**3GPP TSG-RAN WG4 Meeting #112 *R4-2412822***

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

**Agenda item:** 8.2.6

**Source:** Moderator (Nokia)

**Title:** Topic summary for [112][120] FS\_NR\_IMT\_part2

**Document for:** Information

# Introduction

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

Summary of contributions under agendas for FS\_NR\_IMT\_4400\_7125\_14800MHz:

8.2.4 - Study the IMT parameters relevant for sharing and compatibility for 14800 to 15350 MHz frequency range

8.2.5 - Other aspects.

A number of TPs for TR 38.922 have been provided for this meeting, mostly according to previously agreed work-split. The intention is to either agree these or revised based on comments during the meeting.

Work-Split:

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| **Item** | **Company** |
| TP for 15GHz BS RF parameters | CATT |
| TP for 15GHz BS Antenna parameters | ZTE |
| TP for 15GHz UE RF parameters | Samsung |
| TP for 15GHz UE Antenna parameters | MTK |
| TP for 15GHz simulation parameters | Nokia (including further revisions at RAN4#112 etc.) |
| TP for 15GHz simulation results | Samsung |
| TP for other issues (MIMO modelling) | Nokia/Spark |
| TP for other issues (Adjacent channel modelling) | CATT |
| RAN4#112 WF on 15GHz BS parameters | ZTE |
| RAN4#112 WF on 15GHz UE parameters | Qualcomm |
| RAN4#112 WF on other issues (MIMO) | Nokia/Spark |

Since the work-split have been separated into a WF for UE, one for BS and one for others this summary will follow the same approach. Additionally, a Topic have been added to include the discussion on General Parameters.

This means all Tdocs are listed in the following and proposals are treated under relevant topics in the following.

## Companies’ contributions summary for agenda 8.2.4.1

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| **T-doc number** | **Company** | **Title** | **Proposals / Observations** |
| [**R4-2411091**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411091.zip) | CATT | Further discussion on IMT parameters for NR in 14.8GHz to 15.35GHz | Proposal : Set BS array size as 1536 and the sub-array size as 4. |
| [**R4-2411092**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411092.zip) | CATT | TP to TR 38.922 for 15GHz BS RF parameters | TP for clause: 6.3 BS parameters |
| [**R4-2411522**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411522.zip) | Qualcomm Germany | Views on co-existence parameters for 14800 - 15350 MHz | Observation 1: Urban macro deployments for the 14800 – 15350 MHz frequency range is feasible based the assumptions of large antenna array at the BS side.  Proposal 1: RAN4 to prioritize urban macro deployment scenarios and consider Indoor scenario after all assumptions/ parameters for the urban macro deployment are agreed.  Proposal 2: RAN4 to consider as a first priority uncoordinated urban macro deployments in the adjacent channel coexistence framework, similar to TR 38.921.  Proposal 3: RAN4 to consider 200 MHz as a baseline in the adjacent channel coexistence framework.  Proposal 4: RAN4 to consider at least 1k elements at the BS side and study feasibility of deploying larger number of antenna elements in the BS compared to FR1 for the 15 GHz range.  Observation 2: BS AAS parameters should be selected to facilitate the coexistence with other incumbent services.  Proposal 5: As an alternative option for the “FR1-like UE BF”, RAN4 to consider UE with a single antenna element at the UE with random orientation in the azimuth domain, uniformly distributed between -90 and 90 degrees.  Proposal 6: As an alternative option for the “FR2-like UE BF”, RAN4 to consider two panels, with each having 1x2 array.  Proposal 7: RAN4 to consider FR1-like UE beamforming as two panels with single element at each while for FR2-like as two panels with 1x2 array at each.  Observation 3: There is an observed performance enhancement when considering directionality at the UE via single elements compared to the isotropic 0 dBi assumption.  Observation 4: TP loss performance is marginal between 1x2 and 2x2 array at the UE side.  Observation 5: Large antenna arrays at the BS enables feasible adjacent channel coexistence via directing the wanted signal to the target destination and reducing the adjacent channel interference.  Observation 6: Due to the regulatory occupied bandwidth requirement, required UE ACLR is technically equal to 24 dBc.  Observation 7: Exploring higher power classes is feasible for this frequency range given the observed ACIR values.  Observation 8: ACIR values for are observed to be approximately 2 dB higher when considering UE maximum output power = 26 dBm compared to 23 dBm.  Proposal 8: RAN4 to consider 26 dBm as the UE maximum output power in the 14800-15350 MHz frequency range adjacent coexistence study. |
| [**R4-2411720**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411720.zip) | ISSDU | Discussion on ACLR Calculation Procedure for 14800 - 15350 MHz with Beamforming and MIMO | Proposal 1: Both SU MIMO and MU MIMO cases should be considered.  Proposal 2: Bandwidth up to 200 MHz should be considered.  Proposal 3: Simulation parameters for the 14.8 to 15.35 GHz range should reference the 10-10.5 GHz frequency range, with the 5G NR waveform used for ACLR evaluation.  Proposal 4: Beamforming should not be use on resource elements of CSI-RS.  Observation 1: There is a need to understand the impact of PA non linearities on out of band emissions.  Observation 2: Whether beamforming should be implemented on resource elements of PDCCH should be further discussed for test model.  Observation 3: Frequency dependent nonlinearity model for high-power amplifier should be further considered. As the Pas are distributed, a model for PA non linearity variation across the PAs need to be agreed. |
| [**R4-2411775**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411775.zip) | MediaTek inc. | Coexistence study for 14800 to 15350 MHz | Proposal 1: FFS to consider the UE FR1-like antenna radiation pattern:   * DL 4Rx: 5dB gain for UE receive signals from its serving cell regardless the AoA, and 0dB for signals from all non-serving co-channel and adjacent-channel neighbouring cells regardless the AoA * UL 4Tx: 5dB gain for UE transmit signals toward its serving cell regardless the AoA, and 0dB for signals toward all non-serving co-channel and adjacent-channel neighbouring cells regardless the AoA.   Proposal 2: RAN4 to further align the inconsistency in TR38.922   * Antenna element gain (dBi) for Indoor case in Table 6.1.2.3.2.4-3 and Table 6.1.2.3.2.3-1 * Front-to-back ratio of H and V for Indoor case in Table 6.1.2.3.2.4-3 and Table 6.1.2.3.2.3-1 * 3dB beamwidths of H and V in Table 6.1.2.3.2.4-3 is different from those in Table 6.1.2.3.2.1-1 and Table 6.1.2.3.2.2-1 for or Urban marco and Dense Urban, respectively * The unit used in Antenna sub-array configuration and Note 4 in Table 6.1.2.3.2.4-3 |
| [**R4-2412069**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412069.zip) | vivo | Discussion on the coexistence for 14800 to 15350 MHz | Observation 1: For Urban macro, 18dB ACIR for FR2-like UE and 22dB for FR1-like UE are required.  Observation 2: For Indoor office, 13dB ACIR for FR2-like UE and 15dB for FR1-like UE are required.  Proposal: For FR1-like UE, the ACLR/ACS in TR38.921 is reused. For FR2-like UE, the ACLR/ACS in TS38.101-2 can be reused. |
| [**R4-2412126**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412126.zip) | Ericsson | On Co-existence simulation assumptions for 14800 to 15350 MHz frequency range | Observation 1 UL coverage is challenged in Urban Macro scenarios with the assumption of 20% Indoor users.  Observation 2 ISD higher than 450m can be considered as sufficient DL coverage is achieved assuming 0% indoor users. However, UL coverage still remains a challenge to be addressed with 20% Indoor users.  Observation 3 0% and 20% Indoor probability options present different behaviors, with the latter presenting UL coverage challenges with ISD as 450m.  Observation 4 The UE maximum Tx power should be clarified in the Table 6.1.2.4-1 of TR 38.922 for the two UE antenna architecture options.  Proposal 1 RAN4 should further discuss on how to achieve sufficient UL coverage in Urban Macro scenarios, with a reduced ISD and/ or higher maximum transmit power.  Proposal 2 RAN4 to consider keeping only 0% Indoor users for Urban Macro scenario.  Proposal 3 RAN4 to clarify for Urban Macro scenario that BS output power 43 dBm is defined per polarization. It is given for 100 MHz channel bandwidth.  Proposal 4 RAN4 to consider Indoor office deployment with 1 sector, i.e. option 1 from TR38.802, section A.2.1 and capture it in TR 38.922.  Proposal 5 RAN4 to clarify for Indoor scenario that BS output power 23 dBm is dual polarized. It is given for 100 MHz channel bandwidth.  Proposal 6 RAN4 to revise the table in TR with the correct antenna parameters for (\mathbf{dv},\mathbf{sub}) and Pre-set sub-array down-tilt and modify Note 3,4 and 5 wordings to maintain parity between the scenarios.  Proposal 7 RAN4 to adopt the proposed Antenna configuration parameters for Antenna sub-array configuration and update the Horizontal/Vertical radiating sub-array spacing, Number of element rows in sub-array and Conducted power (before Ohmic loss) per sub-array/element (dBm) parameters for the specified scenarios.  Proposal 8 RAN4 to clarify for Urban Macro and Indoor scenario that BS output power is given per 100 MHz, so if wider channel bandwidth is considered, the PSD reduces.  Proposal 9 For UL transmission power control, RAN4 to consider subclause 9.1 from TR 36.921 with SNR target as 15 dB. |
| [**R4-2412127**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412127.zip) | Ericsson | On Urban Macro and Indoor Co-existence simulation results for 14800 to 15350 MHz frequency range | Observation 1 With FR2 UE type in Urban Macro DL, ACIR of approximate 21 dB and 17 dB is observed at Indoor probability of 0% and 20% respectively.  Observation 2 With FR1 UE type in Urban Macro DL, ACIR of approximate 26 dB and 22 dB is observed at Indoor probability of 0% and 20% respectively.  Observation 3 In Urban Macro Downlink scenario, FR2 UE antenna architecture leads to lower ACIR requirements at 20% Indoor users.  Observation 4 RAN4 should consider both worst-case scenarios as well as feasibility aspects of current semiconductor technologies when deciding ACLR/ ACS requirements.  Observation 5 With FR2 UE type in Urban Macro UL, ACIR requirements cannot be derived as the UL 5%tile throughput loss plots are below 5%.  Observation 6 With FR1 UE type in Urban Macro UL, significantly high outage around 10% is observed assuming 20% Indoor users. Therefore, no requirements can be derived for such scenarios.  Observation 7 Urban Macro scenario UL coverage is challenged by the presence of indoor users, and requirements cannot be derived. For this, more studies should be conducted considering reduced ISD and/or higher maximum transmit power.  Observation 8 With FR1 UE type in Urban Macro UL, ACIR of approximate 16 to 18 dB is observed at Indoor probability of 0%.  Observation 9 RAN4 to clarify how many sectors per node – 1 or 3 are considered for Indoor scenario deployments.  Observation 10 With FR2 and FR1 UE type in Indoor DL and UL, ACIR requirements are quite low for both 1 sector and 3 sector deployments. |
| [**R4-2412138**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412138.zip) | Samsung | Initial simulation results of co-existence scenarios for 14800 – 15350 MHz | Observation 1: Average throughput loss for most cases is low enough compared to other frequency range with the smaller antenna array elements thanks to the massive antenna pattern assumptions, e.g., 64x24 or 64x32, which have much lower side lobe gain of the antenna pattern with narrow beams.  Observation 2: ACIR requirement can be in the range of 14-26 dB. |
| [**R4-2412589**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412589.zip) | Nokia | Urban macro coexistence simulation results for 14800 to 15350 MHz frequency range | Observations from simulation results:  1) The average and 5%-tile downlink throughput losses of the victim UE in all simulated cases are below 5% with downlink ACIR offset of -15dB, except case (b:64x24 BS, FR2 like UE) with coordinated operation and case (c:64x32 BS, FR1 like UE) with un-coordinated operation where the 5%-tile throughput loss is higher than 5%.  2) The average and 5%-tile uplink throughput losses in all simulated cases are below 5% with an uplink ACLR offset of -15 dB, except case (a:64x24 BS, FR1 like UE) with coordinated operation and case (d:64x32 BS, FR2 like UE) with un-coordinated operation where the 5%-tile throughput loss is higher than 5%.  3) 5%-tile throughput (i.e., cell edge coverage) cannot be achieved for case (c: 64x32 BS, FR1 like UE) with both coordinated and un-coordinated operations.  4) The throughput loss for FR1 like UE is higher with un-coordinated operation than with coordinated operation, while the throughput loss for FR2 like UE is higher with coordinated operation than with un-coordinated operation.  5) The throughput loss for FR2 like UE is lower than that for FR1 like UE with the use of beamforming also at the victim UE. |
| [**R4-2412590**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412590.zip) | Nokia, Fujitsu | TP to TR 38.922: Revisions of system level simulation assumptions for study on IMT parameters for 14800 to 15350 MHz frequency range | TP for Clause 6.1.1 Co-existence |
| [**R4-2412711**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412711.zip) | ZTE Corporation, Sanechips | Discussion on co-existence evaluation for 14800 to 15350 MHz | Proposal 1: for coexistence study for 14.8-15.35GHz, consider the coexistence cases as shown in Table 2.1-1 for further evaluation.  Proposal 2: follow the legacy approach and do not consider the Rx number from UE perspective in RAN4 SLS coexistence evaluation.  Observation 1: based on the FR1 like UE assumption, then DL ACIR requirement could be relaxed around 8dB in Urban macro scenario.  Observation 2: based on the FR1 like UE assumption, then UL ACIR requirement for co-located deployment could be relaxed around 6dB, however for non-co-located deployment, even with the existing FR1 ACIR requirements, it is still challenging to meet the 5% throughput loss criteria in Urban macro scenario. |
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## Companies’ contributions summary for agenda 8.2.4.2

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| **T-doc number** | **Company** | **Title** | **Proposals / Observations** |
| [**R4-2411142**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411142.zip) | Apple | On UE antenna parameters for 14800-15350MHz | Since 3GPP already did some studies for the 10-10.5GHz range, we believe that some of the technical parameters can be re-used from that range |
| [**R4-2411143**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411143.zip) | Apple | TP on UE antenna parameters for 14800-15350MHz | TP for Clause 6.5 Antenna characteristics |
| [**R4-2411521**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411521.zip) | Qualcomm Germany | Views on Radio parameters for 14800 - 15350 MHz | Proposal 1: RAN4 to agree on TDD as a baseline duplexing for 14800 – 15350 MHz frequency range and capture the following text in TR 38.922.  “There is no defined 3GPP band for the 14800 - 15350 MHz frequency range. Similar to the 4400 – 4800 MHz and 7125 – 8400 MHz frequency ranges, SBFD can be a candidate duplexing method for this frequency range. The core requirements for Rel-19 SBFD work item can be tracked through the list of impacted specs captured in [6]. To provide a timely response to WP5D regarding the requested RF parameters, RAN4 assumed TDD as a baseline duplexing for the 14800 – 15350 MHz frequency range.”  Proposal 2: RAN4 to adopt 200MHz is a typical channel bandwidth. Higher channel bandwidths should not be precluded for this frequency range.  Proposal 3: As signal bandwidth depends on CHBW and SCS, no need to specify a fixed signal bandwidth but rather mention its dependency on SCS and number of RBs.  Proposal 4: RAN4 to consider at least 1k elements at the BS side for the 14800 – 15350 MHz Frequency range. Exact parameters to be decided after the finalization of the adjacent channel coexistence.  Observation 1: The impact of modelling near-by users using spherical waves on system level evaluations is questionable and currently being studied in RAN1.  Proposal 5: RAN4 to not consider near-field impacts in this frequency range in its correspondence to WP5D.  Observation 2: To derive the BS SEM, RAN4 could follow the same approach as TR 38.921 with the appropriate minimum channel bandwidth.  Proposal 6: For BS ACLR and ACS, RAN4 to decide on the UE ACLR and ACS based on the outcome of the adjacent channel coexistence study.  Proposal 7: RAN4 to agree on 26 dBm (i.e., PC3) as UE maximum output power as a baseline.  Proposal 8: RAN4 to agree on 59 dBm as UE power dynamic range.  Proposal 9: For UE ACLR and ACS, RAN4 to decide on the UE ACLR and ACS based on the outcome of the adjacent channel coexistence study.  Observation 3: UE beamforming assumption based on 0 dBi isotropic element with 0 dB Rx diversity gain paints a pessimistic view of the UE performance from a system level perspective, where in reality some UE gain is observed.  Observation 4: UE beamforming assumption based on 0 dBi isotropic element with 5 dB Rx diversity gain considers a simplistic 5dB addition in the minimum coupling loss for both scheduled and interfering links.  Proposal 10: As an alternative option for the “FR1-like UE BF”, RAN4 to consider UE with a single antenna element at the UE with random orientation in the azimuth domain, uniformly distributed between -90 and 90 degrees.  Proposal 11: As an alternative option for the “FR2-like UE BF”, RAN4 to consider two panels, with each having 1x2 array. |
| [**R4-2411776**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411776.zip) | MediaTek inc. | Coverage study for 14800 to 15350 MHz | Observation 1: In UMa scenario, FR1-like UE outperforms FR2-like UE in most cases  Observation 2: To achieve similar spectrum efficiency as FR1 deployment, 2K BS antenna elements need to be considered for UMa scenario in 15GHz.  Observation 3: With reduced ISD size, the number of required BS AEs in 15GHz also reduces to achieve comparable spectrum efficiency as FR1 deployment.  Observation 4: For a UMa scenario with 450m ISD in 15GHz, a BS down-tilt angle between 9 to 15 degrees offers relatively better SE performance.  Proposal 1: Capture observations 1, 2, 3 and 4 in the TR.  Proposal 2: From a feasibility standpoint, the UE NF could be worse than 11dB. |
| [**R4-2412070**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412070.zip) | vivo | Discussion on the UE parameter for 14800 to 15350 MHz | Proposal 1: 200MHz is used as typical channel bandwidth for 14800 to 15350 MHz in the LS.  Observation 1: It is inefficient to try to down-selection from different UE form factor since there no commercial UE is designed in this new frequency range at this stage.  Proposal 2: The UE parameters for both FR1-like and FR2-like are provided in the reply LS for 14800-15300MHz. |
| [**R4-2412128**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412128.zip) | Ericsson | On Antenna feasibility and RF parameters for 14800 to 15350 MHz frequency range | Observation 1 RAN4 need to evaluate feasibility of current technology capabilities for output power per branch, ACLR and efficiency for power amplifiers based on available semiconductor technologies.  Observation 2 Further inputs are needed from UE vendors on feasibility aspects of both FR1 and FR2 UE type for a reasonable UE architecture.  Observation 3 In the TR 38.921, it has been specified that sensitivity is not a critical parameter for sharing and compatibility studies and “to be specified” in the previous LS sent for 6.425-7.025 GHz, 7.025-7.125 GHz and 10.0-10.5 GHz.  Observation 4 High power UEs adoption can be further studied to solve the problem of UL coverage for these frequency ranges.  Proposal 1 RAN4 to consider following sub-array structures: 6x1 and 4x1 for Urban Macro and drop 8x1 as a larger sub-array would limit the coverage angular range due to narrow sub-array radiation pattern in vertical axis.  Proposal 2 RAN4 to only consider 4x4 array for indoor office deployment.  Proposal 3 RAN4 to consider following BS array antenna architectures:  1. 2048 AEs: 8x32 array and 4x1 sub-array  2. 1536 AEs: 8x16 and 6x1 sub-array  Proposal 4 RAN4 to agree on 0 dB as power dynamic range.  Proposal 5 RAN4 to consider BS spurious emission limits in Table 2.2.3-1 and 2.2.3-2 as baseline for initial discussions.  Proposal 6 RAN4 to consider BS NF as 8 dB for WA BS, 13 dB for MR BS and 16 dB for LA BS respectively based on information in TR 38.820 and TR 38.921.  Proposal 7 RAN4 to further discuss based on the agreements of BS NF and Antenna model, if should be agreed to mention any value for this parameter.  Proposal 8 RAN4 to consider UE spurious emission limits from TS 38.101-1, - 30 dBm / 1 MHz as baseline for initial discussions.  Proposal 9 RAN4 to consider as 23 dBm UE maximum output power as starting point.  Proposal 10 RAN4 to consider UE NF as 8 dB based on information in TR 38.820.  Proposal 11 RAN4 to further discuss based on the agreements of UE NF and Antenna model, if should be agreed to mention any value for this parameter. |
| [**R4-2412139**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412139.zip) | Samsung | Views on UE type for 14800 to 15350 MHz frequency range | Observation 1: For FR2 like UE type, taking the complexity of beam management into account, the benefit from using a beam steering antenna system with such a small number of elements need to be reconsidered.  Observation 2: It would not make sense for handheld UE to expect the similar uplink and downlink performances when compared with FR2, considering the estimated antenna array size and number of modules/panels.  Observation 3: For FR1 like UE type, it should be also noted that increasing the number of antennas is not necessarily guarantee the better performance given the higher frequency ranges and the limited form factor.  Observation 4: RAN4 needs more discussions to find out the optimal balance between Option 1 and Option 2 for the better performance than legacy UEs in FR1 and FR2.  Observation 5: One possible solution for RAN4 is to have both options for the frequency range in-between FR1 and FR2 so that UE can apply or declare either option based on the UE type.  Proposal: Both UE type options could be considered together in the LS and TR. Otherwise, if only one parameter required for LS, FR1 like option is preferred for the LS at this stage. |
| [**R4-2412591**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412591.zip) | Nokia | BS antenna and simulation parameters for 14800 to 15350 MHz frequency range | Proposal 1: Use 64x24=1536 (Sub Array size 4) BS antenna configuration.  Proposal 2: Prioritize 450 m and 20% indoor UE ratio with the use of 64x24=1536 (Sub Array size 4) BS antenna configuration.  Proposal 3: Apply un-coordinated operation with FR1 like UE and coordinated operation with FR2 like UE.  Proposal 4: Prioritize 23 dBm maximum UE transmit power with the use of 64x24=1536 (Sub Array size 4) BS antenna configuration. |
| [**R4-2412712**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412712.zip) | ZTE Corporation, Sanechips | Discussion on radio and antenna parameters for 14800 to 15350 MHz | Proposal 1: assume TDD duplex mode as default assumption unless there are other operation mode proposals from certain regions/countries or certain operators.  Proposal 2: prioritize the following BS RF requirements for the following discussions: ACLR, UEM, f\_OBUE requirement, NF, ACS requirements, OOBB and f\_OOBB requirements.  Proposal 3: prioritize the following UE RF requirements for the following discussions: Maximum output power, Power dynamic range, spectral mask, ACLR, Noise figure, Sensitivity, ACS, Blocking.  Observation 1: given the wide area coverage assumption for 15GHz as baseline, even with 4096 antenna elements implementation assuming FR2 hybrid architecture, its total transmission power might be still limiting factor to achieve similar coverage as 4GHz from BS perspective.  Observation 2: UE with phase antenna array assumption could offer the additional help on mitigation the coverage gap between 4GHz and 15GHz.  Observation 3: for BS with 4096 antenna elements assumption at 15GHz, both near filed problem should be taken into account according to the current WA BS class assumption.  Observation 4: UE with phase antenna array assumption could offer the additional help on mitigation the coverage gap between 7GHz and 15GHz. |

## Companies’ contributions summary for agenda 8.2.5

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| **T-doc number** | **Company** | **Title** | **Proposals / Observations** |
| [**R4-2411021**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411021.zip) | Spark NZ Ltd | Text Proposals on MIMO models and PA nonlinearity impacts and ACLR | TP to Clause 7.1.4, 7,2 and 8  Observation 1: Is the method to compute an array ACLR as defined currently in 3GPP specification still correct? If not, what improvements are needed?  Observation 2a: There is no definition of an array correlation factor. Is it the correlation of the in-band signal with out of band signal. But the in-band signal, Pinband (θ,φ), is spatially sensitive and as discussed below the out of band signal , P oob (θ,φ), may also be spatially sensitive. Then the array correlation  is also spatially sensitive may be defined as:  A black and red text  Description automatically generated  Observation 2b: This also means that θφ) defined above is a function of frequency separation from the band centre. In this case best to denote this as:    Where f is the frequency separation from band centre  Observation 3: In order to do this, we would therefore need to characterise and investigate the constituent components of P oob (θ,φ) as a function of f  Observation 4: The change in array performance due to a different vertical and horizontal spacing arising from the lower and upper adjacent bands is not large enough to warrant a conclusion that the array drops down to a single element in adjacent bands.  Observation 5: The choice of a PA behavioural model validated by measurements is needed. Ref [10,11] provide a good framework to model these non-linearities via polynomial models.  Observation 6: The differences in the linear responses of the parallel PAs have a large impact on the system performance. The nonlinear terms do not necessarily adopt the digital predistortion as easily and efficiently. Therefore, the impact of nonlinear power amplifiers is nontrivial both in band and out of band. However, to do this we would need a model for the differences in the PA models in an AAS.  Observation 7: PA non linearities may result in the array beamforming in different spatial directions than the desired signal. The impact of Power Amplifier non linearities when MIMO arrays are used vary with single user and multiuser systems. In multiuser beamforming case the distortion resulting from non-linearities is beamformed into distinct spatial directions that are different from the desired signal direction.  Observation 8: It is important to specify a bandwidth and a model for the BPF.  Observation 9: Array ACLR and antenna ACLR are different quantities. As given in observation 1, there is a need to determine if the computation of array ACLR as given in the specifications is still accurate. Furthermore, when the number of users increases, the array ACLR becomes almost isotropic as the channel is now beamforming in many directions. Therefore, out of band distortions are also influenced by MU MIMO; this needs the numbers of simultaneous users.  Proposal 1: The text proposals in this document be included in TR 38 922, section 7  Proposal 2: AS WP 5D has started the process of technical calculations, it is best to advise them of how to calculate ethe BF weights only rather than the results as they would be scenario specific. A text on BF weights is included in section 3 of this contribution. This text could be sent in an LS to WP 5D.  Proposal 3: There is a need to define array correlation factor so that it may be computed. Equation (1) may be used.  Proposal 4: Define the constituent components of P oob (θ,φ) and their dependence on f  Proposal 5: There is a need to investigate array ACLR and see that its computation method in the standards is still the correct way.  Proposal 6: An array will not drop down to a single element in adjacent bands. Nor its performance will drop down to a sub array.  Proposal 7: Power Amplifier non linearities should be carefully modelled when considering adjacent channel impacts when MIMO arrays are used. The choice of a PA model should be agreed (say via polynomial models), then it may be validated by measurements and also agree on a model for the differences in the parameters for the distributed PAs.  Proposal 8: We may assume for the sake of simplicity there are no differences in the PA model parameters in a distributed PA AAS.  Proposal 9: A model for the BPF needs to be agreed  Proposal 10: MU-MIMO precoder type and numbers of simultaneous users need to be agreed and could impact out of band distortions to fall in un-intended directions. |
| [**R4-2411093**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411093.zip) | CATT | TP for other issues (Adjacent channel modelling) | TP to Clause 7.x Adjacent channel modelling |
| [**R4-2411873**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411873.zip) | Ericsson | On the topic of additional information requested by ITU-R WP 5D | TP to Clause 7.2  Observation 1: Support for modelling array antenna gain adjacent carrier have been documented since Rel-13 in TS 37.840, while relevant parameters for the adjacent channel regions have not been defined.  Observation 2: The array antenna average gain varies between peak sub-array gain and peak full array gain (including array factor) depending on signal correlation properties.  Observation 3: The modelled array average gain characteristics will depend on the carrier bandwidth.  Observation 4: When adjacent channel gain is modelled in sharing studies it is essential to use correct information for power fed to the array antenna in conjunction with information on array correlation properties. In a sharing situation both power and gain will affect the produced EIRP level.  Observation 5: Based on our simulation results, there is no need to change the beamforming assumptions in Recommendation ITU-R M.2101. The differences introduced by ZF beamforming technique, compared to the model in M.2101, are minor. The simulation results show minimal impact on the overall AAS BS gain towards a number of potential interfered-with receivers and on the BS antenna gain integrated over parts of or the entire sphere around the antenna.  Proposal 1: In TR 38.922 capture information on how to model adjacent channel EIRP using the array antenna model and capture relevant model for correlation factor in the adjacent channel regions.  Proposal 2: Based on outcome of beamforming modelling evaluation, the current modelling approach remains effective for its intended purposes. Modifying the existing beamforming model is not necessary, as the variations observed are insignificant and do not justify the complexity of updating the model. Capture simulation results and corresponding conclusion in TR 38.922.  Proposal 3: Include information relevant for adjacent channel EIRP modelling and beamforming evaluation in scheduled LS responses to ITU-R WP 5D. |
| [**R4-2411948**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411948.zip) | Nokia | IMT parameters: General system and UE aspects | Proposal 1: In addition to 100 MHz, 200 MHz is also mentioned as a typical maximum channel bandwidth for 7125 – 8400 MHz in LS. *[Moderator] – This is handled under thread [119] FS\_NR\_IMT\_part1.*  Proposal 2: 200-400 MHz is considered as typical maximum channel bandwidth for 14800 – 15350 MHz.  Proposal 3: Typical signal bandwidth for 100 MHz channel bandwidth is assumed 273 RB with 30 kHz SCS for 7125 – 8400 MHz. For wider channel bandwidth such as 200 MHz, 273 RB with 60 kHz SCS can be assumed as tentative agreement. *[Moderator] – This is handled under thread [119] FS\_NR\_IMT\_part1.*  Proposal 4: It is proposed that NF=10 dB for 7125 – 8400 MHz and NF=11 dB for 14800 – 15350 MHz in the reply LS to WP5D.  Proposal 5: ACLR 30dB is proposed for PC3 and 31dB (n104) for PC2 for 7125 – 8400 MHz. It is TBD for 14800-15350 MHz.  Proposal 6: It is proposed to formally agree the tentative agreement in RAN4#111 to capture 23 dBm as typical maximum output power in the LS to ITU and refer to TR for other power classes. *[Moderator] – This is handled under thread [119] FS\_NR\_IMT\_part1.*  Observation 1: FR1-like architecture may be more feasible for handheld devices for 14800-15300 MHz.. FR2 may not be excluded for other UE types. It may be premature to single out the UE architecture for 14800-15300 MHz.  Proposal 7: Unless there is no clear consensus, both FR1 and FR2 architecture assumptions are informed to WP5D in the LS reply. |
| [**R4-2412592**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412592.zip) | Nokia | Study of AAS performance in adjacent bands | Observations from simulation results:  1) With 400 MHz channel bandwidth at the 15 GHz carrier frequency, the composite array radiation patterns formed by the AAS in the adjacent bands are similar to that formed at the designed carrier frequency, even with the adjusted horizontal/vertical radiating sub-array spacing and vertical element separation in sub-array. Therefore, the array will continue to perform in the adjacent bands, and it is not correct to assume that its performance will drop down to that of a single element or that of a sub-array.  2) The average and 5%-tile downlink and uplink throughput losses are similar for the three simulated cases with the composite array radiation patterns formed using the designed or adjusted horizontal/vertical radiating sub-array spacing and vertical element separation in sub-array. |
| [**R4-2412713**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2412713.zip) | ZTE Corporation, Sanechips | Discussion on other issues in ITU-R LS | In this contribution, we share some initial views on other questions raised in the coming ITU-R LS. |
| [**R4-2413281**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413281.zip) | Huawei, HiSilicon | AAS modelling considerations for IMT base stations | Observation: multiuser spatial beamforming zero-forcing (ZF) impact on the AAS BS gain towards potential interfered-with receivers located in the upper hemisphere is minor and the interference to the receiver sample points is even less.  Proposal 1: there is no strong motivation to change the beamforming assumptions in Recommendation ITU-R M.2101. |
| [**R4-2413368**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2413368.zip) | Nokia | Impact of beamforming schemes on the coexistence of IMT with other services | This contribution provides simulation results for assessing the impact of different MU-MIMO schemes to the study of coexistence of IMT with other services. Simulations assume a 2.6 GHz IMT system and show the interference levels measured at different spatial points over AWGN channels and UMa channels for ZF MU-MIMO and ITU MU-MIMO beamforming techniques.  Since the interference delta CDF values are very similar (less than 0.3 dB), different beam forming techniques have similar impact to victim service, and there is no need for implementing more complex MU-MIMO models for coexistence studies with other services in ITU. |
| [**R4-2411520**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_112/Docs/R4-2411520.zip) | Qualcomm Germany | Views on Additional AAS aspects | Proposal 1: RAN4 to respond to WP5D on the generic questions (i.e., Frequency range agnostic) captured in WP5D LS by the RAN4#113 meeting. *[Moderator] – This is handled under thread [119] FS\_NR\_IMT\_part1.*  Observation 1: WP5D is currently investigating whether it is needed or not to consider multi-user beamforming techniques impact on top of the AAS model (i.e., ITU-R M.2101).  Observation 2: RAN4 is expected to provide its technical response on the impact of multi-UE beamforming techniques impact on system level studies to WP5D and capture its findings in TR 38.922.  Proposal 2: RAN4 should investigate whether incorporating ZF technique in a system level framework would lead to additional unwanted emissions above the horizon for an IMT BS serving its scheduled UEs.  Observation 3: Enough angular separation should be considered in the system level studies to avoid performance degradation due to limited spatial resolution of the BS AAS.  Observation 4: From Monte-Carlo studies, similar IMT BS gain above the horizon is observed when zero forcing is considered at the BS IMT when compared to the case without zero forcing beamforming.  Proposal 3: RAN4 to reply to WP5D that it is sufficient to adopt the legacy AAS model based on ITU-R Recommendation M.2101 since the performance when ZF beamforming is considered is similar to the performance without ZF beamforming technique. |

# Topic #1: General Parameters

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

The discussion on this topic will focus on the general simulation parameters while the ones specific for BS and UE will be treated under Topic 2 and Topic 3 while all other discussions have been included under Topic 4.

## Open issues summary

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

### Sub-topic 1-1: Duplex Mode for 14800 – 15350 MHz frequency range

**Issue 1-1: Duplex Mode**

* Proposals
  + Option 1: TDD as a baseline. (Qualcomm, ZTE)
    - Suggestion for TR text found in R4-2411521 which can be further discussed if option 1 is agreed
  + Option 2: TBD
* Recommended WF
  + Option 1

*Agreement:*

* *TDD as a baseline.* 
  + *Suggestion for TR text found in R4-2411521 which can be further discussed*

### Sub-topic 1-2: Channel Bandwidth for 14800 – 15350 MHz frequency range

**Issue 1-2: Channel Bandwidth**

* Proposals
  + Option 1: 200MHz is assumed typical channel bandwidth for 14800 – 15350 MHz frequency range. Larger bandwidths are not precluded. (Qualcomm, Vivo)
  + Option 2: 200-400MHz is assumed typical channel bandwidth for 14800 – 15350 MHz frequency range (Nokia)
  + Option 3: Up to 200 MHz is assumed typical channel bandwidth for 14800 – 15350 MHz frequency range. (ISSDU)
* Recommended WF
  + TBD

CATT: Is it for simulation only or included in reply LS?

Apple: 200MHz is assumed as baseline. The licenses will be given to multiple operators. We do not preclude the possibility to have higher channel bandwidth.

ISSDU: We suggest to set 200MHz as the upper limit.

ZTE: What is the SCS?

Apple: we do not need mention SCS in LS.

Nokia: we need separate the agreement for simulation. We can consider 100MHz for simulation. In response to ITU, companies suggest higher number. We could mention that 100MHz as baseline for study and should not preclude the bandwidth up to 400MHz.

Apple: we do not preclude the larger bandwidth.

Qualcomm: What is the expected difference between 100MHz and 200Mhz simulation? Why do we not consider 200Mhz as baseline. We propose to consider 200Mhz as typical number.

Nokia: We have already agreed to use 100MHz, 200MHz and 400MHz for the simulation. For the time being, we can focus on LS. We do not need change the simulation assumption.

ZTE: 200MHz with 30KHz SCS double the FFT size.

Agreement:

* For LS about 15GHz, choose the single value out of 100MHz, 200MHz or 400MHz as baseline with understanding that the other channel bandwidths are not precluded.

### Sub-topic 1-3: Scenario Prioritization

At last meeting the following agreement was captured in the WF (R4-2410741):

**Agreement:**

* 1st priority urban macro
* 2nd priority indoor
* 3rd priority dense urban

**Issue 1-3: Scenario Prioritization**

* Proposals
  + Option 1: Follow the agreement from last meeting.
  + Option 2: Amend the agreement from last meeting with “only consider Indoor scenario after all assumptions/ parameters for the urban macro deployment are agreed” (Qualcomm)
* Recommended WF
  + TBD

CATT: We do not think that we need amend the agreements last meeting.

ZTE: Qualcomm pointed that some scenario is missing. We can agree on the indoor scenario assumption.

### Sub-topic 1-4: Coordination of Scenario

At last meeting the following agreement was captured in the WF (R4-2410741):

**Agreement:**

* Both co-ordinated and un-coordinated for outdoor
* Only co-ordinated for indoor

**Issue 1-4: Coordination of Scenario**

* Proposals
  + Option 1: Follow the agreement from last meeting.
  + Option 2: Apply un-coordinated operation with FR1 like UE and coordinated operation with FR2 like UE (Nokia)
  + Option 3: Amend the agreement from last meeting with “consider as a first priority uncoordinated urban macro deployment” (Qualcomm)
* Recommended WF
  + TBD

Nokia: for FR2, we use coordinate. To Qualcomm, you use FR1-like assumption.

CATT: It makes sense to reduce time. OK with Option 2.

Mediatek: For FR1 like UE, the detailed assumption should be discussed further. We do not preclude companies to submit other scenario.

Apple: Why is coordinate and un-coordinate impacting UE side?

Nokia: When we do FR2 simulation, we assume coordination for beam pointing. The coordinate case would be the worst case. To Mediatek, we have TP to clarify.

Apple: refer to paper for FR1 approach. We should consider coordinate scenario for FR1 too.

Qualcomm: We are proposing that companies should clarify whether it is coordinate or un-coordinate.

Skyworks: We just need understand the co-existence or other requirements.

### Sub-topic 1-5: Inter Site Distance (ISD)

At last meeting the following agreement was captured in the WF (R4-2410741):

**Agreement:**

* For indoor, agree 20m
* For outdoor, consider both 450m (1st priority) and 350 (2nd priority) until August.
  + Also other ISD not precluded as 3rd priority than 450 and 350.

Note there are also proposals in R4-2412126 related to ISD. The discussion related to the this is intended handled in relation to this issue.

**Issue 1-5: Inter Site Distance**

* Proposals
  + Option 1: Indoor = 20m. Outdoor = 450m.
  + Option 2: Indoor = 20m. Outdoor = 350m.
  + Option 3: Indoor = 20m. Outdoor = TBD
* Recommended WF
  + TBD

Ericsson: If assuming 20% indoor users, 450m cannot be supported for uplink.

Nokia: We use the another antenna array, and then 450m is OK.

Qualcomm: Same observation as Nokia.

CATT: in our understanding, we can narrow down further in the next meeting.

### Sub-topic 1-6: Indoor user in Urban Macro

At last meeting the following agreement was captured in the WF (R4-2410741):

**Agreement:**

* Keep both options

Note there are also proposals in R4-2412590 to add priority to the percentage of indoor uses. The discussion related to the this is intended handled in relation to this issue.

**Issue 1-6: Indoor user in Urban Macro**

* Proposals
  + Option 1: Keep both 0% and 20% indoor users.
  + Option 2: Prioritize 20% indoor users. (Nokia)
  + Option 3: Keep only 0% users. (Ericsson)
* Recommended WF
  + TBD

Nokia: We have different results than Ericsson. We use the larger antenna gain.

### Sub-topic 1-7: 1 sector or 3 sector per node in Indoor deployment

**Issue 1-6: Clarify in TR if Indoor deployments have 1 sector or 3 sector per node**

* Proposals
  + Option 1: 1 sector per node and capture in TR (Ericsson)
  + Option 2: 3 sector per node and capture in TR
* Recommended WF
  + TBD

Nokia: Option 1 is OK.

Agreement: 1 sector per node and capture in TR

### Sub-topic 1-8: Co-existence simulation assumptions and Adjacent channel modelling update to TR 38.922

According to the work-split agreement a TP draft for updating the co-existence simulation assumptions in the TR have been provided in R4-2412590. Similar, a TP draft for updating the Adjacent channel modelling have been provided in R4-2411093. The intention of the moderator is to revise these during RAN4#112 to address agreements reached on proposed updates,

It is understood by the moderator that not all proposed changes/updates have been captured directly in this summery. However, it is suggested that the remaining is discussed directly related to work on a revision of the TR TP.

**Issue 1-8: Co-existence simulation assumptions** **and Adjacent channel modelling update to TR 38.922**

* Proposals
  + Option 1: Revise R4-2412590 to capture co-existence simulation assumptions and R4-2411093 to capture Adjacent channel modelling in the TR
  + Option 2: TBD
* Recommended WF
  + Option 1

Agreement: Revise R4-2412590 to capture co-existence simulation assumptions and R4-2411093 to capture Adjacent channel modelling in the TR

# Topic #2: BS Parameters

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

## Open issues summary

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

### Sub-topic 2-1: BS antenna array size

At last meeting the following agreement was captured in the WF (R4-2410741):

**Agreement:**

Per polarization, for simulation only:

* 2048 (Sub Array size 8)
* 1536 (Sub Array size 4)
* Array size and Sub Array size for the response will be decided later, taking into account feasibility

This means this meaning the Array size and Sub Array size should be further discussed

**Issue 2-1: BS antenna array and sub-array size**

* Proposals
  + Option 1: BS array size as 1536 and the sub-array size as 4 (CATT)
  + Option 2: At least 1k elements (Qualcomm)
  + Option 3: 1536=16x24 (Sub Array size 4) per polarization. (Nokia)
  + Option 4: Two options based on the simulation assumptions (dual polarization): (Ericsson)
    - 2048 AEs: 8x32 array and 4x1 sub-array
    - 1536 AEs: 8x16 and 6x1 sub-array
* Recommended WF
  + TBD

### Sub-topic 2-2: BS antenna array size for Indoor scenarios

**Issue 2-2: BS antenna array size**

* Proposals
  + Option 1: Prioritize 4x4 array for Indoor scenarios (Ericsson)
* Recommended WF
  + TBD

### Sub-topic 2-3: BS Output Power

At last meeting the following agreement was captured in the WF (R4-2410741):

**Agreement:**

* Assume 43dBm BS power for simulations

**Issue 2-3: BS Output Power**

* Proposals
  + Option 1: 43dBm (CATT)
  + Option 2: 43 dBm for Urban Macro, 23 dBm for indoor, both with dual polarization. (Nokia)
  + Option 3: Based on Scenario (Ericsson)
    - 43 dBm per polarization for Urban Macro and 23 dBm with dual polarization for Indoor.
    - For both scenarios BS output power is given per 100 MHz, so if wider channel bandwidth is considered, the PSD reduces.
* Recommended WF
  + TBD

### Sub-topic 2-4: BS noise factor

At last meeting the following agreement was captured in the WF (R4-2410741):

**Agreement:**

* For simulations, assume 8dB

It is suggested to continue the discussion to also align what is potentially to be added to a LS to WP5D.

**Issue 2-4: BS noise factor**

* Proposals
  + Option 1: 8 dB i.e. follow simulation assumption (CATT)
  + Option 2: BS Type Dependent (Ericsson, Nokia)
    - 8 dB for Wide-Area BS
    - 13 dB for Medium Range BS
    - 16 dB for Local Area BS
* Recommended WF
  + TBD

### Sub-topic 2-5: BS power dynamic range

At last meeting the understanding is that 0dB was agreed as assumption to be used in the LS reply, however it is not captured in in the WF (R4-2410741)

It is suggested to continue the discussion to also align what is potentially to be added to a LS to WP5D.

**Issue 2-5: BS power dynamic range**

* Proposals
  + Option 1: 0 dB (CATT, Ericsson)
  + Option 2: TBD
* Recommended WF
  + TBD

### Sub-topic 2-6: BS RF and Antenna parameter update to TR 38.922

According to the work-split agreement a TP draft for updating the BS RF parameter in the TR have been provided in R4-2411092. The intention of the moderator is to revise this during RAN4#112 to address agreements reached on proposed updates. Additionally, a TP can be assigned for BS Antenna parameters according to work.

It is understood by the moderator that not all proposed changes/updates have been captured directly in this summery. However, it is suggested that the remaining is discussed directly related to work on a revision of the TR TP.

**Issue 2-6: Co-existence simulation assumptions update to TR 38.922**

* Proposals
  + Option 1: Revise R4-2411092 to capture BS RF parameters in the TR. Assign a TP according to work-split to capture BS antenna parameters in the TR.
  + Option 2: TBD
* Recommended WF
  + Option 1

# Topic #3: UE Parameters

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

## Open issues summary

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

### Sub-topic 3-1: UE Type

At last meeting the following agreement was captured in the WF (R4-2410741):

**Agreement:**

* For simulations, consider both options.
  + FR1 like
    - RX diversity gain: [0 or 5] dB assuming 4RX
    - TX: 0dBi omnidirectional
    - Max Power: 23 dBm, 26dBm
  + FR2 like
    - Two panels (one in each direction) 2x2 antenna
      * 5dBi element gain. Array gain comes on top
    - Power: 23 dBm as max TRP

Multiple contributions for this meeting further discusses the UE Type(s) to be considered which are captured in the proposals below.

**Issue 3-1: UE Type**

* Proposals
  + Option 1: Keep both FR1-like and FR2-like UEs in the assumptions (Samsung, Vivo, Nokia)
  + Option 2: Down-select to either FR1-like or FR2-like UEs in the assumptions ()
  + Option 3: Consider FR1-like UE beamforming as two panels with single element at each panel while for FR2-like as two panels with 1x2 array at each panel (Qualcomm).
  + Option 4: TBD
* Recommended WF
  + TBD

### Sub-topic 3-2 UE Output Power

At last meeting assumptions were made on UE max power of 23dBm and 26dBm.

**Issue 3-2: UE Output Power**

* Proposals
  + Option 1: 23dBm (Ericsson, Nokia)
  + Option 2: 26dBm (Qualcomm)
  + Option 3: TBD
* Recommended WF
  + TBD

### Sub-topic 3-3 UE noise factor

At last meeting the following agreement was captured in the WF (R4-2410741):

**Agreement:**

* 11dB for simulations. Actual noise factor for reply will be decided based on feasibility.

It is suggested to continue the discussion to also align what is potentially to be added to a LS to WP5D.

**Issue 3-3: UE noise factor**

* Proposals
  + Option 1: 11 dB i.e. follow simulation assumption (Nokia)
  + Option 2: 8 dB (Ericsson)
  + Option 3: More than 11 dB (MediaTek)
  + Option 4: TBD
* Recommended WF
  + TBD

### Sub-topic 3-4: UE RF and Antenna parameter update to TR 38.922

According to the work-split agreement a TP draft for updating the UE antenna parameter in the TR have been provided in R4-2411143. The intention of the moderator is to revise this during RAN4#112 to address agreements reached on proposed updates. Additionally, a TP can be assigned for UE RF parameters according to work-split.

It is understood by the moderator that not all proposed changes/updates have been captured directly in this summery. However, it is suggested that the remaining is discussed directly related to work on a revision of the TR TP.

**Issue 3-4: Co-existence simulation assumptions update to TR 38.922**

* Proposals
  + Option 1: Revise in R4-2411143 to capture UE antenna parameters in the TR. Assign a TP according to work-split to capture UE RF parameters in the TR.
  + Option 2: TBD
* Recommended WF
  + Option 1

# Topic #4: Other aspects

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

## Open issues summary

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

### Sub-topic 4-1: MIMO

**Issue 4-1: MIMO scenarios**

* Proposals
  + Option 1: Consider both SU MIMO and MU MIMO (ISSDU)
  + Option 2: TBD
* Recommended WF
  + TBD

### Sub-topic 4-2: Beamforming

**Issue 4-2: Beamforming**

* Proposals
  + Option 1: Beamforming scenarios should be further discussed in RAN4 as WP 5D is currently having a correspondence group on this subject and the results may be sensitive to the scenarios. Nevertheless beamforming weights for ZF and MMSE beamforming can however be supplied to ITU R WP 5D (Spark)
  + Option 2: Modifying the existing beamforming model, based on ITU-R M.2101, is not necessary.(Huawei, Ericsson, Qualcomm)
  + Option 3: TBD
* Recommended WF
  + TBD

### Sub-topic 4-3: MIMO parameter update to TR 38.922

According to the work-split agreement a TP draft for updating the UE antenna parameter in the TR have been provided in R4-2411021. The intention of the moderator is to revise this during RAN4#112 to address agreements reached on proposed updates.

It is understood by the moderator that not all proposed changes/updates have been captured directly in this summery. However, it is suggested that the remaining is discussed directly related to work on a revision of the TR TP.

**Issue 4-3: Co-existence simulation assumptions update to TR 38.922**

* Proposals
  + Option 1: Revise in R4-2411021 to capture UE antenna parameters in the TR.
  + Option 2: TBD
* Recommended WF
  + Option 1