**3GPP TSG-RAN WG4 Meeting # 102-e R4-220XXXX**

**Electronic Meeting, 21 February – 3 March, 2022**

**Agenda item:** 10.16.4

**Source:** Moderator (Nokia)

**Title:** Email discussion summary for [102-e][312] NR\_exto71GHz\_BSRF

**Document for:** Information

# Introduction

This email discussion summary covers BS RF requirements for extending NR operation to 71 GHz. Also performance part of the work has been included. Based on the input contributions the discussion is split into two major topics, Tx requirements and Rx requirements, within which individual requirements are discussed in various sub-topics. Generally, proposals and requirements having most dependency have been grouped together.

The template has been adapted to include comment section separately for each issue to facilitate discussion.

# Topic #1: Tx requirements

This topic covers Tx requirements.

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203577 | Ericsson | **Observation 1:** TAE < 33 ns for SCS = 960 kHz, based on theoretical analysis.**Observation 2:** Simulations show good performance for TAE = 65 ns @ SCS = 480 kHz and TAE = 32.5 ns @ SCS = 960 kHz. **Proposal 1:** For DfOBUE set the upper band size boundary to 14000 MHz. **Proposal 2:** For ACLR not define specific requirements for non-contiguous operation in the frequency range 52.6 to 71 GHz.**Proposal 3:** For spurious emission, add new table row for band n264 as described in Table 2.1.2-1.**Proposal 4:** MIMO TAE = 32.5 ns for SCS = 960 kHz and TAE = 65 ns for SCS = 480 kHz.**Proposal 5:** For EVM, add new tables with information only agreed values and remaining FFS 480 kHz and 960 kHz as described in Table 2.4-3 and Table 2.4-4. Put values within [] util conformance test feasibility issues are resolved.  |
| R4-2203649 | Nokia, Nokia Shanghai Bell | **Proposal 1:** The intra-band contiguous CA time alignment error requirements for NR operation in 52.6 – 71 GHz range should be specified as 65 ns for 480 kHz SCS and 32.5 ns for 960 kHz SCS.**Proposal 2:** The intra-band non-contiguous CA time alignment error requirements for NR operation in 52.6 – 71 GHz range should be specified as 260 ns for 480 kHz SCS and 960 kHz SCS.**Proposal 3:** The MIMO time alignment error requirements for NR operation in 52.6 – 71 GHz range should be defined as 65 ns for 480 kHz SCS and 32.5 ns for 960 kHz SCS.**Proposal 4:** The EVM window length for NR operation in 52.6 – 71 GHz range should be defined as 50% of the normal CP length for 120 kHz, 480 kHz and 960 kHz SCS.**Proposal 5:** The upper bound of FDL,high – FDL,low for ΔfOBUE = 3500 MHz for NR operation in 52.6 – 71 GHz range should be defined as 18.4 GHz, i.e., ΔfOBUE = 3500 MHz for 4000 MHz < FDL,high – FDL,low £ 18.4 GHz. |
| R4-2203975 | CATT | **Proposal 1:** For MIMO TAE，to adopt 32.5 ns for 480 kHz and 16.25 ns for 960kHz SCS(Option 2).**Proposal 2:** To specify 4000 MHz < FUL\_high – FUL\_low ≤14000 MHz. |
| R4-2204436 | NEC | **Proposal 1:** Define TAE for contiguous intra-band CA as 65 ns for 480 kHz SCS, 32.5 ns for 960 kHz SCS. Define TAE for MIMO as 65 ns for 480 kHz SCS, 32.5 ns for 960 kHz SCS.**Proposal 2:** Re-use 50% of the normal CP EVM window length for 480 kHz SCS and 960 kHz SCS.**Proposal 3:** Define the he upper bound of FDL,high – FDL,low for ΔfOBUE as 14,000 MHz. |
| R4-2205460 | ZTE Corporation | **Proposal 1:** for MIMO case, propose to define the option 2 from both ensuring acceptable performance loss and practical achievable capability in filed.**Proposal 2:** for intra-band contiguous CA, propose to define the option 2 from both ensuring acceptable performance loss and practical achievable capability in filed.**Proposal 3:** not to define TAE requirements for intra-band non-contiguous CA in Rel-17. |
| R4-2206119 | Huawei, HiSilicon | **Proposal 1:** Confirm the TAE requirement for contiguous intra-band CA proposal from WF*Moderator: refers* to R4-2203016**Proposal 2:** ok, but seems not needed in Rel-17 due to CA scope discussion.*Moderator: refers to [260] ns TAE for intra-band non-contiguous CA***Proposal 3:** Option 1*Moderator: refers to R4-2203016 MIMO TAE WF where* “*Option 1: 65 ns for 480 kHz SCS, 32.5 ns for 960 kHz SCS.”***Proposal 4:** For the upper bound: suggest to limit it to the n263 bandwidth, and leave if for future if RAN4 would need any wider bands (if possible at all).*Moderator: refers to which operating band bandwidths 3.5 GHz OBUE boundary is applicable.* |

## Open issues summary and comment collection

Please note it is possible and often necessary to select multiple options to create coherent agreements/requirements.

### Sub-topic 1-1 TAE

**Issue 1-1-1: Intraband contiguous CA TAE**

* Proposals
	+ Option 1: The intra-band contiguous CA time alignment error requirements for NR operation in 52.6 – 71 GHz range should be specified as 65 ns for 480 kHz SCS and 32.5 ns for 960 kHz SCS. (Nokia, R4-2203649, NEC R4-2204436, Huawei R4-2206119)
	+ Option 2: adopt 32.5 ns for 480 kHz and 16.25 ns for 960kHz SCS (ZTE R4-2205460)
* Recommended WF
	+ TBA

**Issue 1-1-2: Intraband non-contiguous CA TAE**

* Proposals
	+ Option 1: The intra-band non-contiguous CA time alignment error requirements for NR operation in 52.6 – 71 GHz range should be specified as 260 ns for 480 kHz SCS and 960 kHz SCS. (Nokia R4-2203649, Huawei R4-2206119)
	+ Option 2: not to define TAE requirements for intra-band non-contiguous CA in Rel-17. (ZTE R4-2205460)
	+ Option 3:
* Recommended WF
	+ TBA

**Issue 1-1-3: MIMO TAE**

* Proposals for
	+ Option 1: MIMO TAE = 32.5 ns for SCS = 960 kHz and TAE = 65 ns for SCS = 480 kHz. (Ericsson, R4-2203577, Nokia R4-2203649, NEC R4-2204436, Huawei R4-2206119)
	+ Option 2: For MIMO TAE，to adopt 32.5 ns for 480 kHz and 16.25 ns for 960kHz SCS (CATT, R4-2203975, ZTE R4-2205460)
* Recommended WF
	+ TBA

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| **Company** | **Comments** |
|  | **Issue 1-1-1: Intraband contiguous CA TAE****Issue 1-1-2: Intraband non-contiguous CA TAE****Issue 1-1-3: MIMO TAE** |
|  |  |

### Sub-topic 1-2 EVM

**Issue 1-2: EVM window length**

* Proposals
	+ Option 1: For EVM, add new tables with information only agreed values and remaining FFS 480 kHz and 960 kHz as described in Table 2.4-3 and Table 2.4-4. Put values within [] util conformance test feasibility issues are resolved. (Ericsson R4-2203577)

Table 2.4-3: EVM window length for normal CP, FR2-2, 480 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth(MHz) | FFT size | CP length in FFT samples | EVM window length W | Ratio of *W* to total CP length(%) |
| 400 | 4096 | 72 | 36 | 50 |
| 800 | 4096 | 144 | 72 | 50 |
| 1600 | 4096 | 288 | 144 | 50 |

Table 2.4-4: EVM window length for normal CP, FR2-2, 960 kHz SCS

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Channel bandwidth(MHz) | FFT size | CP length in FFT samples | EVM window length W | Ratio of *W* to total CP length(%) |
| 400 | 4096 | 36 | 18 | 50 |
| 800 | 4096 | 72 | 36 | 50 |
| 1600 | 4096 | 144 | 72 | 50 |
| 2000 | 4096 | 180 | 90 | 50 |

* + Option 2: The EVM window length for NR operation in 52.6 – 71 GHz range should be defined as 50% of the normal CP length for 120 kHz, 480 kHz and 960 kHz SCS. (Nokia R4-2203649, NEC R4-2204436)
* Recommended WF
	+ TBA

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| **Company** | **Comments** |
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### Sub-topic 1-3 Emissions: OBUE

**Issue 1-3: deltafOBUE**

Proposals

* + Option 1: For DfOBUE set the upper band size boundary to 14000 MHz (Ericsson R4-2203577, CATT R4-2203975, NEC R4-2204436, Huawei R4-2206119)
	+ Option 2: The upper bound of FDL,high – FDL,low for ΔfOBUE = 3500 MHz for NR operation in 52.6 – 71 GHz range should be defined as 18.4 GHz, i.e., ΔfOBUE = 3500 MHz for 4000 MHz < FDL,high – FDL,low £ 18.4 GHz. (Nokia R4-2203649)
* Recommended WF
	+ Option 1

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| **Company** | **Comments** |
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### Sub-topic 1-4 Emissions: Spurious emissions

**Issue 1-4: Spurious emission limits**

* Proposals
	+ Option 1: Add new table row for band n264 as described in Table 2.1.2-1 (Ericsson R4-2203577)

Table 2.1.2-1: Step frequencies for defining the BS radiated transmitter spurious emission limits in FR2 (Category B)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Operating band | Fstep,1(GHz) | Fstep,2(GHz) | Fstep,3(GHz)  | Fstep,4(GHz)  | Fstep,5(GHz) | Fstep,6(GHz) |
| n257 | 18 | 23.5 | 25 | 31 | 32.5 | 41.5 |
| n258 | 18 | 21 | 22.75 | 29 | 30.75 | 40.5 |
| n259 | 23.5 | 35.5 | 38 | 45 | 47.5 | 59.5 |
| n263 | 18 | 43 | 53.5 | 74.5 | 84 | 127 |
| n264 | 46 | 61 | 62.5 | 74.5 | 76 | 91 |

* + Option 2: TBA
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
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|  |  |

### Sub-topic 1-5 Emissions: ACLR

**Issue 1-5: ACLR**

* Proposals
	+ Option 1: For ACLR not define specific requirements for non-contiguous operation in the frequency range 52.6 to 71 GHz. (Ericsson R4-2203577)
	+ Option 2: TBA
* Recommended WF
	+ TBA.
	+ *Moderator suggestion: Whichever the outcome, align the outcome with non-contiguous CA TAE, i.e. either we have requirement for both non-contiguous CA TAE and ACLR, or we have neither requirement.*

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| **Company** | **Comments** |
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### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2203579Draft CR to TS 38.104: Addition of requirements for NR extension up to 71 GHz in subclause 9.6 to 9.8 | Company A |
| Company B |
|  |
| R4-2203650Draft CR to TR 38.104: Clauses 9.1 to 9.5 | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

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

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

### CRs/TPs

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

## Discussion on 2nd round (if applicable)

# Topic #2: Rx requirements

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203578 | Ericsson | **Proposal 1:** For ACS define interferer signal offset as defined in Table 2.1-2.**Table 2.1-2: ACS interferer frequency offset for BS type 2-O**

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency range** | **BS channel bandwidth** **(MHz)** | **Interfering signal centre frequency offset** **(MHz)** | **Type of interfering signal** |
|  FR2-1 | 50 | ±24.29 |   |
|   | 100 | ±24.31 | 50 MHz DFT-s-OFDM NR |
|   | 200 | ±24.29 | signal, 60 kHz SCS, 64 RBs |
|   | 400 | ±24.31 |   |
|   FR2-2 | 100 | ±48.58 |  100 MHz DFT-s-OFDM NRsignal,120 kHz SCS, FFS RBs |
|   | 400 | ±48.62 |   |
|   | 800 | ±48.58 |   |
|   | 1600 | ±48.62 |   |
|   | 2000 | ±48.58 |   |

  **Proposal 2:** For in-band blocking set the upper boundary for the operating band size equal for DfOOB and DfOBUE.**Proposal 3:** For in-channel selectivity define wanted signal power level and interfering signal power level as described in Table 2.3-1.**Table 2.3-1: Relation between wanted signal power and interfering signal power**

|  |  |  |
| --- | --- | --- |
| **BS channel bandwidth****(MHz)** | **Wanted signal power****(dBm)** | **Interfering signal power****(dBm)** |
| 50 | EISREFSENS\_50M + ΔFR2\_REFSENS | EISREFSENS\_50M + 10 + ΔFR2\_REFSENS |
| 100 | EISREFSENS\_50M + 3 + ΔFR2\_REFSENS | EISREFSENS\_50M + 13 + ΔFR2\_REFSENS |
| 400 | EISREFSENS\_50M + 9 + ΔFR2\_REFSENS | EISREFSENS\_50M + 19 + ΔFR2\_REFSENS |

 **Proposal 4:** For receiver spurious emission add row with values in Table 2.4-1 for band n264. **Table 2.4-1: Step frequencies for defining the spurious emission limits**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Operating band** | **Fstep,1****(GHz)** | **Fstep,2****(GHz)** | **Fstep,3****(GHz)** | **Fstep,4****(GHz)** | **Fstep,5****(GHz)** | **Fstep,6****(GHz)** |
| n257 | 18 | 23.5 | 25 | 31 | 32.5 | 41.5 |
| n258 | 18 | 21 | 22.75 | 29 | 30.75 | 40.5 |
| n259 | 23.5 | 35.5 | 38 | 45 | 47.5 | 59.5 |
| n260 | 25 | 34 | 35.5 | 41.5 | 43 | 52 |
| n261 | 18 | 25.5 | 26.0 | 29.85 | 30.35 | 38.35 |
| n262 | 37.2 | 45.2 | 45.7 | 49.7 | 50.2 | 58.2 |
| n263  | 18 | 43 | 53.5 | 74.5 | 84 | 127 |
| n264 | 46 | 61 | 62.5 | 74.5 | 76 | 91 |

 |
| R4-2203651 | Nokia, Nokia Shanghai Bell | **Table A.1-2: FRC parameters for FR2 OTA reference sensitivity level, OTA ACS, OTA in-band blocking, OTA out-of-band blocking, OTA receiver intermodulation and OTA in-channel selectivity**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Reference channel** | **G-FR2-A1-1** | **G-FR2-A1-2** | **G-FR2-A1-3** | **G-FR2-A1-4** | **G-FR2-A1-5** | **G-FR2-A1-6** | **G-FR2-A1-7** | **G-FR2-A1-8** | **G-FR2-A1-9** |
| Subcarrier spacing (kHz) | 60 | 120 | 120 | 60 | 120 | 480 | 960 | 480 | 960 |
| Allocated resource blocks | 66 | 32 | 66 | 33 | 16 | 66 | 32 | 33 | 16 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Payload size (bits) | 5632 | 2792 | 5632 | 2856 | 1416 | 5632 | 2792 | 2856 | 1416 |
| Transport block CRC (bits) | 24 | 16 | 24 | 16 | 16 | 24 | 16 | 16 | 16 |
| Code block CRC size (bits) | - | - | - | - | - | - | - | - | - |
| Number of code blocks - C | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Code block size including CRC (bits) (Note 3) | 5656 | 2808 | 5656 | 2872 | 1432 | 5656 | 2808 | 2872 | 1432 |
| Total number of bits per slot | 19008 | 9216 | 19008 | 9504 | 4608 | 19008 | 9216 | 9504 | 4608 |
| Total symbols per slot | 9504 | 4608 | 9504 | 4752 | 2304 | 9504 | 4608 | 4752 | 2304 |

 **Proposal 1:** Consider the FRC parameters for reference sensitivity and in-channel selectivity in updated table A.1-2 above.**Proposal 2:** Define the ACS interfering signal type as 100 MHz DFT-s-OFDM NR signal, 120 kHz SCS, 64 RBs.**Proposal 3:** Define the in-band blocking interfering signal type as 100 MHz DFT-s-OFDM NR signal, 120 kHz SCS, 64 RBs.**Proposal 4:** Apply the same upper bound of FDL,high – FDL,low to ΔfOOB when the upper bound of FDL,high – FDL,low for ΔfOBUE is agreed.**Proposal 5:** Define the modulated interfering signal type for receiver intermodulation requirement as 100 MHz DFT-s-OFDM NR signal, 120 kHz SCS, 64 RBs. |
| R4-2203976 | CATT | **Observation 1: For ACS interfering signal type for 52.6GHz, RBs for 100 MHz DFT-s-OFDM NR signal with 120 kHz SCS should be 64 instead of 32.** **Proposal 1: To specify 100 MHz DFT-s-OFDM NR signal, 120 kHz SCS, 64 RBs as ACS interfering signal type for FR2-2.****Proposal 2: To adopt the following ACS interferer frequency offsets for FR2-2.****Table 10.5.1.3-2: OTA ACS interferer frequency offset for *BS type 2-O***

|  |  |  |  |
| --- | --- | --- | --- |
| ***Frequency Range*** | ***BS channel bandwidth* of the *lowest/highest carrier* received (MHz)** | **Interfering signal centre frequency offset from the lower/upper *Base Station RF Bandwidth edge* or sub*-block edge* inside a *sub-block gap* (MHz)** | **Type of interfering signal** |
| FR2-1 | 50 | ±24.29 |   |
|   | 100 | ±24.31 | 50 MHz DFT-s-OFDM NR |
|   | 200 | ±24.29 | signal,60 kHz SCS, 64 RBs |
|   | 400 | ±24.31 |   |
| FR2-2 | 100 | ±48.58 | 100 MHz DFT-s-OFDM NRsignal,120 kHz SCS, 64RBs |
|   | 400 | ±48.58 |   |
|   | 800 | ±48.62 |   |
|   | 1600 | ±48.58 |   |
|   | 2000 | ±48.62 |   |

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| R4-2205461 | ZTE Corporation | **Proposal 1: to specify the frequency offset for ACS interfering signal for FR2-2 as following:****Table 1: OTA ACS interferer frequency offset for *60GHz***

|  |  |  |
| --- | --- | --- |
| ***BS channel bandwidth* of the *lowest/highest carrier* received (MHz)** | **Interfering signal centre frequency offset from the lower/upper *Base Station RF Bandwidth edge* or sub*-block edge* inside a *sub-block gap* (MHz)** | **Type of interfering signal** |
| 100 | 48.58 | 100 MHz DFT-s-OFDM NR signal,120 kHz SCS, 64 RBs |
| 400 | 48.58 |   |
| 800 | 48.62 |   |
| 1600 | 48.58 |   |
| 2000 | 48.62 |   |

**Proposal 2: to specify the frequency offset for Rx IMD interfering signal for FR2-2 as following:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ***CBW*** | ***SCS [KHz]*** | ***PRB*** | ***GB for wanted signal*** | ***interfering signal CBW*** | ***GB for interfering signal*** | ***Intefering signal offset*** | ***CW offset*** |
| ***FR2-1*** |   |   |   |   |   |   |   |   |
|   | 50 | 60 | 66 | 1240 | 50 | 1240 | 40 | 7.5 |
|   | 100 | 60 | 132 | 2480 | 50 | 1240 | 40 | 6.88 |
|   | 200 | 60 | 264 | 4960 | 50 | 1240 | 40 | 5.64 |
|   | 400 | 120 | 264 | 9920 | 50 | 1960 | 45 | 6.02 |
| ***FR2-2*** | 100 | 120 | 66 | 2480 | 100 | 2480 | 65 | 7.5 |
|   | 400 | 120 | 264 | 9920 | 100 | 2480 | 70 | 6.28 |
|   | 800 | 480 | 132 | 19840 | 400 | 9920 | 225 | 7.54 |
|   | 1600 | 480 | 264 | 39680 | 400 | 9920 | 245 | 7.62 |
|   | 2000 | 960 | 165 | 49600 | 400 | 15680 | 245 | 5.54 |

 **Proposal 3: to specify the tentative ICS requirement in FR2-2 as following:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Frequency Range*** | ***BS channel bandwidth* (MHz)** | **Subcarrier spacing (kHz)** | **Reference measurement channel** | **Wanted signal mean power (dBm)****(Note 2)** | **Interfering signal mean power (dBm)****(Note 2)** | **Type of interfering signal** |
| FR2-2 | 100,400 | 120 | G-FR2-A1-2 | EISREFSENS\_50M + 3 + ΔFR2\_REFSENS | EISREFSENS\_50M + 13 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 120 kHz SCS, 32 RB |
|   | 400 | 480 | G-FR2-A1-9 | EISREFSENS\_50M + 9 + ΔFR2\_REFSENS | EISREFSENS\_50M + 19+ ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 480 kHz SCS, 32 RB |
|   | 800, 1600 | 480 | G-FR2-A1-6 | EISREFSENS\_50M + 12 + ΔFR2\_REFSENS | EISREFSENS\_50M + 22 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 480 kHz SCS, 64 RB |
|   | 400 | 960 | G-FR2-A1-10 | EISREFSENS\_50M + 9 + ΔFR2\_REFSENS | EISREFSENS\_50M + 19+ ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 960 kHz SCS, 16 RB |
|   |  800, 1600, 2000 | 960 | G-FR2-A1-7 | EISREFSENS\_50M + 3 + ΔFR2\_REFSENS | EISREFSENS\_50M + 13 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 960 kHz SCS, 32 RB |
| NOTE 1: Wanted and interfering signal are placed adjacently around Fc, where the Fc is defined for *BS channel bandwidth* of the wanted signal according to the table 5.4.2.2-1. The aggregated wanted and interferer signal shall be centred in the *BS channel bandwidth* of the wanted signal.NOTE 2: EISREFSENS\_50M is defined in clause 10.3.3. |   |   |   |   |   |   |

**Table 4 : PRB allocation of in-channel selectivity for FR2-2 NR**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NR *BS channel bandwidth* [MHz]** | **subcarrier spacing[KHz]** | **Transmission bandwidth configuration NRB** | **Reference measurement channel** | **Wanted signal PRB**  | **Interfering signal PRB** |
| 100, 400 | 120 | 132,264 | G-FR2-A1-2 | 32PRB | 32PRB |
| 400 | 480 | 66 | G-FR2-A1-9 | 33PRB | 32PRB |
| 800,1600 | 480 | 132,264 | G-FR2-A1-6 | 66PRB | 64PRB |
| 400 | 960 | 32 | G-FR2-A1-10 | 16PRB | 16PRB |
| 800,1600,2000 | 960 | 66,132,165 | G-FR2-A1-7 | 32PRB  | 32PRB  |

 **Table 5: FRC table for REFSENS and ICS requirement for FR2-2**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **RB number**  | **SCS (KHz)** | **TBS (Bits)** |
| G-FR2-A1-2 | 32 | 120 | 2792 |
| G-FR2-A1-3 | 66 | 120 | 5632 |
| G-FR2-A1-5 | 16 | 120 | 1416 |
| G-FR2-A1-6 | 66 | 480 | 5632 |
| G-FR2-A1-7 | 32 | 960 | 2792 |
| G-FR2-A1-8 | 66 | 960 | 5632 |
| G-FR2-A1-9 | 33 | 480 | 2856 |
| G-FR2-A1-10 | 16 | 960 | 1416 |

 |
| **R4-2206120** | **Huawei** | **Proposal 1**: confirm the 9dB scaling due to wider CHBW. *Moderator: Relates to refsens for 480 and 960 kHz SCS FRCs* |

## Open issues summary

Please note it is possible and often necessary to select multiple options to create coherent agreements/requirements.

### Sub-topic 2-1 EIS

**Issue 2-1: EIS**

* Proposals
	+ Option 1: Confirm the 9dB scaling due to wider CHBW. (Huawei R4-2206120)
	+ Option 2: TBA
* Recommended WF
	+ TBA

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| **Company** | **Comments** |
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### Sub-topic 2-2 FRC

**Issue 2-2: FRC**

* Proposals
	+ Option 1: Consider the FRC parameters for reference sensitivity and in-channel selectivity in updated table A.1-2 below. (Nokia R4-2203651)

**Table A.1-2: FRC parameters for FR2 OTA reference sensitivity level, OTA ACS, OTA in-band blocking, OTA out-of-band blocking, OTA receiver intermodulation and OTA in-channel selectivity**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Reference channel** | **G-FR2-A1-1** | **G-FR2-A1-2** | **G-FR2-A1-3** | **G-FR2-A1-4** | **G-FR2-A1-5** | **G-FR2-A1-6** | **G-FR2-A1-7** | **G-FR2-A1-8** | **G-FR2-A1-9** |
| Subcarrier spacing (kHz) | 60 | 120 | 120 | 60 | 120 | 480 | 960 | 480 | 960 |
| Allocated resource blocks | 66 | 32 | 66 | 33 | 16 | 66 | 32 | 33 | 16 |
| CP-OFDM Symbols per slot (Note 1) | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 | 12 |
| Modulation | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK | QPSK |
| Code rate (Note 2) | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 | 1/3 |
| Payload size (bits) | 5632 | 2792 | 5632 | 2856 | 1416 | 5632 | 2792 | 2856 | 1416 |
| Transport block CRC (bits) | 24 | 16 | 24 | 16 | 16 | 24 | 16 | 16 | 16 |
| Code block CRC size (bits) | - | - | - | - | - | - | - | - | - |
| Number of code blocks - C | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Code block size including CRC (bits) (Note 3) | 5656 | 2808 | 5656 | 2872 | 1432 | 5656 | 2808 | 2872 | 1432 |
| Total number of bits per slot | 19008 | 9216 | 19008 | 9504 | 4608 | 19008 | 9216 | 9504 | 4608 |
| Total symbols per slot | 9504 | 4608 | 9504 | 4752 | 2304 | 9504 | 4608 | 4752 | 2304 |

* + Option 2: TBA
* Recommended WF
	+ TBA

*Moderator: Companies please also check FRC table in ICS section.*

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| **Company** | **Comments** |
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### Sub-topic 2-3 ACS

**Issue 2-3: ACS**

* Proposals
	+ Option 1: For ACS define interferer signal offset as defined in Table 2.1-2. (Ericsson R4-2203578)

**Table 2.1-2: ACS interferer frequency offset for BS type 2-O**

|  |  |  |  |
| --- | --- | --- | --- |
| **Frequency range** | **BS channel bandwidth** **(MHz)** | **Interfering signal centre frequency offset** **(MHz)** | **Type of interfering signal** |
|  FR2-1 | 50 | ±24.29 |   |
|   | 100 | ±24.31 | 50 MHz DFT-s-OFDM NR signal, 60 kHz SCS, 64 RBs  |
|   | 200 | ±24.29 |
|   | 400 | ±24.31 |
|   FR2-2 | 100 | ±48.58 |  100 MHz DFT-s-OFDM NRsignal,120 kHz SCS, FFS RBs     |
|   | 400 | ±48.62 |
|   | 800 | ±48.58 |
|   | 1600 | ±48.62 |
|   | 2000 | ±48.58 |

* + Option 2: To adopt the following ACS interferer frequency offsets for FR2-2. (CATT R4-2203976, ZTE R4-2205461)

**Table 10.5.1.3-2: OTA ACS interferer frequency offset for *BS type 2-O***

|  |  |  |  |
| --- | --- | --- | --- |
| ***Frequency Range*** | ***BS channel bandwidth* of the *lowest/highest carrier* received (MHz)** | **Interfering signal centre frequency offset from the lower/upper *Base Station RF Bandwidth edge* or sub*-block edge* inside a *sub-block gap* (MHz)** | **Type of interfering signal** |
| FR2-1 | 50 | ±24.29 |   |
|   | 100 | ±24.31 | 50 MHz DFT-s-OFDM NR signal,60 kHz SCS, 64 RBs  |
|   | 200 | ±24.29 |
|   | 400 | ±24.31 |
| FR2-2 | 100 | ±48.58 | 100 MHz DFT-s-OFDM NRsignal,120 kHz SCS, 64RBs     |
|   | 400 | ±48.58 |
|   | 800 | ±48.62 |
|   | 1600 | ±48.58 |
|   | 2000 | ±48.62 |

* + Option 3: Define the ACS interfering signal type as 100 MHz DFT-s-OFDM NR signal, 120 kHz SCS, 64 RBs. (Nokia R4-2203651, CATT R4-2203976)

*Moderator: Please note option 1 and 2 propose interferer signal offsets whereas option 3 is about interfering signal type and PRB allocation -> multiple options can be supported simultaneously.*

* Recommended WF
	+ TBA

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| **Company** | **Comments** |
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|  |  |

### Sub-topic 2-4 In-band blocking

**Issue 2-4: In-band blocking**

* Proposals
	+ Option 1: Define the in-band blocking interfering signal type as 100 MHz DFT-s-OFDM NR signal, 120 kHz SCS, 64 RBs. (Nokia R4-2203651)
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
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|  |  |

### Sub-topic 2-5: ΔfOOB

**Issue 2-5: ΔfOOB**

* Proposals
	+ Option 1: For in-band blocking set the upper boundary for the operating band size equal for DfOOB and DfOBUE. (Ericsson R4-2203578, Nokia R4-2203651)
* Recommended WF

Discuss the boundary in Tx side, align decision for Rx, no comments needed.

### Sub-topic 2-6: Spurious emissions step frequencies

**Issue 2-6: Spurious emissions step frequencies**

* Proposals
	+ Option 1: For receiver spurious emission add row with values in Table 2.4-1 for band n264. (Ericsson R4-2203578)

**Table 2.4-1: Step frequencies for defining the spurious emission limits**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Operating band** | **Fstep,1****(GHz)** | **Fstep,2****(GHz)** | **Fstep,3****(GHz)** | **Fstep,4****(GHz)** | **Fstep,5****(GHz)** | **Fstep,6****(GHz)** |
| n257 | 18 | 23.5 | 25 | 31 | 32.5 | 41.5 |
| n258 | 18 | 21 | 22.75 | 29 | 30.75 | 40.5 |
| n259 | 23.5 | 35.5 | 38 | 45 | 47.5 | 59.5 |
| n260 | 25 | 34 | 35.5 | 41.5 | 43 | 52 |
| n261 | 18 | 25.5 | 26.0 | 29.85 | 30.35 | 38.35 |
| n262 | 37.2 | 45.2 | 45.7 | 49.7 | 50.2 | 58.2 |
| n263  | 18 | 43 | 53.5 | 74.5 | 84 | 127 |
| n264 | 46 | 61 | 62.5 | 74.5 | 76 | 91 |

* + Option 2: TBA

* Recommended WF

TBA

### Sub-topic 2-7 Rx IMD

**Issue 2-7: Rx IMD**

* Proposals
	+ Option 1: Define the modulated interfering signal type for receiver intermodulation requirement as 100 MHz DFT-s-OFDM NR signal, 120 kHz SCS, 64 RBs. (Nokia R4-2203651)
	+ Option 2: Specify the frequency offset for Rx IMD interfering signal for FR2-2 as following (ZTE R4-2205461):

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | ***CBW*** | ***SCS [KHz]*** | ***PRB*** | ***GB for wanted signal*** | ***interfering signal CBW*** | ***GB for interfering signal*** | ***Intefering signal offset*** | ***CW offset*** |
| ***FR2-1*** |   |   |   |   |   |   |   |   |
|   | 50 | 60 | 66 | 1240 | 50 | 1240 | 40 | 7.5 |
|   | 100 | 60 | 132 | 2480 | 50 | 1240 | 40 | 6.88 |
|   | 200 | 60 | 264 | 4960 | 50 | 1240 | 40 | 5.64 |
|   | 400 | 120 | 264 | 9920 | 50 | 1960 | 45 | 6.02 |
| ***FR2-2*** | 100 | 120 | 66 | 2480 | 100 | 2480 | 65 | 7.5 |
|   | 400 | 120 | 264 | 9920 | 100 | 2480 | 70 | 6.28 |
|   | 800 | 480 | 132 | 19840 | 400 | 9920 | 225 | 7.54 |
|   | 1600 | 480 | 264 | 39680 | 400 | 9920 | 245 | 7.62 |
|   | 2000 | 960 | 165 | 49600 | 400 | 15680 | 245 | 5.54 |

* Recommended WF

TBA

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| --- | --- |
| **Company** | **Comments** |
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### Sub-topic 2-8 In-channel selectivity

**Issue 2-8: In-channel selectivity levels**

* Proposals
	+ Option 1: For in-channel selectivity define wanted signal power level and interfering signal power level as described in Table 2.3-1. (Ericsson R4-2203578)

**Table 2.3-1: Relation between wanted signal power and interfering signal power**

|  |  |  |
| --- | --- | --- |
| **BS channel bandwidth****(MHz)** | **Wanted signal power****(dBm)** | **Interfering signal power****(dBm)** |
| 50 | EISREFSENS\_50M + ΔFR2\_REFSENS | EISREFSENS\_50M + 10 + ΔFR2\_REFSENS |
| 100 | EISREFSENS\_50M + 3 + ΔFR2\_REFSENS | EISREFSENS\_50M + 13 + ΔFR2\_REFSENS |
| 400 | EISREFSENS\_50M + 9 + ΔFR2\_REFSENS | EISREFSENS\_50M + 19 + ΔFR2\_REFSENS |

* + Option 2: Specify the tentative ICS requirement in FR2-2 as following (ZTE R4-2205461)

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ***Frequency Range*** | ***BS channel bandwidth* (MHz)** | **Subcarrier spacing (kHz)** | **Reference measurement channel** | **Wanted signal mean power (dBm)****(Note 2)** | **Interfering signal mean power (dBm)****(Note 2)** | **Type of interfering signal** |
| FR2-2 | 100,400 | 120 | G-FR2-A1-2 | EISREFSENS\_50M + 3 + ΔFR2\_REFSENS | EISREFSENS\_50M + 13 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 120 kHz SCS, 32 RB |
|   | 400 | 480 | G-FR2-A1-9 | EISREFSENS\_50M + 9 + ΔFR2\_REFSENS | EISREFSENS\_50M + 19+ ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 480 kHz SCS, 32 RB |
|   | 800, 1600 | 480 | G-FR2-A1-6 | EISREFSENS\_50M + 12 + ΔFR2\_REFSENS | EISREFSENS\_50M + 22 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 480 kHz SCS, 64 RB |
|   | 400 | 960 | G-FR2-A1-10 | EISREFSENS\_50M + 9 + ΔFR2\_REFSENS | EISREFSENS\_50M + 19+ ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 960 kHz SCS, 16 RB |
|   |  800, 1600, 2000 | 960 | G-FR2-A1-7 | EISREFSENS\_50M + 3 + ΔFR2\_REFSENS | EISREFSENS\_50M + 13 + ΔFR2\_REFSENS | DFT-s-OFDM NR signal, 960 kHz SCS, 32 RB |
| NOTE 1: Wanted and interfering signal are placed adjacently around Fc, where the Fc is defined for *BS channel bandwidth* of the wanted signal according to the table 5.4.2.2-1. The aggregated wanted and interferer signal shall be centred in the *BS channel bandwidth* of the wanted signal.NOTE 2: EISREFSENS\_50M is defined in clause 10.3.3.  |

**Table 4 : PRB allocation of in-channel selectivity for FR2-2 NR**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **NR *BS channel bandwidth* [MHz]** | **subcarrier spacing[KHz]** | **Transmission bandwidth configuration NRB** | **Reference measurement channel** | **Wanted signal PRB**  | **Interfering signal PRB** |
| 100, 400 | 120 | 132,264 | G-FR2-A1-2 | 32PRB | 32PRB |
| 400 | 480 | 66 | G-FR2-A1-9 | 33PRB | 32PRB |
| 800,1600 | 480 | 132,264 | G-FR2-A1-6 | 66PRB | 64PRB |
| 400 | 960 | 32 | G-FR2-A1-10 | 16PRB | 16PRB |
| 800,1600,2000 | 960 | 66,132,165 | G-FR2-A1-7 | 32PRB  | 32PRB  |

**Table 5: FRC table for REFSENS and ICS requirement for FR2-2**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **RB number**  | **SCS (KHz)** | **TBS (Bits)** |
| G-FR2-A1-2 | 32 | 120 | 2792 |
| G-FR2-A1-3 | 66 | 120 | 5632 |
| G-FR2-A1-5 | 16 | 120 | 1416 |
| G-FR2-A1-6 | 66 | 480 | 5632 |
| G-FR2-A1-7 | 32 | 960 | 2792 |
| G-FR2-A1-8 | 66 | 960 | 5632 |
| G-FR2-A1-9 | 33 | 480 | 2856 |
| G-FR2-A1-10 | 16 | 960 | 1416 |

* Recommended WF
	+ TBA

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| **Company** | **Comments** |
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### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2205462Draft CR for TS 38.104 on introduction of BS RF Rx requirements for 57-71GHz in section 10.6 – 10.9 | Company A |
| Company B |
|  |
|  | Company A |
| Company B |
|  |

##  Summary for 1st round

### Open issues

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

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

### CRs/TPs

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

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

## Discussion on 2nd round (if applicable)

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

# Topic #3: Conformance testing

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203582 | Ericsson | **Proposal:** Based on presented considerations plan the BS RF conformance work. |
| R4-2203652 | Nokia, Nokia Shanghai Bell | **Proposal 1:** Consider scaling down the duration for all NR FR2-2 test models for 480 kHz SCS and 960 kHz SCS, e.g., 1 subframe for TDD (5 ms).**Proposal 2:** Also consider other options to reduce EVM measurement time for NR operation in 52.6 – 71 GHz range, e.g., limit the number of samples over which the EVM has to be averaged. |
| R4-2204712 | Keysight Technologies UK Ltd | Observation-1* Test system MU numbers will be increased because of higher frequency and wider modulation bandwidth, also there are test equipment availability issue which potentially causes increase of MU numbers.

Observation-2* In order to calculate pathloss, Antenna assumption needs to be confirmed.

Observation-3* For Spurious emission and out-of-band blocking, existing max frequency limit number for FR2-1 doesn’t work for FR2-2. This needs to be studied.

Proposal-1* MU numbers defined for FR2-1 should NOT be re-used for FR2-2. MU values for FR2-2 bands should be studied and calculated with using MU budget table.

Proposal-2* RAN4 to confirm TR38.808 table 4.2.5.1-1 “Example antenna arrays” 32x32 example, is good and right antenna assumption for FR2-2 BS as assumption for test system MU calculation. In case it is not appropriate example for calculating MU, good example as assumption needs to be provided from BS vender.

Proposal-3* Practical max frequency for spurious emission test needs to be defined for FR2-2.
* Practical max frequency for out-of-band blocking interferer frequency needs to be defined for FR2-2.
 |
| R4-2205668 | ROHDE & SCHWARZ, KEYSIGHT |  |

## Open issues summary

Please note it is possible and often necessary to select multiple options to create coherent agreements/requirements.

### Sub-topic 3-1 Workplan for conformance

**Issue 3-1: Workplan for conformance**

* Proposals
	+ Option 1: Based on presented considerations plan the BS RF conformance work. (Ericsson R4-2203582)
	+ Option 2: TBA
* Recommended WF
	+ Please provide comments which aspects need to be addressed during conformance part.

|  |  |
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| **Company** | **Comments** |
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### Sub-topic 3-2 Test setup related aspects

**Issue 3-2-1: Measurement uncertainty**

* Proposals
	+ Option 1: MU numbers defined for FR2-1 should NOT be re-used for FR2-2. MU values for FR2-2 bands should be studied and calculated with using MU budget table. (Keysight R4-2204712)
	+ TBA
* Recommended WF
	+ TBA

**Issue 3-2-2: Antenna assumptions/path loss**

* Proposals
	+ Option 1: RAN4 to confirm TR38.808 table 4.2.5.1-1 “Example antenna arrays” 32x32 example, is good and right antenna assumption for FR2-2 BS as assumption for test system MU calculation. In case it is not appropriate example for calculating MU, good example as assumption needs to be provided from BS vender. (Keysight R4-2204712)
	+ TBA
* Recommended WF
	+ TBA

**Issue 3-2-3: Frequency range considerations**

* Proposals
	+ Option 1: Practical max frequency for spurious emission test needs to be defined for FR2-2. (Keysight R4-2204712)
	+ Option 2: Practical max frequency for out-of-band blocking interferer frequency needs to be defined for FR2-2. (Keysight R4-2204712)
* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
|  | **Issue 3-2-1: Measurement uncertainty****Issue 3-2-2: Antenna assumptions/path loss****Issue 3-2-3: Frequency range considerations** |
|  | **Issue 3-2-1: Measurement uncertainty****Issue 3-2-2: Antenna assumptions/path loss****Issue 3-2-3: Frequency range considerations** |

### Sub-topic 3-3 Test time

**Issue 3-3: Test time**

* Proposals
	+ Option 1: Consider scaling down the duration for all NR FR2-2 test models for 480 kHz SCS and 960 kHz SCS, e.g., 1 subframe for TDD (5 ms). (Nokia R4-2203652)
	+ Option 2: Also consider other options to reduce EVM measurement time for NR operation in 52.6 – 71 GHz range, e.g., limit the number of samples over which the EVM has to be averaged. (Nokia R4-2203652)

See also Tdoc R4-2205668 and consider that in comments.

* Recommended WF
	+ TBA

|  |  |
| --- | --- |
| **Company** | **Comments** |
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## Summary for 1st round

### Open issues

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

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

## Discussion on 2nd round (if applicable)

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

# Recommendations for Tdocs

## 1st round

**New tdocs**

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

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
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Notes:

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

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

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** |
|  |  |  |

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)