**3GPP TSG-RAN WG4 Meeting # 102-e draft R4-2207172**

**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 fOBUE 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** |
| Nokia | **Issue 1-1-1: Intraband contiguous CA TAE**  Propose option 1; for option 2, implementation flexibility should also be considered, especially for <20 ns requirement.  **Issue 1-1-2: Intraband non-contiguous CA TAE**  Propose option 1; for option 2, currently see no need to delay the requirement to next release.  **Issue 1-1-3: MIMO TAE**  Propose option 1; for option 2, implementation flexibility should also be considered, especially for <20 ns requirement. |
| Qualcomm | **Issue 1-1-1: Intraband contiguous CA TAE**  We support option 1. Option 2 might have implementation aspects that should be avoided.  **Issue 1-1-2: Intraband non-contiguous CA TAE**  Support option 1.  **Issue 1-1-3: MIMO TAE**  Support option 1. |
| Huawei | **Issue 1-1-1: Intraband contiguous CA TAE**  Confirm the proposal from WF, i.e. 65 ns for 480 kHz SCS, 32.5 ns for 960 kHz SCS  **Issue 1-1-2: Intraband non-contiguous CA TAE**  It is still not clear if the non-contiguous operation consideration makes much sense in this frequency range, especially that such operation requires more complex architectures for the products. If there would be clear market demand for such non-cont operation, we would be fine to reuse the legacy non-cont CA TAE requirement. However, we would prefer not to introduce unnecessary requirements.  **Issue 1-1-3: MIMO TAE**  Our initial proposal was Option 1, however based on further internal evaluations, we support the more stringent proposal of Option 2 (32.5 ns for 480 kHz and 16.25 ns for 960kHz SCS).  In order to address companies concerns on TAE < 20ns, maybe we can proceed with the WF to set the MIMO TAE as 32.5ns for both 480 and 960 kHz SCS. |
| Ericsson | **Issue 1-1-1: Intraband contiguous CA TAE**  We support option 1. This is colocated and proposed TAE = 65 ns and 32.5 ns fit within CP and leave margin for channel dispersion. Intra band contiguous should fit in common wide receiver FFT, so CP fraction is main design parameter. CBM discussion in RRM is related to interband CA.  **Issue 1-1-2: Intraband non-contiguous CA TAE**  We tend to lean towards option 2, which would mean that the specification does not support non-contiguous CA. The use-case seems not be the most relevant for FR2-2. If we proceed with option 2, we need to align with CACLR.  **Issue 1-1-3: MIMO TAE**  We support option 1. Values is based on simulation results from last meeting. For MIMO, receiver we can look at time domain and check first principles and intuition, ie that a channel inside CP or a channel with very little power outside CP will perform well. The CP for SCS = 480 kHz is 146 ns and the CP for SCS = 960 kHz is 73 ns. The TDLA-5 last tap is at 48 ns delay and -30 dBc down. The TDLA-5 second to last tap is at 26.5 ns delay. For SCS=480 kHz a TAE=65 ns will fit the entire TDLA-5 delay train inside CP = 146 ns  No degradation is expected from a receiver estimating channel across all CP. For SCS = 960 kHz a TAE = 32.5 ns will push last tap of TDLA-5 out, but last tap is 30 dB down => negligible impact. This is what we see in our simulation, ie TAE = 65 ns and TAE = 32.5 ns works for TDLA-5, when UE estimates channel across whole CP. |
| CATT | **Issue 1-1-1: Intraband contiguous CA TAE**  From system performance point of view, we support option 2. In theory, TAE + Tchannel should be less than CP length. However, 50% CP EVM window decreases the usable CP that only 0.5+0.5/2=0.75 CP can be used, i.e. when the signal delay is very long to exceed the 0.75 CP, single FFT is not possible. For 480kHz SCS, 0.75CP is 112.5ns, for 960kHz SCS, 0.75CP is 52.15 ns. So if assuming 40 ns indicated in R4-2203577. Then the time left for 480kHz is 72.5 ns, for 960kHz is 12.15 ns. Leaving some implementation margin for UE, such as timing error, then option 2 is the only choice. There’s another point which should be noted that there’s no intraband contiguous MRTD requirement for UE. Our understanding is that UE may use the same timing for the contiguous CA, so too relaxed requirements will cause UE Rx signal degradation.  From implementation point of view, there’s no difficulties to implement option 2.  **Issue 1-1-2: Intraband non-contiguous CA TAE**  We support option 2 from two aspects. First is to support the argument from option 2 that NC CA is not supported in the system parameter discussion part. Second is that we’re not sure if 260 ns is sufficient. We’re not sure if the two carriers timing is separately implemented for UE. Maybe UE vendors can be involved. 260 ns is much larger than the CP length. In TS 38.133, for FR1 3us MRTD requirement, there’s a note:  Note 1: In the case of different SCS on different CCs, if the receive time difference exceeds the cyclic prefix length of that SCS, demodulation performance degradation is expected for the first symbol of the slot.  So we’re not sure if we can make this decision just by BS experts.  **Issue 1-1-3: MIMO TAE**  We support option2. The theoretical analysis can’t use CP theory, the two MIMO layers interfere each other because they’re not independent in the Tx/Rx. Our simulation results show only option 2 can meet the system performance. |
| Samsung | **Issue 1-1-1: Intraband contiguous CA TAE**  Support to confirm the baseline assumption in previous meeting in option1.  **Issue 1-1-2: Intraband non-contiguous CA TAE**  This may be better to decide the scenario first as discussed for ACLR. If the scenario is postponed as common agreement, the requirement should be postponed as well. Otherwise, we would support option 1 as agreed in last meeting.  **Issue 1-1-3: MIMO TAE**  Our preference is still option1. |
| NEC | **Issue 1-1-1: Intraband contiguous CA TAE**  Support option 1.  **Issue 1-1-2: Intraband non-contiguous CA TAE**  Support option 2. We should avoid defining requirements if the feature is not unsupported. It would lead to unnecessary confusion.  **Issue 1-1-3: MIMO TAE**  Support option 1. |
| ZTE | **Issue 1-1-1: Intraband contiguous CA TAE**  Support option 2 which should be same as MIMO TAE case.  **Issue 1-1-2: Intraband non-contiguous CA TAE**  We don’t see its necessity in Rel-17 timeframe except operator have strong market demand.  **Issue 1-1-3: MIMO TAE**  Support option 2. Based on our simulation results, option 2 is more reasonable one. In addition, from our understanding, even the whole CP is missed by TAE and doppler delay, then it seems that we could increase the EVM window to 100% instead of agree 50%, we are just contradicting with each other. |

### 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** |
| Nokia | Propose option 2; for option 1, ok to put 50 in []. |
| Qualcomm | Agree with Nokia’s comment. |
| Huawei | Option 1 with [] until conformance part. |
| Ericsson | We are ok with both option 1 and option 2, since they say the same thing. Until SU and testability is settled it is best to put [50%] and other values within []. Based on 50% windows lengths in tables above can be calculated and added in to proper Annex in TS 38.104. |
| CATT | We’re ok with option 2 with brackets to be confirmed when SU is settled. EVM window is related to the digital filter design which leads to the data on the boundary of OFDM symbols destroyed.  In theory, for the CBW up to 1600MHz, if the RF requirement relative to CBW is the same as FR2-1, we think the same SU can be used and the same EVM window can be used. Please note that that analysis assumes that the PA capability is similar. For 2000MHz, it may also be ok because there maybe no digital filter in BB.  For option 1, many FFT size are not correct, the CP length for 2000MHz is not correct. All the them should be checked one by one. |
| NEC | Ok with both option 1 and option 2. |
| ZTE | FFT is not correct and please fine following FFT proposals  Table 4 : EVM window length for normal CP, FR2, 480 kHz SCS for FR2-2   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **Channel bandwidth (MHz)** | **FFT size** | **CP length in FFT samples** | **EVM window length W** | **Ratio of *W* to total CP length (Note) (%)** | **RB number** | **FFT utilization** | **SU** | | 400 | 1024 | 72 | 36 | 50 | 66 | 0.77 | 0.9504 | | 800 | 2048 | 144 | 72 | 50 | 132 | 0.77 | 0.9504 | | 1600 | 4096 | 288 | 144 | 50 | 264 | 0.77 | 0.9504 |   Table 5 : EVM window length for normal CP, FR2, 960 kHz SCS for FR2-2   |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | | **Channel bandwidth (MHz)** | **FFT size** | **CP length in FFT samples** | **EVM window length W** | **Ratio of *W* to total CP length (Note) (%)** | **RB number** | **FFT utilization** | **SU** | | 400 | 512 | 36 | 18 | 50 | 33/32 | 0.77 | 0.9504 | | 800 | 1024 | 72 | 36 | 50 | 66 | 0.77 | 0.9504 | | 1600 | 2048 | 144 | 72 | 50 | 132 | 0.77 | 0.9504 | | 2000 | 2048 | 144 | 72 | 50 | 132 | 0.77 | 0.76032 | | 2000 | 4096 | 288 | 144 | 50 | 165 | 0.48 | 0.9504 | | 2000 | 3072 | 216 | 108 | 50 | 165 | 0.64 | 0.9504 | |

### Sub-topic 1-3 Emissions: OBUE

**Issue 1-3: deltafOBUE**

Proposals

* + Option 1: For fOBUE 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** |
| Nokia | Propose option 2; ok with option 1. |
| Qualcomm | Support option 1. |
| Huawei | Option 1 |
| Ericsson | We support option 1. Set the upper limit based on largest band know today. If a larger band comes in the future, we deal with it then. |
| CATT | Option 1 and agree that we can revisit when new spectrum is available. |
| NEC | Support option 1. |
| ZTE | Fine with option 1 |

### 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

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| **Company** | **Comments** |
| Nokia | For option 1, licensed band n264 should be waiting for final decision in main session given that regulatory requirements are missing, as of now it cannot be specified. |
| Qualcomm | Ok with the proposed option 1, while considering Nokia’s comment on n264. |
| Huawei | Clearly we need to align with the Main session on the licensed band consideration, but we would be supportive of option 1 to introduce the licensed band’s requirements. |
| Ericsson | We support option 1, since we see no harm to introduce the band now even though the regulatory situation is unknown. By having a 3GPP band we can influence regions still not decided on how to handle the upper part of the spectrum. |
| CATT | We support to define licensed band. But it may not be decided only by BS part. So go to general part? UE spec should be aligned. |
| Samsung | Agree that introduction of n264 would be aligned with decision in main session. But since the discussion on BS RF requirement covers both licensed and unlicensed aspects, it would be beneficial to capture the agreement on licensed operation formally. |
| NEC | Ok with option 1. |
| ZTE | Similar comments as other companies, we need to wait for the decision from main session, |

### 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** |
| Nokia | For option 1, does this mean no need to specify NC CA TAE? |
| Qualcomm | Ok with option 1. |
| Huawei | We should have a general agreement on the non-contiguous operation requirements (as related to the TAE requirement). As commented in TAE, for now the need for non-contiguous operation in FR2-2 is not settled and we would rather leave it out of Rel-17, unless there is clear market demand. |
| Ericsson | Looking at use-cases, deployments and spectrum situation for FR2-2 NC CA TAE seems not to be a very important feature. Therefore, we suggest postponing the derivation of a requirement until there is a clear need in later release. If we decided not do NC CA TAE we need to align also with TAE. We prefer to focus on contiguous CA and DC/CA cases first. We prefer option 1. |
| CATT | Support not to touch NC CA. |
| NEC | Ok with option 1. |
| ZTE | Fine with option 1 and don’t define NC CA TAE requirement; |

### CRs/TPs comments collection

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| **CR/TP number** | **Comments collection** |
| R4-2203579  Draft CR to TS 38.104: Addition of requirements for NR extension up to 71 GHz in subclause 9.6 to 9.8 | Nokia: In table 9.7.5.3.2.3-2, licensed band n264 should be waiting for final decision in main session given that regulatory requirements are missing, as of now it cannot be specified. |
| Huawei:  Table 9.6.3.3-4: pending the final decision on TAE requirement. There are still [] for the non-cont operation – related conclusion needed first.  Table 9.7.4.3.3-3: can someone clarify where this 500 MHz is coming from? |
| Ericsson: We see no harm in introducing n264 at this point in time. We rather see an opportunity to capture both licensed and unlicensed operation within the scope of the WI. |
| NEC: There are issues on the base document. We think this draft CR is based on R4-2203013 endorsed in the last meeting. Based on the guideline, change marks in R4-2203013 shall be kept. In the last meeting, R4-2203013 was submitted to the change on ver. 17.3.0. It had to be to ver. 17.4.0. Although cover sheet of this document says current version is 17.4.0, base document is not aligned with ver.17.4.0. |
| Ericsson: Thanks for the feedback NEC. We are not sure what guidelines that applies for the work in this WI. We will provide a new version with updates. A revision is required. |
| ZTE: for Table Table 9.6.3.3-4:, ns should be kept together with TAE instead scs.  In addition, NC CA TAE requirement should be keep aligned with NC CACLR requirement; maybe we need to delete that one.  To Huawei, 500MHz is coming from ITU-R regulation similar as FR2-1.  n264 should be kept in the []; |
| R4-2203650  Draft CR to TR 38.104: Clauses 9.1 to 9.5 | Nokia: Draft CR should be revised with agreements in this meeting. |
| Huawei: Remaining FFS to be replaced in the final version of the CR. |
| Ericsson: Looks similar as agreed draft CR from last meeting. |
| NEC: What are the changes from R4-2203650 endorsed in the last meeting? Is this a place holder to be revised after the first round? |
| ZTE: please remove the section which has no impacts. |

## Summary for 1st round

### Open issues

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

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

### CRs/TPs

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

## Discussion on 2nd round (if applicable)

# Topic #2: Rx requirements

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

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203578 | 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 NR  signal,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 fOOB and fOBUE.  **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 NR  signal,120 kHz SCS, 64RBs | |  | 400 | ±48.58 |  | |  | 800 | ±48.62 |  | |  | 1600 | ±48.58 |  | |  | 2000 | ±48.62 |  | |
| 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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | OK for option1. |
| Qualcomm | Support option 1. |
| Huawei | Option 1 by default. |
| Ericsson | The scaling of 9 dB is a consequence from using 50 MHz carrier bandwidth as reference for FR2. 9 dB comes from 10log10(400/50) to support 400 MHz carrier bandwidth using new FRC for 480, 960 kHz SCS. Maybe we need some more clarifications in the specification. We support option 1. |
| CATT | Ok with option 1. |
| NEC | Ok with option 1. |
| ZTE | We need to agree on FRC firstly, then we could further discuss the scaling factor later on. Scaling factor is directly related with the FRC for each CBW. |

### 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.*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Propose option 1, ok to wait for SU finalization in main session. |
| Qualcomm | Ok with option 1. |
| Huawei | First wait for the SU conclusion. |
| Ericsson | In general, we are ok with proposed values, but we think we need to lift the discussion on SU to main session. First agree on principles regarding SU, then all values will fall out from that. |
| CATT | Agree with above comments for SU, can put them in brackets. |
| ZTE | It depend on the further discussion in SU part.  Maybe FRC for 960kHz with 66 PRBs should be also needed similar as FR2-1 for 100MHz with 120KHz SCS. Again, we need to wait for su conclusion. |

### 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 NR  signal,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 NR  signal,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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Propose option 3; ok with option 2; for option 1, the sub-carrier grid of the interferer is not ½ of the sub-carrier spacing offset from the sub-carrier grid of the wanted signal for 400 MHz, 800 MHz, 1600 MHz and 2000 MHz channel bandwidth, should apply formula in clause 7.4.1 of TR 38.817-02. |
| Qualcomm | Ok with options 2 and 3. |
| Huawei | Option 2 as baseline, as seems to be the most complete for the final CR implementation. |
| Ericsson | We are ok to support option 3 as a first step. We see that we have two proposals for frequency offsets. Maybe if we have on-line time, we could have a short discussion on how to decide the frequency offsets. |
| CATT | Support option 2 and option 3. The option 2 calculation is aligned with the current FR2-1 methodology. To Ericsson, we have detail description on how they’re derived in R4-2203976. |
| ZTE | Support the option 2 and option 3. For option 2 is based on 100MHz, 120KHz with 66PRB CP-OFDM |

### 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** |
| Nokia | Propose option 1. |
| Qualcomm | Support option 1. |
| Ericsson | We prefer option 1. |
| CATT | Ok with option 1. |
| ZTE | Ok with option 1. |

### 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 fOOB and fOBUE. (Ericsson R4-2203578, Nokia R4-2203651)
* Recommended WF

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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Propose option 1. |
| Qualcomm | Support option 1. |
| Huawei | Option 1 |
| Ericsson | We prefer option 1 |
| NEC | Support option 1. |
| ZTE | Okay with option 1 |

### 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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | For option 1, licensed band n264 should be waiting for final decision in main session given that regulatory requirements are missing, as of now it cannot be specified. |
| Qualcomm | Ok with the proposed option 1, while considering Nokia’s comment on n264. |
| Huawei | Clearly we need to align with the Main session on the licensed band consideration, but we would be supportive of option 1 to introduce the licensed band’s requirements. |
| Ericsson | We see no harm in introducing n264 at this point in time. We rather see an opportunity to capture both licensed and unlicensed operation within the scope of the WI. |
| Samsung | Same to comment on subtopic 1-4: Agree that introduction of n264 would be aligned with decision in main session. But since the discussion on BS RF requirement covers both licensed and unlicensed aspects, it would be beneficial to capture the agreement on licensed operation formally. |
| ZTE | Similar comments as other companies, it’s better to keep n264 in [] at the current phase. |

### 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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Propose option 1, ok to further consider using 400 MHz interfering signal with 800 MHz, 1600 MHz and 2000 MHz wanted signal channel bandwidth; for option 2, offset values for 480kHz and 960kHz SCS should wait for SU finalization in the main session. |
| Qualcomm | Agree to wait for SU finalization. |
| Huawei | 64RM interferer (from option 1), as well as the interferer offset (from option 2) both seems to be justified. More time to analyze during the second round needed. |
| Ericsson | We support option 1 as a first step. We need some more discussion on the interferer signal bandwidth. Following the principles used for FR2-1, 100 MHZ would be sufficient. Having 400 MHz, could stretch test complexity due to the fact that larger bandwidth would put higher demands on the signal generators to be used during conformance testing. Further discussion is required. |
| CATT | We have the same confusion as Ericsson, i.e. if 100MHz can be sufficient. |
| ZTE | Please find the detailed clarifications for 400MHz due to the increasing SCS and scs of wanted signal and interfering signal should be same. |

### 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

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | Ok with option 1; for option 2, the power level calculation is not accordingly to agreed WF in R4-2203017, and the values for 800 MHz, 1600 MHz and 2000 MHz channel bandwidth are not correct, G-FR2-A1-8 is 800 MHz channel bandwidth FRC which is not agreed yet. |
| Qualcomm | Support option 1. |
| Huawei | Option 1 is embedded in option 2, which is more complete solution. Consider option 2 as baseline for further corrections and the final CR. |
| Ericsson | We support option 1. We think that option 2 does not really follow agreed principles from last meeting. |
| CATT | Ok with option 1 and the methodology of option 2. Some power levels for option 2 are not correct as Nokia commented. |
| Samsung | The discussion for signal power level should be based on decision for FRC of wanted signal and interference signal RB for each CHBW and SCS applied for ICS, which are not fully addressed in option 1 at least. |
| ZTE | Disagree with option 1, please check in more details from ZTE contribution, I have explained in details how it’s done for FR2-1 and use the approach for FR2-2. For 800,1600,2000MHz, i could further check it.  Again power level is directly related with FRC design as mentioned by samsung. |

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2205462  Draft CR for TS 38.104 on introduction of BS RF Rx requirements for 57-71GHz in section 10.6 – 10.9 | Nokia: In table 10.8.3.2, number of RBs for RxIMD interfering signal for 480kHz and 960kHz SCS should wait for SU finalization in the main session. |
| Huawei: Table 10.8.3-1: the requirement is the same for FR2-1 and FR2-2. The only difference are the applicable CHBW. Suggest to remove both columns: “*Frequency Range*” and the “*BS channel bandwidth* of the *lowest/highest carrier* received (MHz)”, and to keep a single row with the wanted and interferer signal data. |
| Ericsson: In sub-clause 10.6.3.1, consider to define a parameter dfOOB as we did for FR1. Then the additions in the table can be minimized. A new table for dfOOB is required. In other words align with how the spec is written for FR1. |
|  | 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.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Nokia | R4-2203582 includes a list the potential topics to be considered, document should be for discussion but not approval. |
| Qualcomm | Agree with the list provided in R4-2203582. |
| Huawei | The initial observations are good starting point, but not sure what we are supposed to agree on here. Conclusions on the MU contributors is suggested to be captured in TR 37.941 for completeness. |
| Ericsson | The intension was to agree to some high level challenges to be able to create a work plan for the conformance work. |
| Keysight | On 38.141-2 sub-clause list (which could be impacted by this work), Annex L for EVM will also need to be modified. It looks like most of comment for EVM measurement time reduction agrees at least as direction and this affects Annex L.  Regarding with potential work list, like to thank Ericsson for this. it looks like good list as high level. |
| CATT | W’re ok to use option 1 as the starting point for discussion in future meetings. |
| ZTE | This is just high level of review, not for approval |

### 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** |
| Nokia | **Issue 3-2-1: Measurement uncertainty**  Option 1 seems to be reasonable.  **Issue 3-2-2: Antenna assumptions/path loss**  For option 1, in regulations for unlicensed spectrum there are limitations to e.g., 40 or 55 dBm EIRP, so also smaller antenna arrays are expected to be used.  **Issue 3-2-3: Frequency range considerations**  Options 1 and 2 seem to be reasonable. |
| Qualcomm | **Issue 3-2-1: Measurement uncertainty**  Agree with option 1.  **Issue 3-2-2: Antenna assumptions/path loss**  Proposal to utilize the discussion on antenna assumption followed in the coexistence work that was concluded in RAN4#101-bis.  **Issue 3-2-3: Frequency range considerations**  Agree with options 1 and 2. |
| Huawei | **Issue 3-2-1: Measurement uncertainty**  Option 1 as staring point. TR 37.941 is proposed to be used as the placeholder for related conclusions.  It shall be highlighted, that in case of band n262 (47GHz), the MU budget approach was not used.  **Issue 3-2-2: Antenna assumptions/path loss**  As the referred antenna array is just an example listed in the TR 38.808, we are wondering how to avoid any misleading conclusions in future discussions. MU analyses shall not imply implementation limitations for future products. More analysis needed.  **Issue 3-2-3: Frequency range considerations**  Agree with both (observations). |
| Ericsson | **Issue 3-2-1: Measurement uncertainty**  We support option 1, under the condition that new test approaches need to be considered. Such as adding additional calibration stages to improve individual error contributions.  **Issue 3-2-2: Antenna assumptions/path loss**  We currently do no see a direct relation to the number of array elements and the MU. Previously for FR1 and FR2 the array size has not been considered. If we see that the array size is vital for MU for FR2-2, RAN4 needs to agree on typical antenna sizes for BS. Further discussions is required.  **Issue 3-2-3: Frequency range considerations**  Practical upper test frequencies for emission and blocking are required to facilitate conformance testing of regulatory requirements. It would be a stretch to set the upper limit to 2nd harmonic as for FR2 core requirements for FR2-2, a reasonable upper limit is required. |
| Keysight | **3-2-1, MU topic**  **Option 1**  **3-2-2 antenna assumption**  **I’d like to add more back ground and implication of antenna assumption in relation with test system MU and practical upper frequency topic. Antenna assumption as well as Tx power makes FF distance and pathloss calculation then set expected signal strength at measurement receiver end for Tx test as example. Depending on this level, there could be something like additional LNA needed which add uncertainty also increases test system noise floor. Also, with frequency goes up, test system noise floor increases and larger path loss makes measurement difficult for weak signal such as unwanted emission then could set possible practical upper frequency.**  **3-2-3 Frequency range considerataion**  **In relation with comment above for antenna, default on this frequency range topic is 2nd harmonic frequency as upper range rather setting practical upper frequency. My intention is to try to see if anything we can agree with lower than 2nd harmonic as practical upper frequency but I believe it needs to have good technical back ground reason and assumption.** |
| CATT | **Issue 3-2-1: Measurement uncertainty**  We support option 1 to be studied further.  **Issue 3-2-2: Antenna assumptions/path loss**  We support this issue to be discussed further and would like to see if it’s a critical issue if there will be different implementations.  **Issue 3-2-3: Frequency range considerations**  Support the options to be studied further. |
| NEC | **Issue 3-2-1: Measurement uncertainty**  Support option 1.  **Issue 3-2-3: Frequency range considerations**  Support option 1 and 2. |
| ZTE | **Issue 3-2-1: Measurement uncertainty**  We support option 1 to be studied further.  **Issue 3-2-2: Antenna assumptions/path loss**  We support this issue to be discussed further  **Issue 3-2-3: Frequency range considerations**  Support the options to be studied further |

### 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** |
| Nokia | Propose options 1 and 2; R4-2205668 provides the EVM measurement results with shorter measurement time, it would be helpful to have more s.d. results at 4-8 ms analysis length to see the rate of s.d. reduction over this range. |
| Qualcomm | Ok with scaling down the duration for all NR FR2-2 test models. |
| Huawei | In general are supportive of the test time reduction measures. However, both options are formulated quite vaguely as “consideration” – so it may be a starting point for some WF, rather the Approval as such. |
| Ericsson | Since EVM measurements will be conducted on regular basis not only for type approval, it is essential to reduce the time. At the same time we need to consider the MU. In the proposal from R&S the MU was analyzed based on measured samples, which indicated that the test time could be reduced to something more reasonable. At this time we think its to early to decide on specific details or solutions, but we need to consider ways to reduce the test time maintaining acceptable MU. |
| Keysight | This is important topic for TE vender to set reasonably short but good enough length for FR2-2. And I believe this is everyone’s benefit too. I’m fine to continue to discuss. |
| CATT | We support the direction and would support the proposal in R4-2205668 if decision must be made in this meeting. |
| NEC | Support option 1 and 2 in general. Need further study. |

## 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 |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

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

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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)