling logical antenna ports rather than physical antenna ports  Observation 4: DL polarization scan method is applicable for non-codebook based transmission which is seldom used in RAN4 and RAN5 test cases.  Observation 5: DL polarization scan method depends on special UE implementation and does not eliminate polarization mismatch between TE and UE.  Observation 6: DL polarization scan method increase test time by N times which conflicts with the test time reduction objective, and not practical since the battery does not support so long time test.  Observation 7: it is normal and useful tool to adopt test mode in RF measurement.  Proposal 1: TPMI side condition method is only applicable for EIRP measurement for UL MIMO operation for partial UEs. Other methods to enhance EIRP measurement need to be investigated for non-MIMO cases in clause 6.2 of TS 38.101-2.  Proposal 2: Codebook based transmission shall be adopted in EIRP measurement, and DL polarization scan is not suitable  Proposal 3: Test mode to trigger TX diversity shall be adopted in EIRP measurement for non-MIMO cases (i.e. clause 6.2 rather than 6.2D of TS38.101-2). |
| [R4-2014827](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014827.zip) | MediaTek Inc. | **Analysis on practical TPMI and 2-port CSI-RS for EIRP measurement**  Observation 1: Apply TPMI is the typical case for Rel-15 and forward UE.  Observation 2: Two-antenna-ports TPMI cases are defined for Rel-15 and forward UE.  Observation 3: The available TPMI while “transform precoder is enabled” is defined in TS 38.212. For example, while UE support “meet fullyAndPartialAndNonCoherent”, TPMI 0~5 can be used. Hence, practical TPMI can be used to enhance UE performance in real filed.  Observation 4: EIRP measurement result based on 1-port CSI-RS is not enough to reflect real UE achievable EIRP performance in real field.  Proposal 1: List and apply “TPMI side condition method” as one of EIRP measurement enhancement methods for Rel-15 and forward UE.  Proposal 2:”Practical TPM” shall be further applied for “TPMI side condition method”  Proposal 3: “2-port CSI-RS” shall be provided in EIRP test procedure.  Proposal 4: “2-port CSI-RS” can be provided simultaneously or in sequent. |
| [R4-2014920](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014920.zip) | Apple Inc. | **Views on polarization mismatch**  Proposal 1: It is proposed to remove Option 3 (test mode to trigger TX diversity) from the list of candidate solutions for the EIRP measurement enhancement part of the polarization mismatch objective.  Proposal 2: It is proposed to confirm the dual polarization coherent receivers measurement setup as the enhancement which addresses the UE demodulation part of the polarization mismatch objective. |
| [R4-2015871](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2015871.zip) | Sony, Ericsson | **Views on testability enhancement for UE FR2 test**  Observation 1: There is no conflict between core requirement and EIRP test.  Observation 2: The current test method can capture the UE transmitted power correctly, and how a UE uses one or more Tx chains to transmit is an implementation issue.  Observation 3: The mapping between digital ports and RF ports can be flexible in the implementation.  Observation 4: The codebook-based transmission is typically used when the uplink/downlink reciprocity does not hold, which may be against the principle of beam correspondence test.  Observation 5: The power command has been adopted in the RF test to ensure the UE reaches its maximum output power.  Observation 6: Power command is the only mechanism that the network can use to control the UE output power in real life.  Proposal 1: The current EIRP test is feasible to be applied to different UE RF implementations and shall be kept without any modification  Proposal 2: Any potential command or setting for the EIRP test enhancement shall be avoided. The Test Equipment shall use the same signaling/commands to the UE as a real deployed network would.  Proposal 3: Devices that do not support Tx diversity in the field shall not be triggered with Tx diversity in the EIRP test.  Proposal 4: A UE cannot transmit with Tx diversity with power command should been seen as an ill-behaved devices and should not be accommodated by modifying the test procedure.  Proposal 5: Test enhancement for EIRP shall focus on the power command as it is the only command that the network can use to control the UE output power in the field. |
| [R4-2016212](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2016212.zip) | Keysight Technologies | **On minimizing the impact of polarization basis mismatch between the TE and DUT**  Observation 1: For coherent UEs, both Rel-15 and Rel-16 allow a TPMI to be used that forces single-layer transmission using two antenna ports.  Observation 2: For non-coherent UEs, Rel-15 does not allow a TPMI to be used that forces single-layer transmission using two antenna ports.  Observation 3: For non-coherent UEs, Rel-16 allows a TPMI to be used that forces single-layer transmission using two antenna ports with the newly introduced ul-FullPowerTransmission = fullpowerMode1 mode.  Observation 4: : A polarization scan with N different scans requires the EIRP based test times to increase approximately by a factor or N  Observation 5: The polarization scan with linear polarizations can capture the TX diversity gain when the single DL polarization triggers both UE polarizations transmitted in UL  Observation 6: Whether there is a difference between test and field with the polarization scan should be irrelevant as long as this methodology can reliably capture the diversity gain.  Observation 7: A test mode would reliably trigger both polarizations in the UL with almost no increase in test time.  Observation 8: A test mode would require non-standardized implementations and some additional overhead by OEMs to support and maintain the test modes.  Observation 9: Whether there is a difference between test and field with the test mode should be irrelevant as long as this methodology can reliably capture the diversity gain  Proposal 1: Clarification is needed whether RAN1â€™s definition of TPMI indices 2-5 forcing single-layer transmission using two antenna ports corresponds to the UE enabling two transmit chains at all times  Proposal 2: Given the limited applicability of the TPMI approach and the uncertainty whether transmission using two antenna ports corresponds to enabling both transmit chains, it is proposed to focus on the alternative approaches instead.  Proposal 3: OEMs to provide feedback on the minimum number of required polarization scans to guarantee the diversity gain to be captured reliably.  Proposal 4: Clarification of the differences in behaviour between the field and the current measurement methodologies is needed.  Proposal 5: RAN4 to further consider the polarization scan which can reliably force the UE to simultaneously transmit on both transmit chain/antennas in order to minimize the impact of polarization basis mismatch between the TE and DUT.  Proposal 6: RAN4 to further consider the test mode to trigger both polarizations in UL if OEMs are willing to support these efforts. |
| [R4-2016568](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2016568.zip) | Rohde & Schwarz | **Views on polarization basis mismatch**  Observation []: Test mode to trigger Tx Diversity is the most consistent and reliable option to ensure a two port transmission in all cases.  Proposal 1: DL polarization scan method shall not be considered as an option.  Proposal 2: Chipset and OEM manufacturers to confirm whether Rel-15 nonCoherent UEâ€™s and Rel-16 nonCoherent without full power transmission mode1 (ul-FullPowerTransmission = fullpowerMode2 or fullpower) are still affected by this DL polarization mismatch issue.  Proposal 3: Chipset and OEM manufacturers to confirm whether CSI-RS transmitted simultaneously over the two polarizations of the test antenna is enough to trigger the UE to transmit over two ports.  Proposal 4: Chipset and OEM manufacturers to confirm whether a two-layer DL transmitted over polarization diversity from the test antenna will trigger the UE to transmit over two ports.  Proposal 5: select the method based on manufacturer declaration:  a. If UE declares codebookSubset = fullyAndPartialAndNonCoherent, TPMI index is set to [2]. This is applicable to UE’s from Rel.15 onwards.  b. If UE declares codebookSubset = nonCoherent and ul-FullPowerTransmission-r16 = fullpowerMode1, TPMI index is set to [2]. This is applicable to UE’s from Rel.16 onwards.  c. Otherwise, an alternate method TBC is to be used (e.g. 2-port CSI-RS, test mode or other). |

## Open issues summary

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

### Sub-topic 2-1: EIRP measurement

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 2-1-1: TPMI side condition method**

* Proposals
  + Alt 2-1-1-1a: TPMI side condition method (option 1 in WF R4-2012714) to enhance UE EIRP measurement has been adopted by the standard, and the testability enhancement “TPMI side condition method” can be considered adopted
  + Alt 2-1-1-1b: Alt 2-1-1-1a with further clarification that “Practical TPMI” shall be further applied for “TPMI side condition method”
  + Alt 2-1-1-1c: Alt 2-1-1-1a only if clarification is provided whether RAN1’s definition of TPMI indices 2-5 forcing single-layer transmission using two antenna ports corresponds to the UE enabling two transmit chains at all times
  + Alt 2-1-1-1d: Alt 2-1-1-1a only if chipset and OEM manufacturers can confirm whether Rel-15 nonCoherent UE’s and Rel-16 nonCoherent without full power transmission mode1 (ul-FullPowerTransmission = fullpowerMode2 or fullpower) are still affected by this DL polarization mismatch issue.
  + Alt 2-1-1-2: TPMI side condition method is only applicable for EIRP measurement for UL MIMO operation for partial UEs. Other methods to enhance EIRP measurement need to be investigated for non-MIMO cases in clause 6.2 of TS 38.101-2

**Issue 2-1-2: Configuration of 2-port CSI-RS**

* Proposal: “2-port CSI-RS” shall be provided in EIRP test procedure; it can be provided simultaneously or sequentially

**Issue 2-1-3: Test mode to trigger TX diversity**

* Proposals
  + Alt 2-1-3-1: Remove test mode to trigger TX diversity (Option 3 in WF R4-2012714) from the list of candidate solutions for the EIRP measurement enhancement part of the polarization mismatch objective
  + Alt 2-1-3-2: Test mode to trigger Tx Diversity is the most consistent and reliable option to ensure a two port transmission in all cases

**Issue 2-1-4: Applicability of TPMI, 2-port CSI-RS, and test mode solutions**

* Proposal: select the method based on manufacturer declaration:
  + a. If UE declares codebookSubset = fullyAndPartialAndNonCoherent, TPMI index is set to [2]. This is applicable to UE’s from Rel.15 onwards.
  + b. If UE declares codebookSubset = nonCoherent and ul-FullPowerTransmission-r16 = fullpowerMode1, TPMI index is set to [2]. This is applicable to UE’s from Rel.16 onwards.
  + c. Otherwise, an alternate method TBC is to be used (e.g. 2-port CSI-RS, test mode or other).

**Issue 2-1-5: DL polarization scan method**

* Proposals
  + Alt 2-1-5-1: The DL pol. scan method (option 2 in WF R4-2012714) is not a valid method to enhance UE EIRP measurement
  + Alt 2-1-5-2: RAN4 to further consider the polarization scan which can reliably force the UE to simultaneously transmit on both transmit chain/antennas in order to minimize the impact of polarization basis mismatch between the TE and DUT with the following clarifications:
    - OEMs to provide feedback on the minimum number of required polarization scans to guarantee the diversity gain to be captured reliably
    - Clarification of the differences in behaviour between the field and the current measurement methodologies is needed

**Issue 2-1-6: Power up command to trigger TX diversity**

* Proposal: Test enhancement for EIRP shall focus on the power command as it is the only command that the network can use to control the UE output power in the field

### Sub-topic 2-2: UL demodulation

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 2-2-1: Dual polarization coherent receivers**

* Proposal: It is proposed to confirm the dual polarization coherent receivers measurement setup as the enhancement which addresses the UE demodulation part of the polarization mismatch objective

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Issue** | **Company Comments** |
| Issue 2-1-1: TPMI side condition method | Samsung: Alt 2-1-1-1a is true but only applicable for UL MIMO operation (2 layer UL MIMO and 1 layer ULFPTx). For UE does not support UL MIMO including ULFPTx, TPMI method is not applicable. EIRP requirement in chapter 6.2 of TS38.101 was based on dual polarization gain, so the EIRP enhancement to address the diversity gain for EIRP in chapter 6.2 is more basic and important. So we support Alt 2-1-1-2.  LG: Alt 2-1-1-2. By specification, TPMI method can be only used for some partial UE not all UEs. So, other methods to enhance EIRP measurement need to be investigated for UEs which TPMI method cannot be used.  vivo: share similar view with Alt 2-1-1-2. Based on the discussions, it is the common understanding that TPMI is applicable for partial UEs, however, even using TPMI method, the working condition of 2Tx still can not be confirmed due to virtual or physical antenna port of UE.  R&S: we do not agree with Alt 2-1-1-2. TS 38.212 clearly states TPMI index 2 can be used for single transmission on 2 antenna ports what, in our understanding, means dual polarization transmission in FR2.  When and how this TPMI index 2 is applicable has been thoroughly analyzed over the past 2 meetings and only the cases identified in Alt -1d are the remaining ones to confirm if the polarization mismatch issue is still there.  Keysight: we support Alt 2-1-1-1c for Rel-16 and above including coherent Rel-15 UEs. For non-coherent Rel-15 UEs, this approach is not applicable  MediaTek:  　We propose “Alt 2-1-1-1a” and “Alt 2-1-1-1b”, and also share the technical judgement in “R4-2014827”. Please also refer to our technical clarification for other Alts:   * + About “Alt 2-1-1-1c”:   In our understanding, the answer is “Yes”.   * + About “Alt 2-1-1-1d”:   In our understanding, the answer is “TPMI method is not helpful for non-coherent UE.”   * + About “Alt 2-1-1-2”:   We think RAN4 can provide different enhancement method options for different capabilities UE.  CAICT: prefer Alt 2-1-1-2. The TPMI method uses logical control instead of controlling physical antenna ports, so it largely depends on how the UE performs. Besides, this method is not applicable to non-coherent UEs.  Sony: We are open for further discussion based on Alt 2-1-1-1(a,b,c and d) since TPMI is a command that can be used in the real network. However, we would like to particularly mention for Alt 2-1-1-1d, for the noncoherent UE that cannot transmit with two Tx over single layer, the enhanced test method should not artificially trigger the Tx diversity in the test environment.  Huawei: only UE support full power transmission can apply this.  Ericsson: We believe that in general the variants of Alt 2-1-1-1 needs further discussions, especially the issue stated in 2-1-1-1d that non-coherent UEs are untestable with the TPMI method. We would like to avoid a separate test mode for such UEs.  Apple: we would like to understand how alternatives a, b, and c map to signaled UE capabilities; we can agree to have the study as proposed in Alt 2-1-1-1d. |
| Issue 2-1-2: Configuration of 2-port CSI-RS | Qualcomm: Further study is required:   1. To determine if 2 port CSIRS can actually help, and what further conditions are required, like stipulating mapping between ports and polarizations in the TE 2. In our understanding non-simultaneous CSIRS is not a valid configuration and should not be used as side condition (can proponent provide reference to standards support?)   Samsung:   * if the 2-port CSI-RS is provided simultaneously, is it correct understanding that it is only applicable for TE with dual polarization coherent transmitter? We just start to study dual polarization coherent receivers at TE side and no agreement on dual polarization coherent transmitter at TE side yet. In Rel15/16 discussion it seems that there are some difficulties and technical issues to implement dual polarization coherent transmitter at TE side for 1 layer test. * If the 2-port CSI-RS is provided sequentially, it seems not a typical scenario? * UE may only rely on SSB for beam correspondence. So it seems that this method is only applicable for UE supporting beam correspondence based on CSI-RS   LG: For simultaneous 2 port CSI-RS transmission, we need to check TE implementation feasibility first.  R&S: In our understanding, there is no need for coherent transmitters to implement this 2-port CSI-RS option. It is enough to map the 2 port DL transmission with the 2 polarizations of the measurement antenna. We have used multiport CSI-RS in the past (i.e. Demod for LTE and NR FR1/FR2) without the need for phase coherency between the ports.  MediaTek: We share some analysis results about the benefit by 2-port CSI-RS (#R4-2014827). About “simultaneous and/or non-simultaneous”, we are open to discuss it. In our current understanding, both of them are helpful; hence, we think it can be left for TE implementation consideration.  Sony: It is unclear to us if transmit two CSI-RS over two orthogonal ports can address the issue of triggering Tx diversity, and how this should be implemented. Does it intend to be transmitted coherently or non-coherently if they are transmitted simultaneously? Is the same CSI-RS sequence transmitted on each polarization? |
| Issue 2-1-3: Test mode to trigger TX diversity | Anritsu: We are hesitant to support alt 2-1-3-2, but it might still be one of the compromises if we consider it can also be a solution for another topic of transparent Tx diversity measurement procedure.  Qualcomm: We think test procedure should limit itself to configurations real networks would use. Test modes, or special power commands are ok in special circumstances like TE infeasibility (example: TRP measurement) or incomplete maturity (ability to demodulate OTA UL for freq diversity+pol diversity). ‘Triggering Tx diversity’ is not the job of the TE or the network, it is a UE implementation choice. Consequently, test mode is not a valid avenue for this case.  Samsung: Agree with Anritsu that this discussion is helpful for Tx diversity measurement. So we support Alt 2-1-3-2  LG: support Alt 2-1-3-2.  vivo: we should avoid to use Test mode to force UE to transmit 2Tx, which is not consistent with real condition. Similar to the situation of selecting UBF as the TI for certain control, which is identified as a must to be supported by UE to simplify the test complexity, RAN4 should not go with test mode unless this is the only solution.  R&S: we support Alt 2-1-3-2, but we need first to clarify if other options (TPMI, 2-port CSI-RS or power up command) can solve the issue without the need of a test mode.  Keysight: we support to continue the consideration of Alt 2-1-3-2, especially for Rel-15 UEs. If Alt 2-1-1-1c can be confirmed, it seems that the test mode could be considered a stop gap.  OPPO: of course test mode is not real network configurations, and test mode should be avoided as far as possible. However, if the test mode is the only solution, we have no choice but to accept it.  Sony: Alt 2-1-3-1: no test mode should be adopted for the test enhancement.  Huawei: Huawei: we would like to exclude Alt 2-1-3 , and 2-1-6, this needs additional work for UE test mode.  Ericsson: We would like to avoid using a testmode.  Apple: We prefer Alt 2-1-3-1 |
| Issue 2-1-4: Applicability of TPMI, 2-port CSI-RS, and test mode solutions | Qualcomm: The basic premise of these proposals is incorrect if they are based on manufacturer declarations:  Proposal -a is based on existing Rel-15 behavior. We are ok to establish that TPMI [1 1] be used for coherent capable UEs during MOP testing however. (NOTE: no need for manufacturer declaration)  Proposal -b is already covered by this sentence in the Rel-16 standard ‘The maximum output power requirement for single layer transmission shall apply to a UE that supports ULFPTx feature and is configured for single layer transmission in its declared full power mode (NOTE: no need for manufacturer declaration)  Proposal-c is not ready for agreement. FFS.  Samsung: we think this proposal from R&S is a good idea if it is difficult to achieve agreements among different methods  LG: We think that single option cannot be tested for all UEs. So RAN4 needs to consider a couple of test methods depending on UE type or capability. So, we support the proposal, but detail options should be further discussed.  Vivo: we share similar view, different approaches can be adopted based on UE capability.  R&S: to Qualcomm’s comment: our proposal is primarily meant to isolate the issue. If options –a and –b are already clear based on UE features, we just need to define the side conditions for those cases to ensure proper testing, and then focus only on those cases still not covered (i.e. work on issues 2-1-1, 2-1-2 and 2-1-3 but only for Rel-15 nonCoherent UE’s and Rel-16 nonCoherent without full power transmission).  MediaTek: We think the applicability rule proposal is made sense. If UE have coherent capability, TPMI is a good method; and if UE has no coherent capability, apply other test method(s) can be FFS.  Sony: As the specification does not allow some noncoherent UEs to transmit over two ports over single layer, the test enhancement method should not artificially trigger such a kind of UE to operate with Tx diversity. |
| Issue 2-1-5: DL polarization scan method | Anritsu: Support 2-1-5-1. We suppose the procedure to align the DL polarization is not what a user does in the actual field.  Qualcomm : Alt 2-1-5-1. The standard places no restriction on DL signal polarization type, so UE behaviour must remain insensitive to DL polarization type. Consequently, there is no justification for the TE to seek out the most favourable polarization for each UE. This type of polarization scan is also a significant deviation from deployment conditions. Consequently, we do not think this option is valid as an EIRP measurement method enhancement  Samsung: support 2-1-5-1. This method may only work for a corner case implementation i.e. “beam correspondence specific” scenario and it requires around 45deg mismatch between TE and UE polarizations. What the most important is, this method will increase test time dramatically and the battery even could not even afford.  LG: DL pol. scan method can be considered. But RAN4 should take into account the increasing test time. Without considering test time, DL pol. scan method cannot be applied to the enhanced measurement method.  vivo: support Alt 2-1-5-1. RAN4 needs to confirm whether “the polarization scan can reliably force the UE to simultaneously transmit on both transmit chain/antenna” is fully correct.  In our understanding, 2Tx status of UE with different implementations could not be ensured by this approach. The basic issue for keeping 2Tx status unchanged in conformance testing is not resolved by this methodology. In addition, as commented by companies, this method increases the testing time dramatically.  R&S: we support Alt 2-1-5-1.  Keysight: while we still believe that this approach technically addresses the problem for all UEs without significant system complexity, the TPMI (for all Rel-16 UEs and above) and/or test mode approaches yield lowest impact on test system complexity and test time.  OPPO: we support 2-1-5-1. Can not understand the mechanism how the polarization scan can force the UE to transmit simultaneously on both antennas.  Sony: Alt 2-1-5-1: The DL pol. scan method is not a valid method to enhance UE EIRP measurement.  Huawei: we support this. It can solve the mismatch for all UE type. The step for UE scan can be further disucuss.  Ericsson: We support Alt 2-1-5-1  Apple: We support Alt 2-1-5-2. It can be useful to use 3 polarization scans as a starting point in the analysis. |
| Issue 2-1-6: Power up command to trigger TX diversity | Qualcomm: We think test procedure should limit itself to configurations real networks would use. Test modes, or special power commands are ok in special circumstances like TE infeasibility (example: TRP measurement) or incomplete maturity (ability to demodulate OTA UL for freq diversity+pol diversity). ‘Triggering Tx diversity’ is not the job of the TE or the network, it is a UE implementation choice. Consequently, a power-up command not used in a real network is not a valid avenue for this case.  Samsung: we are not sure if UE supporting TX diversity always transmits in diversity mode. If yes, general power up command is okay. If not, a special power up command or test mode is helpful.  vivo: Power up command ensure UE to transmit maximum output power (the power level can be set), but whether all the UEs are working at TX diversity status could not be ensured/forced by this approach.  Keysight: it is not clear how the power up command triggers the TX diversity gain  OPPO: to my understanding, power up command can not guarantee UE worked in diversity mode.  Sony: Yes to our understanding. The power command in the test procedure is to **ensure** the UE can meet its maximum output power according to 38.521.2, and it will be sent continuously. For devices that transmit over two ports with two orthogonal polarizations, it is our understanding that it can only reach its output transmission power when the Tx diversity is triggered on (otherwise, half of the PAs would be off). Therefore, we think it is a correct UE behavior to trigger its Tx diversity with the power command.  In addition, it is the command for networks to configure the output power of the UE in the field. So we think it is feasible to use it as a triggering for Tx diversity.  Huawei: we do not support this because additional test interface is needed.  Ericsson: We are in favor of pwr up commands, share the view from Sony that a UE who are continuously provided with pwr up commands needs to send on all Tx ports (polarized or not). This is the only way a gNb could use for strengthening the UL (w.r.t pwr). We encourage companies to describe scenarios when this will not happen. We do not understand the comments above on “power-up command not used in a real network”, “special power up command” possibly something we missed.  Apple: According to our understanding, power up commands should not be associated with a procedure to trigger Tx diversity. |
| Issue 2-2-1: Dual polarization coherent receivers | Qualcomm: We support  Samsung: we support. it is a thorough measure to solve the UL demodulation test issue. BTW, we are curious if dual polarization coherent receivers at TE side could be used for EIRP measurement.  vivo: support the proposal.  OPPO: support the proposal.  Apple: We support the proposal. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| Issue 2-1-1: TPMI side condition method | *Company views of the alternatives:*  Alt 2-1-1-1a: MediaTek, Sony, Ericsson, R&S  Alt 2-1-1-1b: MediaTek, Sony, Ericsson, R&S  Alt 2-1-1-1c: Keysight, Sony, Ericsson, R&S  Alt 2-1-1-1d: Sony, Ericsson, Apple, R&S  Alt 2-1-1-2: Samsung, LG, vivo, CAICT  Further discussion is recommended in the 2nd round to converge the companies’ common understanding and is part of the WF scope. |
| Issue 2-1-2: Configuration of 2-port CSI-RS | *Companies’ views on this issue diverged along the following aspects:*   * *Simultaneous vs. sequential configuration and whether sequential is feasible* * *Mapping between ports and polarizations in the test equipment and whether this is feasible for test equipment* * *Applicability to Rel-16 beam correspondence capabilities* * *Whether phase coherency between ports at the test equipment side is needed* * *Whether this configuration can actually help to trigger TX diversity behavior at the UE*   Further discussion is recommended in the 2nd round to converge the companies’ common understanding and is part of the WF scope. |
| Issue 2-1-3: Test mode to trigger TX diversity | *Company views of the alternatives:*  Alt 2-1-3-1 (remove test mode from list of candidate solutions): Qualcomm, Sony, Huawei, Ericsson, Apple  Alt 2-1-3-2 (confirm test mode as a solution): Anritsu, Samsung, LG, Keysight  Alt 2-1-3-3 (new) (RAN4 should not go with test mode unless this is the only solution): vivo, R&S, OPPO  *5 companies prefer Alt 2-1-3-1, but 7 copanies prefer either -2 or -3. Thus, there doesn’t seem to be a clear majority to exclude the test mode solution. Further discussion is recommended in the 2nd round to converge on an outcome which can have better consensus and is part of the WF scope.* |
| Issue 2-1-4: Applicability of TPMI, 2-port CSI-RS, and test mode solutions | *A number of companies considered the proposed applicability rule helpful, although details are still missing to clearly define the rule. It is recommended to try to capture a common undestanding of the applicability rule as well as the remaining open issues during the 2nd round (as part of the WF).* |
| Issue 2-1-5: DL polarization scan method | *Company views of the alternatives:*  Alt 2-1-5-1 (DL pol. Scan is not valid): Anritsu, Qualcomm, Samsung, vivo, R&S, OPPO, Sony, Ericsson (8)  Alt 2-1-5-2 (RAN4 to further consider the DL pol. Scan): LG, Keysight, Huawei, Apple (4)  *A majority of companies prefer Alt 2-1-5-1, and it is not clear whether consensus can be achieved on this issue. It is recommended to capture the outcome that the DL polarization scan method is not a feasible method to enhance the UE EIRP measurement. This can be part of the WF scope.* |
| Issue 2-1-6: Power up command to trigger TX diversity | *There does not seem to be consensus emerging on this issue.*  *The following companies expressed negative views on the feasibility of the proposal: Qualcomm vivo, Keysight, OPPO, Huawei, Apple*  *The following companies expressed positive views on the feasibility of the proposal: Sony, Ericsson*  *Given the majority view, it is not clear whether consensus can be achieved on this issue. It is recommended to capture the outcome that the power up command to trigger TX diversity is not a feasible method to enhance the UE EIRP measurement. This can be part of the WF scope.* |
| Issue 2-2-1: Dual polarization coherent receivers | *The proposal in Issue 2-2-1 seems agreeable.* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on solutions to minimize the impact of polarization basis mismatch between the TE and DUT on the RF testing | Samsung |

*WF scope: All issues in this sub-topic, including the recommended conclusions based on the 1st round of discussions*

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

|  |  |
| --- | --- |
| **Issue or WF** | **Company comments** |
| WF on solutions to minimize the impact of polarization basis mismatch between the TE and DUT on the RF testing (R4-2017594) |  |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: Testability enhancements to support the verification of RF requirements for inter-band (FR2+FR2) CA

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2014265](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014265.zip) | Qualcomm Incorporated | **On impact of non-co-located test antennae for FR2 inter-band testing**  Observation 1: The propagation loss between the QZ and a TE antenna located at the focus of an offset parabolic mirror is not uniform across the QZ.  Observation 2: Off-focus TE antenna causes beam tilt and a change in QZ illumination pattern in an IFF system.  Observation 3: In an IFF system, there is a one-to-one relationship between beam tilt at QZ and the angular offset between source and focus.  Observation 4: Effective QZ size reduces when considering beams from multiple non-co-located sources in an IFF system  Observation 5: Non-co-located sources in an IFF system can trigger different choice of optimum UE beam facing each source  Observation 6: IFF systems with non-co-located sources can benefit from â€˜white/grey boxâ€™ discussion that is broken down by power class. PC1 and PC5 may have a different optimum than PC3.  Observation 7: An IFF test set up with multiple test antennae is feasible for inter-band CA testing of UEs with IBM, but additional considerations must be made, like system calibration procedures, and QZ size characterization.  Observation 8: An IFF test set up with multiple test antennae is feasible for inter-band CA testing of UEs with CBM limitation, but only for band combinations that share the same TE antenna. |
| [R4-2014492](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014492.zip) | Fraunhofer HHI, Fraunhofer IIS | **Beam correspondence performance measurement improvements of FR2 UEs that use carrier aggregation and shared antenna arrays**  Observation 1: In common beam management and when using a shared antenna array and beamformer together with aggregated component carriers (i.e., in carrier aggregation), beam squinting effects and EIRP differences in the uplink can create link performance imbalances.  Observation 2: In CBM, the PCC is used as the reference for beam management and beam correspondence related decisions.  Observation 3: In CBM, the lead component carrier used for beam management and/or beam correspondence purposes should be dynamically chosen between the component carriers assigned to PCC and SCC. Choices should match scheduling decisions made in connection with load balancing and the trade-off of aggregated link performance versus individual link performance.  Observation 4: Existing RRC signalling mechanisms used to change the CC assigned to PCC on a gNB are considered ineffectively slow since it is necessary to rapidly change the lead component carrier used for beam management and/or beam correspondence purposes.  Proposal 1: Measurement procedures of beam correspondence with CA in FR2 should be the subject of further investigation.  Proposal 2: A liaison station should be sent from RAN4 to both RAN1 and RAN2. The LS shall:  • inform and explain the need for enhanced mechanisms that allow for quickly changing the lead component carrier used for beam management and/or beam correspondence for CA in FR2;  • request further study of the identified gap in current framework; and  • consider performance enhancement procedures within CA framework for UEs with shared antenna arrays across all frequencies associated with any particular CC combination in FR2. |
| [R4-2014687](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014687.zip) | Anritsu Corporation | **Testability of FR2 inter-band DL 2CA EIS by non co-located antenna**  Observation 1: A difference of path loss between the main antenna and non co-located antenna (100 mm shift) is 0.07 dB maximum at the range length 800 mm and does not have a significant impact on the DPSD of DL signal in FR2.  Observation 2: Single carrier Rx beam profiles which are measured by the main antenna and the offset antenna can be assumed identical as far as the two calibrated measurement antennas are arranged along with the q rotation of the positioner.  Observation 3: As far as the UE is supporting the IBM and both main antenna and offset antenna are arranged along with the q rotation of the positioner, it is possible to obtain the identical EIS results from either of the two antennas even with the inter-band CA tests.  Observation 4: A post processing to adjust the coordinates of the beam profile is necessary for data obtained by the offset antenna.  Observation 5: Comparing the measured result with the main antenna, a mean error by measuring from the offset antenna (4 degrees angular offset) increased slightly with both non-TTD and TTD type phase shift (0.085 dB increase with non-TTD and 0.116 dB increase with TTD at 43.5 GHz.) which are applied to the CBM UE.  Observation 6: For the standard deviation, only the result with TTD phase shifter showed the slight increase of measurement uncertainty (0.057 dB at 43.5 GHz.).  Observation 7: For both mean error (systematic error) and standard deviation (random error) with the offset antenna (4 degrees angular offset), these uncertainty values are within the acceptable level even with the UE supporting CBM (1x4 elements).  Observation 8: FFS for UEs which supports wider frequencies (such as n262 in addition) or higher power such as PC1.  Observation []: As far as the UE is supporting the IBM and both main antenna and offset antenna are arranged along with the q rotation of the positioner, it is possible to obtain the identical EIS results from either of the two antenna even with the inter-band CA tests s.  Proposal 1: Allow the FR2 OTA test system which has the offset test antenna for inter-band DL CA test cases for both CBM and IBM UEs. |
| [R4-2014921](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014921.zip) | Apple Inc. | **Impact of AoA offset on inter-band CA PSD difference**  Observation 1: At least for IBM inter-band CA requirements, AoA offsets of up to 7 degrees between two FR2 CA component carriers do not significantly impact the PSD difference assumpiton taken for the core requirement.  Proposal 1: An OTA test system configuration with AoA offsets can be considered a permitted test system for IBM FR2 inter-band CA requirements: at least for CA between n261 and n260.  Proposal 2: The applicability of a test system configuration with AoA offsets to band n262 test cases should be checked after band n262 requirements and scope of CA configurations with n262 are better understood.  Proposal 3: The applicability of a test system configuration with AoA offsets to CBM test cases should be checked after the scope of CBM requirements for FR2 CA is better understood. |

## Open issues summary

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

### Sub-topic 3-1: Offset test antennae for FR2 inter-band testing

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 3-1-1: Feasibility of offset test antennae for FR2 inter-band testing**

* Proposals
  + Alt 3-1-1-1: An IFF test set up with multiple test antennae is feasible for inter-band CA testing of UEs with IBM, but additional considerations must be made, like system calibration procedures, and QZ size characterization
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 3-1-2: Remaining open issues with offest test antennae for FR2 inter-band testing**

* Proposals
  + Alt 3-1-2-1: Impact on QZ size and quality
  + Alt 3-1-2-2: Potential to trigger different choice of optimum UE beam facing each source and impact on beam management performance
  + Alt 3-1-2-3: Applicability of potential power class specific manufacturer declarations (e.g. PC1 and PC5 may have a different optimum than PC3)
  + Alt 3-1-2-4: Feasiblity of the solution for inter-band CA with CBM
  + Alt 3-1-2-5: Feasiblity of the solution for inter-band CA with band n262

### Sub-topic 3-2: Other testability aspects related to FR2 inter-band CA

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 3-2-1: Beam correspondence for FR2 inter-band CA and shared antenna arrays**

* Proposal: Measurement procedures of beam correspondence with CA in FR2 should be the subject of further investigation, and an LS to RAN1 is needed to clarify the following:
  + inform and explain the need for enhanced mechanisms that allow for quickly changing the lead component carrier used for beam management and/or beam correspondence for CA in FR2;
  + request further study of the identified gap in current framework; and
  + consider performance enhancement procedures within CA framework for UEs with shared antenna arrays across all frequencies associated with any particular CC combination in FR2.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Issue** | **Company Comments** |
| Issue 3-1-1: Feasibility of offset test antennae for FR2 inter-band testing | Anritsu: For alt 3-1-1-1, we agree that an additional calibration and characterization procedures of QoQZ are needed. For the antenna calibration procedure, we suppose it is same as the already existing antennas such as the in-band main antenna and spurious measurement antennas. For the impact to QoQZ and QZ size, we are currently investigating the difference between the one for the main antenna and for the offset antenna.  Qualcomm: Another possible conclusion for CBM UEs: An IFF test set up with multiple test antennae is feasible but only for band combinations that share the same TE antenna. The open items listed in 3-1-2 apply for the case where TE uses multiple antennae to test a CBM UE  Apple: We believe that based on the currently available analysis, we can conclude Alt 3-1-1-1 for IBM only |
| Issue 3-1-2: Remaining open issues with offest test antennae for FR2 inter-band testing |  |
| Issue 3-2-1: Beam correspondence for FR2 inter-band CA and shared antenna arrays | Qualcomm: Not sure if dynamic reassignment of location of beam management RS is the only solution to this problem. FFS.  Samsung: it seems a fundamental change for inter-band CA mechanism. Does the dynamic configuration means CC1 and CC2 are configured as PCC alternatively?  Fraunhofer to Qualcomm: Thank you for acknowledging this problem and for agreeing that it requires further study. Do you see an alternative to a LS to RAN1/RAN2? Fraunhofer to Samsung: We do not see this as a fundamental change, rather as an enhancement. Currently, RRC messaging can be used to reconfigure PCC assignment to CC1 or CC2. This however uses RRC messaging which is too slow for fast beam tracking. We therefore propose to address this issue via LS to RAN1/RAN2. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| Issue 3-1-1: Feasibility of offset test antennae for FR2 inter-band testing | *It appears that views have converged that the offset test antenna method is feasible for IBM, at least for the configurations for which UE RF core requirements are currently defined. It is recommended to capture this outcome in the WF; all open issues are part of Issue 3-1-2.* |
| Issue 3-1-2: Remaining open issues with offest test antennae for FR2 inter-band testing | *It is recommended to capture a list of remaining open issues with offset test antenna method, such as QoQZ, calibration, CBM, handling additional IBM configurations* |
| Issue 3-2-1: Beam correspondence for FR2 inter-band CA and shared antenna arrays | *Further discussion to clarify the problem statement and potential questions/open issues is needed in the 2nd round. This topic can be part of the WF and, if consensus can be achieved during the 2nd round discussion, an LS to RAN1 could be one possible outcome.* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on testability enhancements to support the verification of RF requirements for inter-band (FR2+FR2) CA | Anritsu |

*Scope: all issues in the sub-topic*

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

|  |  |
| --- | --- |
| **Issue or WF** | **Company comments** |
| WF on testability enhancements to support the verification of RF requirements for inter-band (FR2+FR2) CA (R4-2017595) |  |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #4: Extreme temperature conditions for all applicable FR2 UE RF test cases

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2016214](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2016214.zip) | Keysight Technologies | **On extreme temperature condition testing**  Proposal 1: Based on the work presented in RAN5, RAN4 to consider ETC testing feasible while supporting 3D scans for beam peak searches/spherical coverage and TRP testing |
| [R4-2016223](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2016223.zip) | vivo | **Views on FR2 extreme temperature condition testing**  Observation 1: Currently, ETC test procedure and MU assessment in RAN5 spec is FFS, decision on ETC requirements should be made in RAN4 and inform the agreements to RAN5 to complete the test cases.  Observation 2: It is common understanding that the phase shifter will drift under extreme temperature condition, but the impacts on 3D scan and peak EIRP/EIS performance is not clear.  Proposal 1: RAN4 group should confirm the feasibility of 3D scan for ETC testing, feedback from TE vendors is required.  Proposal 2: RAN4 should establish simulation to calculate the impacts of temperature on FR2 beamforming, and analyse the performance difference under 3D scan (spherical coverage and TRP) with ECT and NCT.  Proposal 3: Additionally, RAN4 should identify new MU elements related to ETC testing, and test tolerance of [x] dB is required to address the measurement impact under ETC.  Proposal 4: If 3D scan is not feasible, then the peak EIRP/EIS should be measured by locking beam peak in NTC, then apply to ETC.  Proposal 5: Considering November meeting is the initial deadline of RAN5 ETC work, if feasibility of 3D scan is confirmed, RAN4 agreements should be informed to RAN5 ASAP to align the actions for next steps.  Proposal []: Set target completion date for TE vendors to complete MU on ETC for conformance test cases that are required ETC testing for Priority 1 and Priority 2 test cases by RAN5#89 meeting in November 2020.  Proposal []: If the MU work on ETC using 3D scans has been completed by RAN5#89.  Proposal []: Â If none of the MU work on ETC has been completed by RAN5#89, only NTC will be tested |

## Open issues summary

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

### Sub-topic 4-1

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 4-1-1: Feasibility of ET conditions**

* Proposals
  + Alt 4-1-1-1: Based on the work presented in RAN5, RAN4 to consider ETC testing feasible while supporting 3D scans for beam peak searches/spherical coverage and TRP testing
  + Alt 4-1-1-2: RAN4 group should confirm the feasibility of 3D scan for ETC testing, feedback from TE vendors is required:
    - If 3D scan is feasible, then we should discuss the impacts on the requirements introduced by ETC, and also study how to define the enhanced test procedure.
    - If 3D scan is not feasible, then the peak EIRP/EIS should be measured by locking beam peak in NTC, then apply to ETC
    - Considering November meeting is the initial deadline of RAN5 ETC work, if feasibility of 3D scan is confirmed, RAN4 agreements should be informed to RAN5 ASAP to align the actions for next steps

**Issue 4-1-2: Open issues related to ET conditions which need to be addressed**

* Proposal: RAN4 to calculate the EIRP shift of each point induced by thermal effect during the 3D scan, and the deviation should be considered as one of the aspects for test tolerance; the following steps are proposed:
  + Perform simulation to calculate the impacts of temperature on FR2 beamforming, and analyse the performance difference under 3D scan (spherical coverage and TRP) with ECT and NCT
  + Identify new MU elements related to ETC testing, and test tolerance of [x] dB is required to address the measurement impact under ETC

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Issue** | **Company Comments** |
| Issue 4-1-1: Feasibility of ET conditions | Anritsu: Feasibility study is done with following aspects;   * a mechanical structure of a box in a chamber to enable 3D scan with a precondition of 30 cm quiet zone size * an availability of a chiller and a heater to support the currently defined temperature range (-10 to +55 ⁰C).   Qualcomm: If there is agreement that 3D scan feasible under ETC conditions, then we do not see any problem with replicating the NTC condition procedure at ETC.  vivo: Considering 3D scan is confirmed by TE vendors, LS to RAN5 is needed to inform RAN5 that RAN4 is discussing how to treat all the FR2 RF requirements. Testability decision of conformance test case for ETC in RAN5 should be based on RAN4’s outcome.  R&S: agree with vivo that RAN5 decision should be based on RAN4’s outcome.  To Anritsu’s comment: we agree that the impact of the mechanical structure inside the chamber should be studied, although it is clear there is external equipment for temperature control (e.g. Thermal Inducing Systems) available that can cover the required temperature range.  Keysight: we support Alt 4-1-1-1. Feasibility of 3D scans in ETC with minimal impact in MU have been confirmed in RAN5. For now, this will allow ETC testing of MOP and REFSENS with beam peak searches performed in ETC. Whether additional test cases, e.g., spherical coverage, will be added with ETC is up to RAN4 and then requires an LS to RAN5.  MediaTek: Not only to clarify the basic ETC 3D scan feasibility is important, we think quantify and mitigate the impact due to ETC 3D scan solution is also important.  Apple: We understood that at least one test equipment vendor has claimed it is feasible to support 3D scan with ET, but we would like to collect more technical details so that the test method enhancement can be adequately described as the outcome of this SI. Based on this, we prefer Alt 4-1-1-2 with the understanding that the necessary technical details will be developed over the course of future meetings. |
| Issue 4-1-2: Open issues related to ET conditions which need to be addressed | Qualcomm: There is no requirement on how much the beam peak direction can or cannot change over temperature. Consequently, there is no need for an additional MU element associated with beam peak direction change.  LG: In our understanding, there are no requirements under ETC in 38.101-2. So we need to define requirements for ETC first, then new MU elements and test tolerance can be discussed.  vivo: impacts under ETC should be studied. Based on the updated work plan of SI, we prefer to align simulation assumption first to identify how much variation of the UE performance.  R&S: impacts of temperature on FR2 beamforming will be useful to define the potential test time reduction between NTC and ETC for the same test case/test condition.  MediaTek: We think the proposal concept is basically made sense.  Apple: We support the proposal to investigate the impact of ET on MU and TT. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| Issue 4-1-1: Feasibility of ET conditions | *Based on test equipment vendor input, feasibility of ET for 3D scan can either be already confirmed (Keysight) or a study based on provided parameters can be conducted (Anritsu, R&S). The next step is to capture the study parameters into the WF and to discuss the feasibility outcome at the next meeting. Close coordination with RAN5 via LS was mentioned by three companies. It is recommended to discuss this issue further in the 2nd round and to capture the outcomes in the WF.* |
| Issue 4-1-2: Open issues related to ET conditions which need to be addressed | *Four companies agree with the proposed open issues, one company prefers to define core requirements for ETC as the first step, and onecompany prefers not to perform any study. There is at least a majority view on the need to perform the proposed study. It is recommended to capture the parameters of the proposed study into the WF and to discuss results at the next meeting.* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on extreme temperature conditions for all applicable FR2 UE RF test cases | vivo |

*Scope: all issues in the sub-topic*

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

|  |  |
| --- | --- |
| **Issue or WF** | **Company comments** |
| WF on extreme temperature conditions for all applicable FR2 UE RF test cases (R4-2017596) |  |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #5: Testability enhancements to support the verification of RF requirements for FR2 DL 256QAM

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

## Companies’ contributions summary

No contributions were submitted

# Topic #6: Testability enhancements to reduce test time

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2014491](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014491.zip) | Fraunhofer HHI, Fraunhofer IIS | **Beam sweeping and test time reduction in FR2**  Observation 1: Issue to be addressed: reduction of measurement uncertainty.  Observation 2 : Issue to be addressed: reduction of measurement time.  Observation 3: Beam sweeping can be used to reduce the time needed for FR2 testing.  Proposal 1: As part of the enhanced test methods for FR2 study item, RAN4 should discuss beam sweeping techniques further. |
| [R4-2014726](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014726.zip) | Samsung | **Discussion on FR2 test time reduction**  Observation 1: most commercial power class 3 models apply 4x1 array (4 elements), which is far from 8x2 array (16 elements).  Observation 2: Even considering possibilities in the future, it would be enough to adopt 4x2 array rather than 8x2 array.  Observation 3: Different sets of measurement grids will be defined for different power classes. When deriving measurement grid, there must be trade-off between worst-case and main stream case.  Observation 4: RSRP measurement accuracy can be improved at high downlink signal level and RSRP measurement based on fine beams are feasible.  Proposal 1: adopt 4x2 array as the antenna assumption for deriving measurement grid for PC3, especially for smart phone UE.  Proposal 2: alternative way is to develop two sets of measurement grids for PC3, one is the same as current grids based on 8x2 array assumption, the other is relatively sparse grids based on 4x1 (or 4x2) assumption. Applicability depends on UE declaration.  Proposal 3: RAN4 study RSRP accuracy at high downlink signal level and then check if RSRP could take place of EIS search as baseline for RX beam peak search.  Proposal 4: For EIRP test of UL MIMO including TX beam peak search, only one link polarization is enough.  Proposal 5: For EIRP test when TX diversity (dual polarization transmission) is activated, only one link polarization is enough. |

## Open issues summary

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

### Sub-topic 6-1: Potential test time reduction techniques

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 6-1-1: Collection of potential test time reduction techniques for RAN4 analysis in future meetings**

*The intention of this issue is to collect all companies’ proposals of potential test time reduction teqniques for future consideration by RAN4. The proposals below are captured as alternatives for ease of labeling, but it is not necessary to down-select the alternatives at this stage.*

* Proposals
  + Alt 6-1-1-1: As part of the enhanced test methods for FR2 study item, RAN4 should discuss beam sweeping techniques further
  + Alt 6-1-1-2: Adopt 4x2 array as the antenna assumption for deriving measurement grid for PC3, especially for smart phone UE.
  + Alt 6-1-1-3: Develop two sets of measurement grids for PC3, one is the same as current grids based on 8x2 array assumption, the other is relatively sparse grids based on 4x1 (or 4x2) assumption. Applicability depends on UE declaration
  + Alt 6-1-1-4: RAN4 study RSRP accuracy at high downlink signal level and then check if RSRP could take place of EIS search as baseline for RX beam peak search
  + Alt 6-1-1-5: For EIRP test of UL MIMO including TX beam peak search, only one link polarization is enough.
  + Alt 6-1-1-6: : For EIRP test when TX diversity (dual polarization transmission) is activated, only one link polarization is enough.
  + Other proposals are not precluded

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Issue** | **Company Comments** |
| Issue 6-1-1: Collection of potential test time reduction techniques for RAN4 analysis in future meetings | Qualcomm:  6-1-1-1: Never a bad time to study or discuss further, but UL beam sweeping is only relevant to subset of FR2 UEs (Pc3 bit 0 UEs). As such, it may have lower priority.  6-1-1-2: Changing array size assumptions has substantiative effects on MU calcs in RAN5, and is very disruptive. RAN4 needs to establish benefits first.  6-1-1-3: We think it will be hard to converge on the ‘smaller array’.  6-1-1-4: This is a good idea and can be revisited.  6-1-1-5: This is a good idea and can be revisited .As an enhancement, an alternative could be 2 port CSIRS. This strategy could also enable a one-shot measurement.  6-1-1-6: The choice of 1 Tx or 2 Tx is a UE implementation detail, it is not activated by a network command. So this proposal seems inconsistent with RAN1 design.  Samsung  6-1-1-1: we are open to any method to save test time, and BC bit-0 UE suffer more test time than bit-1 due to uplink beam sweeping. In context of Fraunhofer contribution 4491, in our understanding, the beam sweeping in 38.810 is already “electronic beam-sweeping” for BC bit-0 UE, so there seems no much room to improve on test time. Please correct it if above understanding is not correct.  6-1-1-2: change array size will not affect MU since it just matches most PC3 UE. previous array size is over-estimated. The benefits is obvious. FR2 OTA test time is mainly caused by so many measurement grid points. If the measurement grid points could be re-evaluated based on PC3 implementation, the measurement grid will be reduced so that test time greatly saved without affecting MU.  6-1-1-3: we think two sets of measurement grid is a possible compromise, bigger array as 8x2 for worst case, smaller array as 4x1 or 4x2 to match PC3 UE implementation, especially for smart phone type UE.  6-1-1-4: Thanks for Qualcomm’s comment. We also think RSRP accuracy at high downlink signal level is promising.  6-1-1-5 and 6-1-1-6: we support the two alternatives since duplicated EIRP measurement exist for 2Tx scenarios.LG:  Alt 6-1-1-2 and Alt 6-1-1-3: we support to adopt 4x2 array assumption for PC3 UE. In general, PC3 UE is smart phone type device, and the most form factor of smart phone type device is 4x1 or 4x2 antenna array. More sparse measurement grid can be used based on 4x2 antenna array assumption, so test time can be reduced.  Alt 6-1-1-4: In our understanding, similar discussion was in demodulation session to select test direction. We can continue to discuss how to use RSRP based Rx beam peak search.  Alt 6-1-1-5: we support  Alt 6-1-1-6: is it related in sub-topic 2-1?  vivo: For Alt 6-1-1-2, considering the developing progress of conformance test case in RAN5, we believe it seems not possible to revisit the UE assumption to update all the measurement grids for Peak searching, TRP, spherical coverage, etc.  However, we support the idea of Alt 6-1-1-3, alternative measurement grids can be specified, and adopted for conformance testing under some specific condition, which can be further discussed.  For Alt 6-1-1-5 and Alt 6-1-1-6, we think they are reasonable approaches.  Keysight:   * Alt 6-1-1-2: a lot of discussions were held during Rel-15 testability SI and TE vendors requested feedback from UE and chipset vendors. In the end, an 8x2 array was considered worst case for PC3 devices for releases 15 and beyond. Since RAN5 has decided on maximum test system uncertainties and test tolerances already, it is not suggested to change the assumptions at this point as this will have significant impact in RAN5. * Alt 6-1-1-3: while this approach seems fair, the handling of MU tables in RAN5 would be rather complex and require even more vendor declarations. * Alt 6-1-1-4: TE vendors have been asking for the RSRP accuracy at high DL levels but no agreement was reached. * Alt 6-1-1-5/ Alt 6-1-1-6: While this might theoretically be applicable to standalone antennas, does the integration of antennas into complex industrial designs not affect each polarization differently?   Samsung2：   * Reply to LG’s question “Alt 6-1-1-6: is it related in sub-topic 2-1?": Yes. For example, the TPMI method with mode 1 (TPMI=[1,1]T), and for Tx diversity mode, Alt 6-1-1-6 apply. * Reply to Keysight’s question on Alt 6-1-1-5/ Alt 6-1-1-6: even for commercial complex design, Alt 6-1-1-5/ Alt 6-1-1-6 also works in RF measurement condition because the transmission status is the same for different link polarization. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| Issue 6-1-1: Collection of potential test time reduction techniques for RAN4 analysis in future meetings | *In general, companies are supportive to continue to discuss the proposals in the list. It does not appear that any proposals were missed. There were also proposals to prioritize some items in the list.*  *It is recommended to capture the list of proposals in the WF and to discuss in the 2nd round whether some prioritization is useful at this stage.* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on testability enhancements to reduce test time | vivo |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

|  |  |
| --- | --- |
| **Issue or WF** | **Company comments** |
| WF on testability enhancements to reduce test time (R4-2017597) |  |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #7: Testability aspects for the introduction of the new band n262

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| T-doc number | Company | Proposals / Observations |
| [R4-2014922](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014922.zip) | Apple Inc. | Band n262 testability  The work on permitted methods further includes scope for RF, RRM, and demodulation measurement setups. According to our understanding, the following aspects of TR38.810 should be considered in scope for this effort:  - RF test setup  - Far-field criteria for the DFF system (Clause 5.2.1.2)  - IFF near-field/far-field boundary and path loss (Clause 5.2.3.2)  - Determine which uncertainy elements are impacted by the new frequency range and determine a preliminary assessment of their value  - RRM test setup  - Reference point SNR derivation (Clause 6.2.1.4.3)  - Determine which uncertainy elements are impacted by the new frequency range and determine a preliminary assessment of their value  - Demodulation test setup  - Reference point SNR derivation (Clause )  - Determine which uncertainy elements are impacted by the new frequency range and determine a preliminary assessment of their value  The work on new enhancements related to Objectives 1 through 6 should be directly integrated into the relevant discussion, such that:  - Low UL / high UL test cases: an evaluation of the scale of the testability issues associated with the identified test cases is needed to determine how much improvement is necessary (we note that this also depends on the outcome of the extension of the permitted method to this frequency range)  - For the polarization mismatch objective, the preliminary assessment of uncertainty should include the new frequency range into the evaluation scope  - For the FR2 CA objective, it is proposed to first check the progress of core requirement work to understand the scope of CA configurations which include band n262  - Since work has not yet started on Objectives 4 – 6, the related discussions should take the new frequency range into account. |
| [R4-2016224](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2016224.zip) | vivo | Discussion on Testability issue of 47GHz band  Observation 1: The increasing in radiated pathloss for 47 GHz systems is about 1dB when compared to 43.5 GHz.  Observation 2: Re-define the measurement grids for 47GHz band is not needed.  Proposal 1: The study of the enhanced test method should be based on 48.2GHz upper limit.  Proposal 2: Adopt the effective antenna aperture approach, similar to the agreed concept for FR1 RTS test method, for FR2 enhanced test method to reduce the measurement distance.  Proposal 3: The effective antenna aperture approach should be applied for all the PCs, reasonable assumption of Deff should be defined based on the feedback of OEMs.  Proposal 4: No new MU element is needed for n262 band, detailed MU assessment work should be done in RAN5.  Proposal 5: The Maximum SNR range assessment of the permitted test system for band n262 is required. |

## Open issues summary

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

### Sub-topic 7-1: General agreements related to the extension of test method applicability to n262

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 7-1-1: Upper frequency limit**

* Proposal: The study of the enhanced test method should be based on 48.2GHz upper limit.

**Issue 7-1-2: Antenna aperture**

* Proposal: Adopt the effective antenna aperture approach, similar to the agreed concept for FR1 RTS test method, for FR2 enhanced test method to reduce the measurement distance. The effective antenna aperture approach should be applied for all the PCs, reasonable assumption of Deff should be defined based on the feedback of OEMs.

**Issue 7-1-3: MU**

* Proposal: No new MU element is needed for n262 band, detailed MU assessment work should be done in RAN5.

### Sub-topic 7-2: Applicability of permitted test methods to n262

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 7-2-1: Open issues with the RF test setup for applicability of permitted test methods to n262**

* Proposal: According to [R4-2014922](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014922.zip)
  + Far-field criteria for the DFF system (Clause 5.2.1.2)
  + IFF near-field/far-field boundary and path loss (Clause 5.2.3.2)
  + Determine which uncertainy elements are impacted by the new frequency range and determine a preliminary assessment of their value

**Issue 7-2-2: Open issues with the RRM test setup for applicability of permitted test methods to n262**

* Proposal: According to [R4-2014922](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014922.zip)
  + Reference point SNR derivation (Clause 6.2.1.4.3)
  + Determine which uncertainy elements are impacted by the new frequency range and determine a preliminary assessment of their value

**Issue 7-2-3: Open issues with the demodulation test setup for applicability of permitted test methods to n262**

* Proposal: According to [R4-2014922](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014922.zip)
  + Reference point SNR derivation (Clause 7.2.1.3.1)
  + Determine which uncertainy elements are impacted by the new frequency range and determine a preliminary assessment of their value

### Sub-topic 7-3: Applicability of test method enhancements to n262

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 7-3-1: Open issues with the applicability of test methodology enhancements to n262**

* Proposal: The work on new enhancements related to Objectives 1 through 6 should be directly integrated into the relevant discussion, such that:
  + Low UL / high UL test cases: an evaluation of the scale of the testability issues associated with the identified test cases is needed to determine how much improvement is necessary (we note that this also depends on the outcome of the extension of the permitted method to this frequency range)
  + For the polarization mismatch objective, the preliminary assessment of uncertainty should include the new frequency range into the evaluation scope
  + For the FR2 CA objective, it is proposed to first check the progress of core requirement work to understand the scope of CA configurations which include band n262
  + Since work has not yet started on Objectives 4 – 6, the related discussions should take the new frequency range into account.

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Issue** | **Company Comments** |
| Issue 7-1-1: Upper frequency limit | Samsung: we support the proposal  Keysight: The upper limit should consider OOB, i.e., like in other RAN5 testability investigations, the upper limit should be 49GHz = 48.2 GHz + 0.8 GHz |
| Issue 7-1-2: Antenna aperture | Qualcomm: There is conflict between scaling of aperture size and multi-band UEs (for example a future n258+n262 UE). A multi-band device may not have a radiating antenna exclusively devoted to n262.  Samsung: we share the same concern as Qualcomm. It is typical implementation that one antenna panel supports multi-bands. In this case, the antenna aperture almost keeps the same. It is different from FR1 multi-band antenna which is not an array.  vivo: this is effective antenna aperture, but not the size of antenna panel. We believe the actual radiated aperture for different frequency could be different, how to estimate the smaller effective antenna aperture for high frequency band can be further discussed.  Keysight: support the proposal to consider a more realistic antenna aperture calculation for NF methodologies and suggest to leave DFF out of these discussions for now.  MediaTek: We think the basic framework/assumption shall align with prior n257/n258/.. etc.Apple: We should assume the highest multi-band complexity UE (i.e. supporting all FR2 bands within the Rel-17 scope) |
| Issue 7-1-3: MU | Samsung: MU affection is not so much for n262 compared with current upper limit at 43.5GHz and we are fine to handle it in RAN5.  Keysight: while not a new MU element, the MU element ‘Multiple measurement antenna uncertainty’ might need to be applied to two/multiple in-band antennas. Agreed that the detailed MU assessment should be done in RAN5 |
| Issue 7-2-1: Open issues with the RF test setup for applicability of permitted test methods to n262 | Qualcomm: Agree with concept, but MU value update falls under RAN5 purview.  Apple: Although MU values are developed in RAN5, according to the RAN4/RAN5 work split on testability, the preliminary assessment of measurement uncertainty is within the RAN4 SI scope (this is also captured in the SID). One approach can be to quantify potential deltas in MU element values and then to hand off the effort to finalize the MU budget to RAN5. |
| Issue 7-2-2: Open issues with the RRM test setup for applicability of permitted test methods to n262 | vivo: Reference point SNR derivation should be revisited for n262, which is RAN4 task. |
| Issue 7-2-3: Open issues with the demodulation test setup for applicability of permitted test methods to n262 | vivo: same as the comment above |
| Issue 7-3-1: Open issues with the applicability of test methodology enhancements to n262 | vivo: we share similar view with the proposal  in our paper we stated that RAN4 should discuss the applicability of permitted test methods from 43.5GHz up to 48.2GHz by a per-TC approach. For example:   * Step 1, make decision on the applicability of the test cases those are well supported by permitted test methods (e.g. MOP, REFSENS, etc). * Step 2, discuss the test cases those could be supported by permitted test methods, with additional test relaxations (e.g. ACS, Maximum Input Level, Spurious emissions, etc). * Step 3, study the applicability of the extreme conditions, other high DL power and low UL power test cases, together with the enhanced test methodology DNF. |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| Issue 7-1-1: Upper frequency limit | *One company proposed to include OOB region into the upper frequency limit definition. Companies are encouraged to check this proposal and to provide feedback whether* 49GHz = 48.2 GHz + 0.8 GHz can be considered as the upper frequency limit. The outcome can be captured in the WF. |
| Issue 7-1-2: Antenna aperture | *Four companies prefer to define antenna aperture based on a device supporting multiple FR2 bands, while two companies prefer to consider optimizations of the effective antenna aperture. Further discussion in the 2nd round is recommended to converge companies’ views and to capture the outcome in the WF.* |
| Issue 7-1-3: MU | *Companies are aligned that detailed MU assessment should be done in RAN5.* |
| Issue 7-2-1: Open issues with the RF test setup for applicability of permitted test methods to n262 | *Agreeable with the confirmation of the understanding in Issue 7-1-3.* |
| Issue 7-2-2: Open issues with the RRM test setup for applicability of permitted test methods to n262 | *Agreeable* |
| Issue 7-2-3: Open issues with the demodulation test setup for applicability of permitted test methods to n262 | *Agreeable* |
| Issue 7-3-1: Open issues with the applicability of test methodology enhancements to n262 | *Agreeable. A refinement is proposed to discuss the applicability of permitted test methods on a per-TC appraach. Further discussion the 2nd round is recommended, and the outcome can be captured in the WF.* |

*Suggestion on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 | WF on testability aspects for the introduction of the new band n262 | Apple |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

|  |  |
| --- | --- |
| **Issue or WF** | **Company comments** |
| WF on testability aspects for the introduction of the new band n262 (R4-2017599) |  |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #8: Rapporteur input

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

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [R4-2014918](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014918.zip) | Apple Inc., vivo | **Updated work plan for FS\_FR2\_enhTestMethods**  Observation 1: We note that Objective 7 implies that the study on enhanced test methods includes scope for RF, RRM, and demodulation with the goal of extending the frequency applicability to include the new band n262.  Observation 2: The scope of any uncertainty assessment is understood to include the identification of potential new uncertainty elements and the derivation of an initial estimated value of its contribution.  Proposal 1: It is proposed to approve the updated work plan for the Study on enhanced test methods for FR2. |

## Open issues summary

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

### Sub-topic 8-1

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 8-1-1: Updated work plan**

* Proposal: It is proposed to approve the updated work plan for the Study on enhanced test methods for FR2, as captured in R4-2014918

## Companies views’ collection for 1st round

### Open issues

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| --- | --- |
| **Issue** | **Company Comments** |
| Issue 8-1-1: Updated work plan | MediaTek: We think the updated work plan is a good guidance. However, if RAN4 really cannot achieve consensus for Object 1~3 in early stage, we still think the deadline is the whole SI deadline, no matter which Objects. |

### CRs/TPs comments collection

*Major close-to-finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## 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.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |
| Issue 8-1-1: Updated work plan | *The work plan in* [R4-2014918](http://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_97_e/Docs/R4-2014918.zip) *is agreeable with the clarification that the deadline for all objectives in the SI is the whole SI deadline.* |

*Recommendations on WF/LS assignment*

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| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |