**3GPP TSG-RAN WG4 Meeting # 102-e R4-2206334**

**Electronic Meeting, February 21 – March 4, 2022**

**Agenda item:** 10.16.3

**Source:** Moderator (Qualcomm)

**Title: DRAFT** Email discussion summary for [102-e][134] NR\_ext\_to\_71GHz\_Part\_2

**Document for:** Information

# Introduction

*Scope is UE RX and TX requirements for 60 GHz.*

# Topic #1: UE TX and RX

*Main technical topic overview.*

## Companies’ contributions summary TX

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **title** | **Company** | **Proposals / Observations** |
| [**R4-2203707**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203707.zip) | On UE spherical coverage for band n263 | Apple | Observation 1: Lensing effects can create limitations in scanning range that also exhibit frequency-dependent behaviour. The limitation in scanning range due to the lensing effect impacts the spherical coverage. Proposal 1: RAN4 shall define the UE spherical coverage for power class 3 for n263 as 1.6 dBm – as shown in Table 1.Proposal 2: RAN4 shall define the EIS spherical coverage for power class 3 for n263 as -61.4 dBm/400MHz – as shown in Table 2. |
| [**R4-2204330**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204330.zip) | Specifications of FR2-2 handheld UE | Murata Manufacturing Co Ltd. | **Observation 1: Minimum peak EIRP is 16.2 dBm in n263.****Observation 2: Handheld UE can communicate over half of ISD, when its minimum peak EIRP is in the range of [13.2 to 14.1] dBm.****Proposal 1: We propose 16.2 dBm minimum peak EIRP, but we can compromise to 14.1 dBm.****Proposal 2: We propose -72.3 dBm REFSENS.****Observation 3: It will contribute to discussions to consider communication quality in addition to specification values.****Observation 4: UE will be able to communicate only less than 3.0m with 1 panel in spherical coverage condition.****Proposal 3: We propose using 2 panels in discussion as base line.****Observation 5: Spherical coverage is 5.7 dBm with 2 panels and its communication range is 6.0m.** |
| [**R4-2204038**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204038.zip) | Minimum Tx requirement for handheld and FWA UEs at 60 GHz | Sony | **Observation 1: The degradation between 50% and 100% array gain at 60 GHz is no worse than at 28 GHz.** **Observation 2: Single panel is not feasible for practical usage due to more sparse propagation environment and more severe body blockage in FR2-2 than FR2-1.** **Observation 3: For FWA type of devices, the performance may be limited by the regulatory requirement rather than the antenna and RF component performances.****Proposal 1: The minimum peak EIRP is about 16.5 dBm for an 8-element array in mobile handsets.** **Proposal 2: 8.5 dB drop from peak EIRP/REFSEN for the spherical coverage. Minimum EIRP at 50% = 8 dBm.** **Proposal 3: Minimum Peak EIRP of FWA devices for n263 is around 30 dBm.**  |
| [**R4-2204227**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204227.zip) | Proposals on FR2-2 spherical drop for requirement calculation | MediaTek Beijing Inc. | ***Proposal:*** *FR2-2 Power Class 3 spherical EIRP/EIS requirements shall consider the calculated spherical drop value [14.1-18.3] dB.* |
| [**R4-2204359**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204359.zip) | Handheld UE RF TX requirements for n263 in FR2-2 | NTT DOCOMO, INC. | **Observation 1: Assume a single-band implementation. Multi-band relaxation should be discussed after agreeing the requirements for single-band implementation.****Proposal 1: Based on our analysis, minimum peak EIRP for n263 is 17.0 dBm.****Observation 2: 50 %-tile gain drop for EIRP is approximately 3.0 dB based on 2 panels assumption.****Proposal 2: Based on our analysis, EIRP spherical coverage for n263 is 14.0 dBm at 50 %-tile.** |
| [**R4-2204590**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204590.zip) | Views on FR2-2 FWA UE | Murata Manufacturing Co Ltd. | **Observation 1:　 Considering the deployment scenarios, communication range between UE and BS should be larger than 75.5m.****Observation 2: 　In n263, the communication range is 60m when min peak EIRP is [25.9-26.0] dBm (UMi NLOS Scenario), so we concern that the use case similar to Dense urban scenario cannot be supported**.**Proposal 1: 　　 Before determining the number of antenna elements, RAN4 needs to discuss the required communication range and use case.****Observation 3:　 It is difficult for 32 antenna element UE to support Dense urban use case. To support this scenario UE seems to need 64 antenna elements.****Proposal 2:　 RAN4 uses 64 antenna elements for FWA discussion as baseline.****Proposal 3:　 Min peak EIRP of PC1 is 32.1 dBm in n263.** |
| [**R4-2204619**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204619.zip) | UE output power for 57-71 GHz | Ericsson | **Proposal 1: The minimum peak EIRP is about 18.5 dBm for an 8-element array in mobile handsets.** **Observation 1: The degradation between 50% and 100% array gain at 60 GHz is not worse than that at 28 GHz.** **Observation 2: a single panel is not feasible for practical usage due to the propagation environment and more severe body blockage in FR2-2.** **Proposal 2: 8.5 dB drop from peak EIRP/REFSEN for the spherical coverage. Minimum EIRP at 50% = 10 dBm.**  |
| [**R4-2204934**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204934.zip) | Further discussion on handheld UE EIRP and spherical coverage requirements for 52.6~71 GHz | vivo | **Proposal 1: Pick the middle value 13.7dBm in the range of 13.2 to 14.1 to finalize the minimum peak EIRP for handheld UE in FR2-2.****Observation 1: For the handheld UE spherical coverage, the peak to 50% percentile gain drop is 14.59 dB with 8 antenna elements based on one panel configuration.****Proposal 2：We propose -0.89dBm (14.59 dB gain drop compared to minimum peak EIRP 13.7dBm) as the Min EIRP at 50%-tile CDF for handheld UE spherical coverage.** |
| [**R4-2205173**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205173.zip) | Draft CR to 38.101-2 on band n263 Tx aspects | Apple |  |
| [**R4-2205188**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205188.zip) | On 60GHz UE Tx RF requirements | Huawei, HiSilicon | ***Proposal 1: For 60GHz handheld UE, 12dBm is proposed for min peak EIRP requirement.******Proposal 2: For 60GHz handheld UE, the averaging is executed in the way of ‘Average (linear) excluding extremes.******Proposal 3: For 60GHz handheld UE, 13.7dB is proposed for 50%-tile gain drop for 1 panel case.******Proposal 4: 64 elements antenna and single panel are assumed for FWA UE in FR2-2.******Proposal 5: For 60GHz FWA UE, adopt 26.8dBm for minimum peak EIRP.******Proposal 6: Specify only 5us ON/ON transient periods in Rel-17.******Proposal 7 The beam direction switching time assumption for FR2-2 shall be the same as FR2-1.*** |
| [**R4-2205210**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205210.zip) | draft CR on vehicular UE Tx RF requirements in FR2-2 | LG Electronics Finland |  |
| [**R4-2205227**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205227.zip) | Discussion on Tx RF requirements in FR2-2 | LG Electronics Finland | **Proposal 1:** For vehicular UE, minimum peak EIRP of 22.7 dBm is proposed (based on 16 antenna elements)**Proposal 2:** For vehicular UE, EIRP at 60%-tile CDF is 15.1 dB lower than minimum peak EIRP (based on 16 antenna elements). |
| [**R4-2205246**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205246.zip) | 60 GHz UE TX | Qualcomm Incorporated | **Handheld array size:****Proposal 1: 8 elements are used for spec development per our previous meeting agreement, and per normal RAN4 working methods other implementations are not precluded.****Handheld spherical coverage:****Observation: 1 panel covers at best a hemisphere, and 2 panels back-to-back work together to cover most of the sphere****Observation: Using 1 panel degrades the %ile coverage CDF significantly.****Proposal: Specifications should be derived assuming a minimum of 2 antenna panels****Handheld min peak EIRP:****Proposal: Handheld min peak EIRP is 15 dBm, per our submissions from previous meetings. If the group decides to stay within the [] range, our preference is 14.2 dBm.****Observation: Peak to 50%ile gain drop is approximately 3 dB higher in FR2-2 than FR2-1 due to antenna pattern and other considerations, and n262 has a 13.1 dB drop. Therefore FR2-2 drop should be 16.1 dB.****Proposal: 50th %ile spherical coverage point is 16.1 dB less than the min peak dBm****PC1 UE min peak EIPR and antenna size:****Observation: The Umi UL outage can benefit from higher UL EIRP.****Proposal: Use 64 elements per polarization assumption to reduce the uplink outage develop the PC1 UE specification****Proposal: PC1 UE minimum peak EIRP is 35 dBm EIRP****PC1 UE spherical coverage:****Proposal: Use the 1-panel curve and additional losses due to beamforming errors and radiated UE structure and material losses to develop minimum performance requirement.****Proposal: Specify the 85%ile at 14 dB down from the peak EIRP value.** **UE ACLR:****Proposal: UE ALCR is 15 dBc.****ON/ON transient periods****Proposal: The transient period from FR2-1 is based on the capability of the UE to configure the transmitter and receiver. The same capability will exist in FR2-2. Use the same 5usec for FR2-2.****Beam direction only switching time baseline assumption****Proposal: UE requires 200 nsec for beam direction only switching for all SCS****Observation: Our understanding is the UE can perform a beam direction change, or a power control change, or both during this 200 nsec time.** |
| [**R4-2205313**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205313.zip) | System parameters for a NR band in the range 52.6GHz – 71GHz | Nokia, Nokia Shanghai Bell | **Proposal 3: Consider similar spectrum utilization for scenarios with 800MHz and 1600MHz as already endorsed for 120 kHz SCS in FR2-2.** **Proposal 4: Support reduced spectrum utilization for 960 kHz SCS & 2 GHz CBW****Proposal 6: For optional ON-ON transient time, only one value among 1 us or 2 us is specified.** |
| [**R4-2205459**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205459.zip) | Further Discussion on spectral utilization requirements for FR2-2 | ZTE Corporation | **Proposal 1**: **the existing spectral utilization requirements for FR2-1 could be reused at least for 100MHz and 400MHz with 120kHz SCS.** **Proposal 2**: **to propose the following transmission bandwidth configuration for FR2-2:**Table 5.3.2-3: *Transmission bandwidth configuration* NRB for FR2-2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| SCS (kHz) | 100 MHz | 400 MHz | 800 MHz | 1600 MHz | 2000 MHz |
| NRB | NRB | NRB | NRB | NRB |
| 120 | 66 | 132 | N/A | N/A | N/A |
| 480 | N/A | 66 | 132 | 264 | N/A |
| 960 | N/A | 33/32 | 66 | 132 | 165 |

 |
| [**R4-2205552**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205552.zip) | On UE Tx RF aspects for FR2-2 | Nokia, Nokia Shanghai Bell | **Observation 1: How many panels including the agreed 8 antenna elements is still FSS.** **Proposal 1: Assumption of antenna elements per antenna panel shall be discussed.****Proposal 2: Minimum UE beamforming requirements shall be defined for devices with a TRP exceeding 20 dBm.****Observation 2: Maximum power level TRP is in Europe defied at 25 dBm for a handheld device and 55 dBm for a fixed outdoor device with ≥ 30 dB transmit directivity.****Proposal 3: Maximum power level TRP of 25 dBm shall be considered.** **Observation 3: Minimum peak EIRP, REFSENS and EIS spherical coverage are still needed agreed to confirm applicable power classes for FR2-2.****Proposal 4: In FR2-2 band n263, handheld UE minimum peak EIRP is specified 17.9 dBm****Proposal 5: Assume a minimum of 2 antenna panels for a handheld UE.****Proposal 6: Use a UE beam direction switching time of 59 ns.** |
| [**R4-2205999**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205999.zip) | UE Tx RF requirements for FR2-2 | Intel Corporation | *Handheld UE power class***Observation 1:** The average considering all proposals in Table 1, is 14.1 dBm. Removing the max and min values of the data set leads to a 13.7 dBm average, which is also the midpoint of the range captured in the WF. These figures are subject to the addition of new proposals and potential revaluation during this meeting.**Proposal 1:** Define the single-band minimum peak EIRP of PC3 in FR2-2 as 13.7 dBm.**Observation 2:** Given the larger array assumption used for FR2-2, its characteristics, and added complexities/losses, the drop from peak of band n263 should be larger than that of band n262 (13.1 dB).*FWA UE power class***Observation 3:** Considering we do not specify the number of antenna elements and the small difference in minimum peak EIRP derivations, the agreed range of 32 to 64 elements should be kept for PC1 in FR2-2. **Proposal 2:** Define the single-band minimum peak EIRP of PC1 in FR2-2 as 26 dBm.**Observation 4:** Performance degradation is expected compared to previously defined FR2-1 bands and the spherical coverage requirement should reflect this. A drop from peak value around 9 – 10 dB can be considered and further discussed for band n263.*ON/ON transient period***Observation 5**: * **Option 1:** No gNB scheduling optimizations for ON/ON transient period
	+ Using 5 µS ON/ON transient period leads to high throughput reduction due to corruption of the PUSCH data symbols. Up to 50% and 12% throughput loss can be expected for bundling size 2 and 8, respectively.
	+ An improved ON/ON transient period faster than 5 µS is required to support at least full MCS for 16 QAM modulation.
* **Option 2:** Optimized gNB scheduling for ON/ON transient period
	+ Using 5 µS ON/ON transient period leads to high throughput loss even with optimized gNB scheduling without corrupted symbols on UE side. Up to 25% and 6% throughput loss can be expected for bundling size 2 and 8, respectively.

An improved ON/ON transient period faster than 5 µS allows better throughput performance with almost 20%, 10% and 5% improvement for scenarios with bundling size 2, 4 and 8, respectively.**Proposal 3**: Introduce 2 µS improved ON/ON transient period as optional UE capabilities for 480 and 960 kHz SCS. |

## Companies’ contributions summary RX

|  |  |  |  |
| --- | --- | --- | --- |
| **T-doc number** | **title** | **Company** | **Proposals / Observations** |
| [**R4-2204039**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204039.zip) | Minimum Rx requirement for handheld UEs at 60 GHz | Sony | **Proposal 1: REFSENS -76 dBm/400MHz for n263****Proposal 2: 8.5 dB drop from REFSEN to the spherical coverage EIS at 50% CDF, which leads to 67.5 dBm/400MHz for n263.** |
| [**R4-2204360**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204360.zip) | Handheld UE RF RX requirements for n263 in FR2-2 | NTT DOCOMO, INC. | **Observation 1: Assume a single-band implementation. Multi-band relaxation should be discussed after agreeing the requirements for single-band implementation.****Proposal 1: Based on our analysis, REFSENS for n263 is -80.7 dBm/400MHz.****Observation 2: 50 %-tile gain drop for EIS is approximately 3.0 dB based on 2 panels assumption.****Proposal 2: Based on our analysis, EIS spherical coverage for n263 is -77.7 dBm/400MHz at 50 %-tile.** |
| [**R4-2204935**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204935.zip) | Further discussion on handheld UE EIS requirements for 52.6~71 GHz | vivo | Table 1: Reference sensitivity for power class 3

|  |  |
| --- | --- |
| Operating band | REFSENS (dBm) / Channel bandwidth |
| 100 MHz | 400 MHz | 800 MHz | 1600 MHz | 2000 MHz |
| n263 | -79.0 | -73.0 | -70.0 | -67.0 | -66 |

Table 2: EIS spherical coverage for power class 3

|  |  |
| --- | --- |
| **Operating band** | **EIS at 50th %-tile CCDF (dBm) / Channel bandwidth** |
| **100 MHz** | **400 MHz** | **800 MHz** | **1600 MHz** | **2000 MHz** |
| n263 | -64.4 | -58.4 | -55.4 | -52.4 | -51.4 |

 |
| [**R4-2205189**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205189.zip) | On 60GHz UE Rx RF requirements | Huawei, HiSilicon | ***Proposal 1: For 60GHz handheld UE, the REFSENS requirement for 52.6~71 GHz is -75.5 dBm/100 MHz based on 8 elements antenna array assumption.******Proposal 2: For 60GHz handheld UE, the averaging is executed in the way of ‘Average (linear) excluding extremes.******Proposal 3: For 60GHz handheld UE, the EIS spherical coverage requirement could be decided by reusing the analysis of EIRP gain drop from 50%-tile to peak EIRP.*** |
| [**R4-2205229**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205229.zip) | draft CR on vehicular UE Rx RF requirements in FR2-2 | LG Electronics Finland |  |
| [**R4-2205231**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205231.zip) | Discussion on Rx RF requirements in FR2-2 | LG Electronics Finland | **Proposal 1:** For vehicular UE, reference sensitivity at channel band width of 400MHz is -80.3dBm is proposed (based on 16 antenna elements).**Proposal 2:** For vehicular UE, EIS spherical coverage 60%-tile CDF is 15.1 dB higher than reference sensitivity (based on 16 antenna elements). |
| [**R4-2205292**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205292.zip) | 60 GHz UE RX | Qualcomm Incorporated | **REFSENS****Proposal: REFSENS for PC1 based on 64 array elements****Proposal: n263 PC1 REFSENS is -88.3 dBm under the assumption of 95% spectral occupancy, 64 elements, and 400 MHz.****Proposal: REFSENS for PC3 based on 8 array elements****Proposal: n263 PC3 REFSENS is -79.2 under the assumption of 95% spectral occupancy, 8 elements, and 400 MHz.****EIS Spherical coverage****Proposal: For PC1 specify the 85%ile at 14 dB down from the peak sensitivity value, based on 64 elements and 400MHz CBW/95% spectral occupancy.** **Proposal: For PC3 specify the 50%ile at 16.1 dB down from the peak sensitivity value, based on 8 elements and 400MHz CBW/95% spectral occupancy.**  |
| [**R4-2205553**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205553.zip) | On UE Rx RF aspects for FR2-2 | Nokia, Nokia Shanghai Bell | **Proposal 1: In FR2-2 band n263, handheld UE REFSENS for 400 MHz channel bandwidth is specified -82.0 dBm.** |
| [**R4-2206000**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206000.zip) | UE EIS requirements for band n263 | Intel Corporation | *Handheld UE***Observation 1:** The average considering all proposals in Table 1, is -71 dBm. Removing the max and min values of the data set leads to a -71.2 dBm average. These figures are subject to the addition of new proposals and potential revaluation during this meeting.**Proposal 1:** Further discussion of the complete list of proposals is needed. Based on current data, we can consider defining the single-band minimum peak EIS of PC3 in FR2-2 as -71 dBm (400MHz CBW).*FWA UE***Observation 3:** The minimum peak EIS requirements (400MHz CBW) of FR2-1 bands range from -88.5 dBm at 28 GHz, to -83.5 dBm for band n262 [6]. As degradation is expected for band n263, a larger than -83.5 dBm value is reasonable. This should be considered when discussing the FR2-2 requirement.**Proposal 2:** Define the PC1 minimum peak EIS single-band requirement as -76.2 dBm (400MHz).**Observation 4:** Given the anticipated degradation compared to previously defined FR2-1 bands, a drop from peak value around 9 –10 dB can be considered and further discussed for band n263 |

## Open issues summary

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

### Minimum peak EIRP

*Sub-topic description:*

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

* Proposals

|  |  |  |  |
| --- | --- | --- | --- |
|  | Power class 3 | Power class 1 | Power class 2 |
| EIRP | EIRP last meeting(for reference) | EIRP | elements | EIRP | elements |
| Murata | 16.2 (14.1 OK) | 15.7 | 32.1 | 64 |  |  |
| Sony | 16.5 |  | 30 | 64 |  |  |
| NTT DOCOMO | 17 |  |  |  |  |  |
| Ericsson | 18.5 |  |  |  |  |  |
| vivo | 13.7 | 11.3 |  |  |  |  |
| Huawei, HiSilicon | 12 | 12 | 26.8 | 64 |  |  |
| LGE | 14.7 | 14.7 |  |  | 22.7 | 16 |
| QCOM | 15 | 15 | 35 | 64 |  |  |
| Nokia, Nokia Shanghai Bell | 17.9 | 20 |  |  |  |  |
| Intel | 13.7 | 13.6 | 26 | 32 to 64 range |  |  |
| Apple | 9.2 |  |  |  |  |  |
| OPPO |  | 12 |  |  |  |  |
|  |  |  |  |  |  |  |

* **PC3 Min Peak EIRP**

*Range of [13.1 – 14.2] was agreed last meeting as WF based on averaging in power and in dB*

**

* Option 1: 13.2 dBm (from [] last meeting)
* Option 2: 14.1 dBm (from [] last meeting)
* Option 3: 15 dBm (dB averaged based on inputs this meeting)
* Option 4: 15.6 dBm (power averaged based on inputs this meeting)
* Option 5: Something else and describe
	+ Recommended WF
		- Companies discuss between the 4 options

|  |  |
| --- | --- |
| **Company** | **PC3 Min Peak EIRP Comments** |
| LGE | We did no resubmit the HH proposals to this meeting as our position has not changed. Therefore we’d like to see our proposal to be included into data analysis in this meeting. Thank you for moderator for showing also the last meeting contributed values as reference in table above.\*\*\*Moderator note\*\*\* the LGE proposal has been added in |
|  |  |
| vivo | The value 13.7 dBm proposed by us is the middle value from the range [13.2-14.1] dBm, which is averaged based on companies’ results in the last meeting. I thought we didn’t need to do the average again. However, from the moderator’s summary, it looks like we are going to do the average again. In general, we proposed to pick a value from the range 13.2-14.1 dBm. However, if we do the average again, please use 11.3 dBm as our value based on our link level analysis. |
| MediaTek | The range agreement last meeting, i.e. [13.2 – 14.1], shall be respected. |
| OPPO | Similar as LGE, our proposal in last meeting (12dBm min peak EIRP) is not included in table, so added, please take into account.Prefer Option 1. |
| Sony | Option 4. multiple companies have provided updated analysis in this meeting so we it is reasonable to take into account the updated inputs. In addition, it is mathematically more correct to average over linear scale rather than dB scale, which is also the way we used before for several cases in FR2-1.  |
| Nokia, Nokia Shanghai Bell | We support option 4, power average based on inputs in this meeting. |
| HW | The range from last meeting is preferred. OK with Option 1 or Option 2  |
| Murata | We prefer option 4 or 3.In previous meeting we agreed using band n263, so min peak EIRP can be larger than [13.2-14.1]. |
| Intel | We should carefully review all the data once again and recalculate the average (we see discrepancies), and options should be updated accordingly.Overall, we think 14 dBm is a reasonable number. |
| Apple | We would like to clarify the parameters submitted by several companies to this meeting.To Murata: last meeting you proposed a range of values from 11.3 dBm to 15.7 dBm, based on 8 antenna elements, while this meeting the proposal has increased to 16.2 dBm. What is the technical explanation for this difference? How can we understand the motivation to define the minium requirement based on a proposal which is characterized as the "maximum"? Would this include any tolerances for manufacturing variations?After reviewing vivo's R4-2204934, we note that the analysis value is provided as 11.3 dBm (based on 8 elements), and 13.7 dBm is their calculated proposal. We suggest that we capture the analysis value in the summary table as we work to calculate the RAN4 average value.To Qualcomm: we checked last meeting's moderator's summary [R4-2202366], and Qualcomm's peak EIRP analysis value is given as 9.4 dBm. The related analysis was provided during the meeting in R4-2202247. Our question is how is 15 dBm justified as the analysis value during this meeting? After reviewing the contribution submitted in R4-2205246, we cannot find the analysis related to this value. Instead, there is a proposal to take 15 dBm based on the outcome from the last meeting. We are afraid that this is not a data-driven approach to derive the requirement and would suggest to retain the analysis value in the table this meeting for the purpose of deriving the requirement from analysis data.A similar comment is about Intel's value in the table of 13.7 dBm. According to R4-2205999, the analysis value is 13.6 dBm, while 13.7 dBm is their proposal.We suggest the following corrected table of min peak EIRP analysis values:Murata 15.7Sony 16.5NTT DOCOMO 17Ericsson 18.5vivo 11.3Huawei, HiSilicon 12LGE 14.7QCOM 9.4Nokia, Nokia Shanghai Bell 17.9Intel 13.7Apple 9.2OPPO 12Average (over mW): 15.0Average (over dB): 14.0We should also respect the agreement reached last meeting, which was a range from [13.2 to 14.1] dBm. Thus, based on the updated analysis this meeting, we should select the maximum value from the previously agreed range, which would be 14.1 dBm. |
| Ericsson | Option 4. Power averaging in linear scale. |
| Murata2 | To Apple: We proposed 15.7 dBm in RAN4#101-e (R4-2117674), but frequency range was 52.0 to 71.0 GHz.We proposed 16.2 dBm in this meeting (R4-2204330), and we used band n263 (57.0 to 71.0 GHz) as frequency range.In the last meeting RAN 4#101-bis-e, we just summarized proposed values previously. 11.3dBm is not our proposed value.From the our proposed value, we prefer option 4 or 3. |
| DOCOMO | Support Option 3 and Option 4.At the last meeting, the target band and antenna assumptions were agreed and clarified. We don't understand why RAN4 should not consider the values provided based on the updated assumption. Please note that the following was agreed at the last meeting:"Companies can provide the additional number and link level analysis." |
| QCOM | To Apple’s question, we changed to a higher power PA processOption 3 |

|  |  |
| --- | --- |
| **PC3 min pk EIRP** | **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** |
|  | *Tentative agreements:* *Candidate options:**Recommendations for 2nd round: further discuss in WF* |

* **PC1 Number of elements per polarization**

*Range Between 32 and 64 elements was agreed last meeting as WF*

* Option 1: 64 element assumption (Murata, Sony, Huawei/HiSilicon, QCOM)
* Option 2: any value between 32 and 64 elements (Intel)
	+ Recommended WF
		- 64 elements by 4 to 1 majority

|  |  |
| --- | --- |
| **Company** | **PC1 elements Comments** |
| OPPO | There is too much gap between 32 and 64, from our point we prefer 32, and can accept something in middle like 48 rather than double the number. |
| Sony | Option 1 is preferred.  |
| HW | Agree with the recommended WF |
| Murata | We prefer Option 1. We need 64 elements in order to communicate over half of ISD or 75.5m. |
| Intel | We have similar view as OPPO and prefer to either keep the agreed range, or meet somewhere in the middle |
| QCOM | Option 1 |

|  |  |
| --- | --- |
| **PC1 elements** | **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** |
|  | *Tentative agreements:* *Candidate options:**Recommendations for 2nd round: further discuss in WF* |

* **PC1 Min Peak EIRP**



* Option 1: 30 dBm (average in dB)
* Option 2: 31.25 dBm (average in power)
* Option 3: Something else and describe
	+ Recommended WF
		- Further discuss between these options

|  |  |
| --- | --- |
| **Company** | **PC1 Min Peak EIRP Comments** |
| OPPO | Option 1. |
| Sony | Option 2.  |
| HW | Option 2 |
| Murata | Option 2. |
| Intel | From the options presented, we prefer 30 dBm; but think we may need to align first |
| QCOM | Option 2 |

|  |  |
| --- | --- |
| **PC1 min pk EIRP** | **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** |
|  | *Tentative agreements:* *Candidate options:**Recommendations for 2nd round: further discuss in WF* |

* **PC2 Number of elements per polarization and Min peak EIRP**

*Greater than or equal to handheld was agreement last meeting*

* Proposal 1: 22.7 dBm based on 16 element assumption
	+ Recommended WF
		- companies discuss proposal 1

|  |  |
| --- | --- |
| **Company** | **PC2 elements and min peak EIRP Comments** |
| LGE | We support proposal 1. |

|  |  |
| --- | --- |
| **PC2 elements** | **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** |
|  | *Tentative agreements: 22.7 dBm* *Candidate options:**Recommendations for 2nd round: record as agreement in WF and no further discussion* |

### Antenna panels and spatial coverage

*Sub-topic description:*

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

* Proposals

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Company | PC3 panels | PC3 drop | PC1 %ile | PC1 drop | PC2 panels | PC2 drop | PC2 %ile | PC2 elements |
| Apple | 2 | 11.6 |  |  |  |  |  |  |
| Murata | 2 | 10.5 |  |  |  |  |  |  |
| QCOM | 2 | 16.1 | 85% | 14 |  |  |  |  |
| Sony | 2 | 8.5 |  |  |  |  |  |  |
| MediaTek | unstated | 14.1 to 18.3 dB |  |  |  |  |  |  |
| DOCOMO | 2 | 3 |  |  |  |  |  |  |
| Ericsson | 2 | 8.5 |  |  |  |  |  |  |
| vivo | 1 | 14.59 |  |  |  |  |  |  |
| Huawei, HiSilicon | 1 | 13.7 |  |  |  |  |  |  |
| LGE | 12 | 149 |  |  | 1 | 15.1 | 60% | 16 |
| Intel |  | >13.1 |  | 9 to 10 dB further discuss |  |  |  |  |

* **PC3 Panels**
* Option 1: >=2
* Option 2: >=1
	+ Recommended WF
		- companies further discuss the options

|  |  |
| --- | --- |
| **Company** | **PC3 Panels Comments** |
| LGE | We do not have a very strong position on this and therefore we provided our analysis for both options in last meeting. Also reflected in table above now. For PC2 we iterated between proposing values based on new approach, but ended up utilizing the FR2-1 approach to maintain specifications more consistent. |
| vivo | Prefer Option 2. |
| MediaTek | Just to clarify our proposal. FR2-1 PC3 gain drop is not based on a single panel quantity assumption, hence, we tried to leverage the compromise result by frequency domain linearity calculation concept to calculate the gain drop for FR2-2.,  |
| OPPO | Prefer Option 2 as already use 8 antenna elements. |
| Sony | Option 1 is preferred since we don’t think single panel can work in real life for handheld mobile devices due to the hand blockage. |
| Nokia, Nokia Shanghai Bell | Option 1: The requirement should be defined based on at least 2 panels |
| HW | Prefer Option 2 |
| Murata | We Prefer Option 1.In 1 panel implementation, communication range will be short under spherical coverage condition, and it is difficult keeping communicating when UE is covered by hands. |
| Apple | Option 2; we can also provide a calculation of gain drop based on a single panel this meeting for the second round, in case this can help the analysis. |
| Ericsson | Option 1 for performance due to the propagation conditions in the 60 GHz range. |
| DOCOMO | Support option 1. It is difficult to support FR2-2 with one antenna panel. |
| QCOM | Option 1. >= 2 panels |

|  |  |
| --- | --- |
| **PC3 panels** | **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** |
|  | *Tentative agreements:* *Candidate options:**Recommendations for 2nd round: further discuss in WF* |

* **PC3 Drop**

****

* Proposal 1: 12 dB drop (dB or linear average are close), 3 dB outlier removed
* Proposal 2: Between 14.1 and 18.3
* Proposal 3: >13.1
* Proposal 4: Something else
	+ Recommended WF
		- further discuss the proposals

|  |  |
| --- | --- |
| **Company** | **PC3 Drop Comments** |
| LGE | Our analysis in last meeting for PC3 50% showed 14dB drop with 1 panel and 9dB drop with 2 panels with 4dB implementation margin. While this performance is important for system robustness we also see the implementation challenges and even limitations that too stringent requirement will cause. It may be difficult to converge in this area with discussion so eventually some kind of averaging needs to be done.  |
| vivo | We are OK for P1 and P2. |
| OPPO | Proposal 1 is ok. |
| Sony | Proposal 4. We see multiple companies have brought concerns on using 1 panel for handheld UEs, therefore, we prefer to align the panel assumption to be 2 then average the inputs. However, if we can’t reach a consensus on panel number, then proposal 1 may also be acceptable. |
| Nokia, Nokia Shanghai Bell | We can accept Proposal 1. |
| HW | OK with Proposal 2 and 3 |
| Murata | Proposal 4. We share similar view with Sony. We prefer to align the panel assumption to be 2 then average the inputs.We believe it is important clarifying what communication quality does spherical coverage relate to.If we use 1 panel, we can communicate around 2 m under spherical coverage condition. Is it feasible for applications or services? We think around 5.7 dBm spherical coverage and around 6 m communication range is feasible from the viewpoint of both implementation and communication range. |
| Intel | Proposal 2 and Proposal 3 are ok. However, we should align on previous issues first |
| Apple | Proposals 1 and 2 are OK for us. |
| Ericsson | We prefer a value based on two panels (this should be settled first as proposed above). This is relevant from a performance standpoint and would enable a value more aligned with FR2-1. We note that this requirement will also impact RRM requirements. |
| DOCOMO | We support an approach of averaging the values provided by each company. (i.e. Option1.)According to our study, the gain drop of 2 panel (Bottom and Top) is shown to be 3dB. If the worst case of antenna placement is assumed, gain drop is 3.4 dB for 2panel (Side and Back) and 8.6 dB for 1panel (Back). Please refer to our paper. |
| QCOM | Option 3. FR2-2 can’t be better than FR2-1/ |

|  |  |
| --- | --- |
| **PC3 drop** | **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** |
|  | *Tentative agreements:* *Candidate options:**Recommendations for 2nd round: further discuss in WF* |

* **PC1 %ile**
* proposal 1: 85%
	+ Recommended WF
		- agree proposal 1

|  |  |
| --- | --- |
| **Company** | **PC1 %ile Comments** |
| XXX | YYY |
| MediaTek | Align FR2-1 PC1 (85%-tile) is okay. |
| HW | Considering more antenna elements and higher frequency range, a percentile higher than 85% could be considered. |
| Murata | We agree with the recommended WF. |
| Intel | Recommended WF is agreeable, continue using 85%-ile |
| QCOM | The WF. 85%ile. |

|  |  |
| --- | --- |
| **PC1 %ile** | **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** |
|  | *Tentative agreements: proposal 1 85%ile**Candidate options:**Recommendations for 2nd round: record as agreement in WF and no further discussion* |

* **PC1 Drop**
* Option 1: 14 dB
* Option 2: 9 to 10 dB
* Option 3: Something else
	+ Recommended WF
		- further discuss options

|  |  |
| --- | --- |
| **Company** | **PC1 Drop Comments** |
| Intel | We are open to further discussion and may meet somewhere in the middle of the two options, but we note that a 14 dB drop is significantly larger than what was defined for band n262 |
| QCOM | Option 3. dB average between 14 and 9.5, so so round that to 11.5 dB. |

|  |  |
| --- | --- |
| **PC1 drop** | **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** |
|  | *Tentative agreements:* *Candidate options:**Recommendations for 2nd round: further discuss in WF* |

* **PC2 %ile**
* Proposal 1: 60%
	+ Recommended WF
		- discuss proposal 1

|  |  |
| --- | --- |
| **Company** | **PC2 %ile Comments** |
| LGE | We support proposal 1, which is based and aligned with development of FR2-1 requirements. |
| MediaTek | Align FR2-1 PC2 (60%-tile) is okay. |

|  |  |
| --- | --- |
| **PC2 %ile** | **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** |
|  | *Tentative agreements:proposal 1. 60%ile for PC2**Candidate options:**Recommendations for 2nd round: no further discussion. record as agreement in WF* |

* **PC2 panels and drop**
* Proposal 1: 1 panel 15.1 dB drop
	+ Recommended WF
		- discuss proposal 1

|  |  |
| --- | --- |
| **Company** | **PC2 Drop Comments** |
| LGE | We support proposal 1, which is based and aligned with development of FR2-1 requirements. |

|  |  |
| --- | --- |
| **PC2 drop** | **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** |
|  | *Tentative agreements:proposal 1. 15.1 dB drop.**Candidate options:**Recommendations for 2nd round: No further discussion. record as agreement in WF* |

### REFSENS and EIS

*Sub-topic description:*

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

* Proposals

|  |  |  |  |
| --- | --- | --- | --- |
|  | PC3 | PC1 | PC2 |
| Sony | -76 |  |  |
| NTT DOCOMO | -80.7 |  |  |
| Vivo | -73 |  |  |
| Murata | -72.3 |  |  |
| Huawei HiSilicon | -69.5 |  |  |
| LGE | -75.3 |  | -80.3 |
| QCOM | -79.2 | -88.3 |  |
| Nokia, Nokia Shanghai Bell | -82.0 |  |  |
| Intel | -71 | -76.2 |  |
| Apple | -61.4 |  |  |

* **PC3 REFSENS 400 MHz CCBW**



* Option 1: average of dB values (-74 dBm)
* Option 2: average of power values (-69.5 dBm)
* Option 3: Something else
	+ Recommended WF
		- further discuss options

|  |  |
| --- | --- |
| **Company** | **PC3 REFSENS Comments** |
| LGE | We proposed -75.3dBm in last meeting and ask this to be taken into account into average. Now added to the table above.\*\*\* moderator note: I have added that in. Thank you. |
| vivo | We proposed -73dBm/400MHz since this is the agreed tentative value averaged based on all participating companies’ results in the last meeting. If we are going to do the average again, please do use -68dBm/400Mhz in the calculation. |
| MediaTek | We prefer -70 dBm (# by frequency domain linearity calculation) ~ -73 dBm (# tentative agreement last meeting) |
| OPPO | Option 2, average in power values. |
| Sony | Option 3. We see that for the EIRP, the deviation between minimum and maximum inputs is less than 10 dB. However, for the REFSENS, it is more than 20 dB different, which is too diverse in our view. We suggest removing the lowest and highest outliers then perform the average. |
| Nokia, Nokia Shanghai Bell | To align with Tx side and to be technically correct power average should be used and the [3] dB outlier(s) should be removed |
| HW | Prefer Option 2 |
| Murata | We prefer option 1. |
| Intel | Similar to vivo, our proposal was to consider -71 dBm based on the data available. To determine the average, please use our derived value of -70 dBm. As with peak EIRP, we should review the data carefully and update accordingly.From the options available, our preference is Option 2. |
| Apple | Our REFSENS proposal from last meeting [R4-2202414] is -67.81 / 400 MHzRecalculating the averages (also taking vivo's and Intel's comments into account):average over mW: -71.7 dBm/400 MHzaverage over dB: -74.1 dBm/400 MHzWe recommend considering the midpoint between these values: -72.9 dBm/400 MHz |
| Ericsson | Option 3: we also note a significant spread of the values, which may lead to less meaningful minimum performance requirement. We would also like to note that regulators in regions also keep an eye on receiver performance nowadays. |
| DOCOMO | We support an approach of averaging the values provided by each company. Whether to average power or dB should be in line with EIRP discussion. |
| QCOM | We are ok with option 1 |

|  |  |
| --- | --- |
| **PC3 REFSENS** | **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** |
|  | *Tentative agreements:* *Candidate options:**Recommendations for 2nd round: further discuss in WF* |

* **PC1 REFSENS 400 MHz CCBW**
* Option 1: -88.3 dBm
* Option 2: -76.2 dBm
* Option 3: Something else
	+ Recommended WF
		- further discuss options

|  |  |
| --- | --- |
| **Company** | **PC1 REFSENS Comments** |
| MediaTek | It’s better to wait for antenna element discussion |
| Intel | Our preference is Option 2. Note that this requirement at 28GHz is -88.5 dBm, for n260 is -85.5 dBm and n262 is -83.5 dBm. Further discussion and alignment are needed. |
| QCOM | Option 1 |

|  |  |
| --- | --- |
| **PC1 REFSENS** | **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** |
|  | *Tentative agreements:* *Candidate options:**Recommendations for 2nd round: further discuss in WF* |

* **PC2 REFSENS 400 MHz CCBW**
* proposal 1: -80.3 dBm
	+ Recommended WF
		- discuss proposal 1

|  |  |
| --- | --- |
| **Company** | **PC2 REFSENS Comments** |
| LGE | We support proposal 1. |
| MediaTek | It’s better to wait for antenna element discussion |
| XXX | YYY |

|  |  |
| --- | --- |
| **PC2 REFSENS** | **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** |
|  | *Tentative agreements: -80.3 dBm**Candidate options:**Recommendations for 2nd round: record as agreement in WF. no further discussion.* *moderator note: from above there is only one proposal for PC2 elements which is 16 and no objections so that is the tentative agreement* |

* **EIS for all power classes**
* Proposal 1 1: use the spherical coverage drops from each power class to determine the EIS
	+ Recommended WF
		- proposal 1

|  |  |
| --- | --- |
| **Company** | **EIS for all power classes Comments** |
| LGE | We agree moderator proposal. |
| vivo | Recommended WF is OK. |
| MediaTek | Same gain drop between Tx/Rx is made sense. |
| Nokia, Nokia Shanghai Bell | We agree with the recommended WF. |
| HW | Agree with the recommended WF |
| Apple | Agree |
| QCOM | agree proposal 1 |

|  |  |
| --- | --- |
| **EIS for power classes** | **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** |
|  | *Tentative agreements: Proposal 1 use the spherical coverage drops from each power class to determine the EIS**Candidate options:**Recommendations for 2nd round: record as agreement in WF no further discussion* |

### TRP

*Sub-topic description:*

*Previous agreements:*

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

* Proposals
	+ Proposal 1: Minimum UE beamforming requirements shall be defined for devices with a TRP exceeding 20 dBm.
	+ Proposal 2: Maximum power level TRP of 25 dBm shall be considered.
* Recommended WF
	+ further discuss proposals

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX | YYYY |
| MediaTek | We don’t understand Proposal 1, because max TRP of power class is a upper limit due to regulator. |
| Sony | For regional requirements, maybe we can consider NS signalling based approach.  |
| Nokia, Nokia Shanghai Bell | To MediaTek: The proposal 2 of max 25 dBm TRP aligns with the general requirement of regulations. Proposal 1 relates to agreement in ETSI BRAN, where implementations with higher than 20 dBm TRP are required to have directivity D = EIRP / TRP of at least max(EIRP – 25, 11) dB. This requirement should be included in 3GPP requirements preferably as a general requirement. |
| Intel | For Proposal 1 – we did not define a minimum TRP in FR2-1, so we don’t think it is needed for FR2-2. Also, this will depend on the power class.For Proposal 2 – as we did with FR2-1, the regulatory requirement is captured for reference |
| Apple | Some meetings ago, there was an agreement on this issue in R4-2107973, as follows:Based on Nokia's comment, RAN4 should discuss how to capture this requirement. Perhaps an NS value approach should also be used, since this requirement is not applicable to other regions. |
| Ericsson | The limits should be subject to NS signaling since they may vary in different regions. The 25 dBm limit and the beamforming requirement are presumably based on a recent agreement in ETSI for c2 operation in Europe in the draft standard EN 303 687. This standard is still in *draft* form and not published. |
| DOCOMO | We can support option 2 if the following agreements continue:"Other regional regulatory requirements are not precluded." |

|  |  |
| --- | --- |
| **TRP** | **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** |
|  | *Tentative agreements:* *Candidate options:**Recommendations for 2nd round: further discussion in WF* |

### UE ACLR

*Sub-topic description:*

*Previous agreements:*

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

* Proposals
	+ Proposal 1: 15 dB ACLR
* Recommended WF
	+ Proposal 1

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | We already agreed UE ACLR as 15dB in the last meeting, see R4-2202367.UL ACIR requirement for 57-71GHz

|  |  |  |
| --- | --- | --- |
| UL ACIR | BS ACS | UE ACLR |
| 13.8 dB | 22 dB | 15 dB |

 |
| QCOM | Proposal 1. To vivo we agree the on the ACIR table but want to make sure this 15 dB is agreed as a requirement. |

|  |  |
| --- | --- |
| **UE ACLR** | **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** |
|  | *Tentative agreements: proposal 1 15 dB ACLR**Candidate options:**Recommendations for 2nd round: record as agreement in WF and no further discussion in rd 2* |

### Spectral utilization

*Sub-topic description:*

*Previous agreements: 66/264 for 120 SCS has been endorsed in draft CR R4-2202364*

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

* Spectral utilization
* Proposal 1: Table proposes 400 MHz (480 and 960 SCS), and 800 – 2000 MHz SU.
* Table 5.3.2-3: *Transmission bandwidth configuration* NRB for FR2-2

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| SCS (kHz) | 100 MHz | 400 MHz | 800 MHz | 1600 MHz | 2000 MHz |
| NRB | NRB | NRB | NRB | NRB |
| 120 | 66 | 264 | N/A | N/A | N/A |
| 480 | N/A | 66 | 132 | 264 | N/A |
| 960 | N/A | 33/32 | 66 | 132 | 165 |

Note: *66/264 for 120 SCS has been endorsed in draft CR R4-2202364*

* Proposal 2: Use same SU for 800 and 1600 MHz as agreed for 120 kHz SCS
* Proposal 3: Specify lower spectral utilization for 2000 MHz CCBW as compared to other CCBWs
	+ Recommended WF
		- discuss proposals

|  |  |
| --- | --- |
| **Company** | **SU comments**  |
| XXX | YYY |
| CATT | We’re ok with proposal 1 except that we think 32 can be chosen for 33/32 considering DFT implementation and alignment with current FR2-1 case. The results align with the analysis in our contribution R4-2117315. And 2000MHz 165 RB justification was provided in R4-2111913.There’s another thing we should decide in this topic is what’s the FFT size for each CBW/SCS. EVM window needs to use it. In our understanding, 2048 FFT size for 960kHz SCS can be used for 2000MHz CBW. The detail analysis is included in R4-2109014. |
| vivo | For P1, why there are 2 values for 960kHz with 400MHz? |
| Nokia, Nokia Shanghai Bell | We are in principle OK with all proposals expect for 165 PRB for 2000 MHz ChBW. For 400 MHz/960 kHz we prefer 33 RB. To allow 2k FFT implementation for 2000 MHz ChBW with reasonable FFT utilization the spectrum utilization should be less than 90% i.e. less than 156 PRB. |
| Apple | We would like to ask more time to check these values before the second round. |
| Ericsson | This should be discussed jointly fir the gNB and UE. |
| QCOM | We would like to check this further this meeting |

|  |  |
| --- | --- |
| **Spectral utilization** | **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** |
|  | *Tentative agreements:**Candidate options:**Recommendations for 2nd round: further discuss round 2* |

### ON/ON transient periods for 480 and 960 SCS

*Sub-topic description:*

Tentative agreement from last meeting: Use the same 5usec for FR2-2.

FFS on introduction of a single value among {1, 2, 3} µS improved ON/ON transient period as the optional UE capabilities for 480 and 960 kHz SCS

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

* Proposals
	+ Option 1: 5usec for all SCS (Huawei/HiSilicon, QCOM)
	+ Option 2: Introduce 2 µS improved ON/ON transient period as optional UE capabilities for 480 and 960 kHz SCS. (Intel)
	+ Option 3: Specify exactly 1 optional capability, either 1usec or 2usec.
* Recommended WF
	+ discuss the 3 options

|  |  |
| --- | --- |
| **Company** | **Comments** |
| AT&T | Option 2. As this is introduced as an optional UE capability, it is important to specify an improved ON/ON transient period for higher SCSs. In addition, this topic seems to be also covered in thread [133] depending on outcome of [143] discussion. It may be good to clarify if this should be consolidated to either [133] or [134]. |
| vivo | Option 1 for this release. |
| OPPO | Option 1. |
| Nokia, Nokia Shanghai Bell | We are ok with option 2 and option 3. We have already agreed the 5 us baseline, and the FFS point was for introduction of one additional optional value. |
| HW | Option 1 |
| MediaTek | Option 1 |
| Intel | With 5us TP we observed up to 20% throughput degradation for high SCS compared to the reduced TP value. This issue cannot be resolved by network. At the same time, if UE supports the reduced TP, performance can be significantly improved. Considering clear performance benefits, we do not see any issue with defining an optional UE capability for the improved TP. Either 2us or 1us is fine for us. |
| Apple | Option 1; We are open to discuss an improved ON/ON transient period proposal as part of the Rel-18 package discussion in RAN) |
| Ericsson | Option 2 or Option 3 (transient-time capability) |
| QCOM | Option 1 |

|  |  |
| --- | --- |
| **ON/ON transient period for 480 and 960** | **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** |
|  | *Tentative agreements:**Candidate options:**Recommendations for 2nd round: Continue discussion in round 2* |

### UE beam direction switching time

*Sub-topic description:*

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

* Proposals
	+ Option 1: 200 nsec as in FR2-1 (Huawei/HiSilicon, QCOM)
	+ Option 2: 59 nsec. (Nokia)
* Recommended WF
	+ discuss the options

|  |  |
| --- | --- |
| **Company** | **Comments** |
| vivo | We support Option 1. |
| OPPO | Option 1. |
| Nokia, Nokia Shanghai Bell | Option 2. |
| HW | Option 1 |
| MediaTek | Option 1 |
| Apple | Option 1 |
| QCOM | Option 1 |

|  |  |
| --- | --- |
| **UE beam duir switching time** | **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** |
|  | *Tentative agreements:option 1 by 6 to 1 majority**Candidate options:**Recommendations for 2nd round: record tentative agreement in WF and no further discussion* |

## Companies views’ collection for 1st round

### CRs/TPs comments collection

*For close-to-finalize Wis and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing Wis, suggest focusing on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| [**R4-2205173**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205173.zip) | Nokia: This needs to be revised based on the outcome of the discussion. |
| Apple: we are fine to capture the outcome of the discussion this meeting in this running draftCR |
|  |
| [**R4-2205210**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205210.zip) | Nokia: This needs to be revised based on the outcome of the discussion. |
| Company B |
|  |
| [**R4-2205229**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205229.zip) | Nokia: This needs to be revised based on the outcome of the discussion. |
| 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:* |

### CRs/TPs

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

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation**  |
|  | *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)

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on 60 GHz UE RF | Qualcomm Incorporated |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **T-doc number** | **title** | **Source** | **Recommendation** | **Comments** |
| [**R4-2203707**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2203707.zip) | On UE spherical coverage for band n263 | Apple | Noted |  |
| [**R4-2204330**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204330.zip) | Specifications of FR2-2 handheld UE | Murata Manufacturing Co Ltd. | Noted |  |
| [**R4-2204033**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204033.zip) | Discussion on NR coverage enhancement PUSCH demodulation | Ericsson | Noted |  |
| [**R4-2204038**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204038.zip) | Minimum Tx requirement for handheld and FWA UEs at 60 GHz | Sony | Noted |  |
| [**R4-2204227**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204227.zip) | Proposals on FR2-2 spherical drop for requirement calculation | MediaTek Beijing Inc. | Noted |  |
| [**R4-2204359**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204359.zip) | Handheld UE RF TX requirements for n263 in FR2-2 | NTT DOCOMO, INC. | Noted |  |
| [**R4-2204590**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204590.zip) | Views on FR2-2 FWA UE | Murata Manufacturing Co Ltd. | Noted |  |
| [**R4-2204619**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204619.zip) | UE output power for 57-71 GHz | Ericsson | Noted |  |
| [**R4-2204934**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204934.zip) | Further discussion on handheld UE EIRP and spherical coverage requirements for 52.6~71 GHz | vivo | Noted |  |
| [**R4-2205173**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205173.zip) | Draft CR to 38.101-2 on band n263 Tx aspects | Apple | Return to |  |
| [**R4-2205188**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205188.zip) | On 60GHz UE Tx RF requirements | Huawei, HiSilicon | Noted |  |
| [**R4-2205210**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205210.zip) | draft CR on vehicular UE Tx RF requirements in FR2-2 | LG Electronics Finland | Return to |  |
| [**R4-2205227**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205227.zip) | Discussion on Tx RF requirements in FR2-2 | LG Electronics Finland | Noted |  |
| [**R4-2205246**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205246.zip) | 60 GHz UE TX | Qualcomm Incorporated | Noted |  |
| [**R4-2205459**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205459.zip) | Further Discussion on spectral utilization requirements for FR2-2 | ZTE Corporation | Noted |  |
| [**R4-2205552**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205552.zip) | On UE Tx RF aspects for FR2-2 | Nokia, Nokia Shanghai Bell | Noted |  |
| [**R4-2205999**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205999.zip) | UE Tx RF requirements for FR2-2 | Intel Corporation | Noted |  |
| [**R4-2204034**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204034.zip) | Discussion on NR coverage enhancement PUCCH demodulation | Ericsson | Noted |  |
| [**R4-2204039**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204039.zip) | Minimum Rx requirement for handheld UEs at 60 GHz | Sony | Noted |  |
| [**R4-2204360**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204360.zip) | Handheld UE RF RX requirements for n263 in FR2-2 | NTT DOCOMO, INC. | Noted |  |
| [**R4-2204935**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2204935.zip) | Further discussion on handheld UE EIS requirements for 52.6~71 GHz | vivo | Noted |  |
| [**R4-2205189**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205189.zip) | On 60GHz UE Rx RF requirements | Huawei, HiSilicon | Noted |  |
| [**R4-2205229**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205229.zip) | draft CR on vehicular UE Rx RF requirements in FR2-2 | LG Electronics Finland | Return to |  |
| [**R4-2205231**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205231.zip) | Discussion on Rx RF requirements in FR2-2 | LG Electronics Finland | Noted |  |
| [**R4-2205292**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205292.zip) | 60 GHz UE RX | Qualcomm Incorporated | Noted |  |
| [**R4-2205553**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2205553.zip) | On UE Rx RF aspects for FR2-2 | Nokia, Nokia Shanghai Bell | Noted |  |
| [**R4-2206000**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_102-e/Docs/R4-2206000.zip) | UE EIS requirements for band n263 | Intel Corporation | Noted |  |

Notes:

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

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |

Notes:

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

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
| Qualcomm Inc | Phil Coan | pcoan@qti.qualcomm.com |
| AT&T | Ron Borsato | ronald.borsato@att.com |
| vivo | Shuai Zhou | Shuai.zhou@vivo.com |
| DOCOMO | Ryu Kitagawa | ryuu.kitagawa.pn@nttdocomo.com |
| CATT | Huiping Shan | shanhuiping@catt.cn |
| Nokia, Nokia Shanghai Bell | Johannes Hejselbaek | Johannes.hejselbaek@nokia.com |
| HW | Chunying Gu | guchunying@huawei.com |
| Murata | Hidefumi Ohira | hidefumi.ohira@murata.com |
| Ericsson | Christian Bergljung | Christian.Bergljung@ericsson.com |

Note:

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