**3GPP TSG-RAN WG4 Meeting # 100-e R4-2115605**

**Electronic Meeting, 16th – 26th August, 2021**

**Agenda item:** 9.16.5

**Source:** Moderator (Nokia)

**Title:** Email discussion summary for [100-e][315] NR\_exto71GHz\_BSRF

**Document for:** Information

# Introduction

This email discussion summary covers BS RF requirements for extending NR operation to 71 GHz. 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** |
| R4-2111749 | ROHDE & SCHWARZ | **Observation:** EVM measurement interval of 10ms over 320 / 640 slots is considered unnecessary to determine a reliable EVM.**Proposal 1a:** Limit the number of slots over which the EVM has to be averaged to 80 slots. This is the maximum number of slots for BWPs for 120kHz SCS before the introduction of FR2-2. It results in a measurement interval of 2.5ms / 1.25ms for 480kHz / 960kHz subcarrier spacing.**Proposal 1b:** Limit the measurement interval to 1ms explicitly for FR2-2. Proposal 1a and 1b are considered to be alternatives and same approach is proposed for both UE and BS EVM. |
| R4-2111972 | CATT | **Proposal 1:** Re-use FR2 6% breakpoint for fractional bandwidth for 52.6-71GHz.**Proposal 2:** Re-use existing FR2 EIRP accuracy (±3.4dB) and FR2 TRP accuracy (±3dB) for 52.6-71GHz.**Proposal 3:** Add maximum offset ΔfOBUE for 4000 MHz ≤ FDL,high – FDL,low ≤ 5000MHz in 52.6-71GHz for licensed band.**Proposal 4:** If ACLR is reduced by x dB relative to 26dBc for 37 – 52.6 GHz, OBUE limit need to be increased by x dB relative to 37 – 52.6 GHz. |
| R4-2112278 | Nokia, Nokia Shaghai Bell | **Proposal 1:** The current FR2 BS EIRP accuracy should be applicable for NR operation in 52.6 – 71 GHz range.**Proposal 2:** Two rated carrier EIRP may be declared by manufacturer for operating bands in 52.6 – 71 GHz range where the supported fractional bandwidth (FBW) is larger than 6%.**Proposal 3:** The current FR2 BS transient period should be applicable for NR operation in 52.6 – 71 GHz range.**Proposal 4:** The MIMO time alignment error requirement for BS type 1-O and BS type 2-O should be applicable for NR operation in 52.6 – 71 GHz range. Moreover, shorter CA time alignment error requirements (than that for BS type 2-O) may be considered for NR operation in 52.6 – 71 GHz range with larger SCS (than that for BS type 2-O).**Proposal 5:** The EVM requirements for BS type 2-O should be applicable for NR operation in 52.6 – 71 GHz range. Moreover, the EVM window length for NR operation in 52.6 – 71 GHz range should be defined as 50% of the normal CP length.**Proposal 6:** The unwanted emissions for licensed operation can be further discussed when related regulatory requirements become available in the regions.**Proposal 7:** The out-of-band emissions and unwanted emissions in the spurious domain specified in ETSI EN 303 722 and/or ETSI EN 303 753 should be considered for unlicensed NR operation in 52.6 – 71 GHz range at least in Europe.**Proposal 8:** The issue of low emission PSD is handled by specifying an absolute requirement level for each relative emission requirement considering both adjacent channel protection and implementation feasibility of test equipment.**Proposal 9:** The results in TR 38.803 can be reused to decide the required ACLR and ACS values for NR operation in 52.6 – 71 GHz range. |
| R4-2113316 | Ericsson | **Observation 1:** The analysis in TR38.803 considering needed ACLR for 70 GHz proxy frequency very well match the outcome of feasibility analysis during SI.**Observation 2:** Existing NR MIMO TAE = 65 ns requirement has just been copied over into LTE and NR FR1 and NR FR2 without any technical analysis.**Observation 3:** Existing NR MIMO TAE = 65 ns requirement is not relevant, already for legacy LTE case of 20 MHz, if one use wideband precoder. **Observation 4:** To keep the BF accuracy we require very strict control of all delay in the array. The required upper bound of delay will be very small and hard to measure for an external BS tester directly but can be achieved through internal calibration.**Observation 5:** Any TAE between the transceivers in an array will affect the main lobe EIRP.**Proposal 1:** It is proposed to use antenna model parameter sets in Table 2.1-2 if co-existence simulations are considered or if antenna parameters are shared to other groups.**Proposal 2:** Re-use FR2 radiated transmit power (EIRP) accuracy requirement of +/- 3.4 dB for the frequency range 52.6 to 71 GHz.**Proposal 3:** Re-use 6 % as limit to allow two EIRP values to be declared for radiated transmit power requirement.**Proposal 4:** NR in 52.6 to 71 GHz should support modulation orders up to 64QAM.**Proposal 5:** Taking to account both co-existence studies in TR 38.803, existing emission masks and feasibility analysis of power amplifiers, the BS ACLR shall be set to 21 dB.**Proposal 6:** Due to diverse emission mask requirements applicable in different regions and the flexibility in terms of both supported SCS and carrier bandwidths for NR in 52.6 to 71 GHz, further discussions and analysis is needed in RAN4 before defining the OBUE/transmitter emission masks.**Proposal 7:** For licensed operation supporting higher EIRP levels, RAN4 should re-use the FR2 approach and adapt the FR2 OBUE/emission mask or alternatively ETSI BRAN emission mask for c2 for NR in 52.6 to 71 GHz and make adaptations e.g. ΔfOBUE taking to account larger carrier bandwidths.**Proposal 8:** For licensed operation and unlicensed operation, RAN4 should re-use the FR2 approach and use FR2 spurious emission requirements for NR in 52.6 to 71 GHz and make adaptations with respect Fstep,X taking to account larger carrier bandwidths.**Proposal 9:** Remove TAE requirements for MIMO and rely on EIRP BS conformance to verify that TAE is within a working range.**Proposal 10:** Remove TAE requirements for contiguous intra band CA and non-contiguous intra band CA and rely on EIRP BS conformance to verify that TAE is within a working range.**Proposal 11:** Keep TAE = 3 µs for inter band CA for extension to 71 GHz WI. |
| R4-2113857 | NEC | **Proposal 1:** To agree the boundary for the OBUE mask is set at ΔfOBUE = 4,500 MHz for 52.6 – 71 GHz. |
| R4-2113922 | ZTE Corporation | Observation 1: if the output power for 60GHz is on the same level of that for the existing FR2 and same PA manufacturing material (e.g. GaAs, Si), then similar ramping up time and ramping down time could be expected for 60GHz. Observation 2: to reduce the GP overhead for 480kHz and 960kHz of 60GHz, alternatives could be extend the TDD periodicity.**Observation 3**: the acceptable TAE requirement should be around 10-20ns for 960kHz and 10-40ns for 480kHz, **Proposal 1**: to discuss the simulation assumptions to further evaluate acceptable TAE requirements for 60GHz 480kHz and 960kHz SCS. **Proposal 2**: to reuse FR2 EVM requirement (up to 64QAM) for 52.6-71GHz and revisit PT-RS configuration for 52.6-71GHz; **Proposal 3:** to propose to discuss the simulation assumptions for 52.6-71GHz for ACLR/ACS evaluation firstly; **Proposal 4:** to agree OBUE limit in Table 3 for 60GHz. |

## 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 EIRP and TRP output power requirements

**Issue 1-1: EIRP and TRP output power requirements**

* Proposals
	+ Option 1: Re-use 6 % as limit to allow two EIRP values to be declared for radiated transmit power requirement. (Ericsson, Nokia, CATT)
	+ Option 2: Re-use FR2 radiated transmit power (EIRP) accuracy requirement of +/- 3.4 dB for the frequency range 52.6 to 71 GHz. (Ericsson, Nokia, CATT)
	+ Re-use existing FR2 TRP accuracy (±3dB) for 52.6-71GHz (CATT)
* Recommended WF
	+ Re-use both current EIRP and TRP accuracy requirements from FR2-1 to FR2-2 and re-use 6% limit to allow two EIRP values to be declared.

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| **Company** | **Comments** |
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| CATT | Support recommended WF. |
| Nokia | Support Recommended WF. |
| Ericsson | We are ok with proposals and recommended WF |
| ZTE | Support Recommended WF. |
| Huawei | FBW: It would be more reasonable to take such decision once we have the bands defined. The FBW discussion for FR2 was concluded with multiple FR2 bands already defined. In case of FR2-2, it would be good to have at least one licensed band defined to conclude FBW. Furthermore, the FBW decision shall be per-band in such case. For sake of progress, Ok to consider 6% FBW threshold for licensed bands as starting point, but we need to have some additional check-point once the licensed band is defined. FBW FFS for the unlicensed band due to high EIRP difference observed. Accuracy: there was no analysis for the consideration of much larger arrays with smaller element spacings, and its potential productions aspects impacting the final accuracy. For sake of progress, we may consider the existing EIRP/TRP accuracy values in [], and would like to have more time to analyze those aspects for next meeting. |
| QCOM | We are ok with the recommended WF. |

### Sub-topic 1-2 Transient times

**Issue 1-2: Transient times**

* Proposals
	+ Option 1: The current FR2 BS transient period should be applicable for NR operation in 52.6 – 71 GHz range. (Nokia)
	+ Option 2: TBA
* Recommended WF
	+ TBA

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| **Company** | **Comments** |
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| CATT | Ok with option 1. |
| Nokia | Propose Option 1. |
| Ericsson | We support option 1 |
| ZTE | Could compromise to option 1, however we would like to see more analysis on transmission period analysis whether this could further reduced. |
| Huawei | Considering the discussion on the timing aspects, more time for further analyses would be beneficial. There are also relations to the output power levels and ramping times (and indirectly to BS classes discussion). |
| QCOM | We support option 1.  |

### Sub-topic 1-3 Signal quality – EVM

**Issue 1-3: Signal quality – EVM**

* Proposals
	+ Option 1: The EVM requirements for BS type 2-O should be applicable for NR operation in 52.6 – 71 GHz range. Moreover, the EVM window length for NR operation in 52.6 – 71 GHz range should be defined as 50% of the normal CP length. (Nokia)
	+ Option 2: NR in 52.6 to 71 GHz should support modulation orders up to 64QAM (Ericsson)
	+ Option 3: to reuse FR2 EVM requirement (up to 64QAM) for 52.6-71GHz and revisit PT-RS configuration for 52.6-71GHz; (ZTE)
* Recommended WF
	+ Re-use current EVM-% requirements up to 64 QAM, confirm whether EVM window length and PT-RS configuration can be re-used

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| **Company** | **Comments** |
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| CATT | Support the recommended WF. For the window length, the conclusion may need to wait the SU conclusion although we think 50% is very possibly to be reused.  |
| Nokia | Support Recommended WF; EVM window length should reuse 50% of the normal CP unless technical issue is identified, PT-RS configuration should wait for and align with RAN1 decision. |
| Ericsson | We prefer option 2, which have already been agreed in previous WF (R4-2106113). For Option 1 we can consider the 50% window length as a starting point, however FR2 has smaller maximum channel bandwidth and SCS compared to what has been agreed in 52 GHz range (currently 960 kHz and 2000 MHz is being tentatively agreed). As such the shorter CP length may have some impact and needs some further checking on this. Regarding Option 3, it has been previously agreed that we will not revisit PT-RS configuration as this is RAN1 task (if needed).  |
| ZTE | Fine with Recommended WF, To Ericsson, instead of redefining PT-RS configuration, it still rely on RAN1 design to choose which one is more applicable for 52.6-71GHz; |
| Huawei | Option 2: OK. However, WF say “up to” 64QAM, which crates some confusion. Do we need to clarify that higher order modulations were already excluded?For the EVM requirement value: ok to reuse FR2 with [] for now (final confirm next meeting).EVM window length and PT-RS configuration are considered to be Conformance testing aspects. Do we need to consider them now? |
| QCOM | We are ok with the recommended WF |

### Sub-topic 1-4 Signal quality – EVM measurement period

**Issue 1-4: EVM measurement period**

* Proposals
	+ Option 1: Limit the number of slots over which the EVM has to be averaged to 80 slots. This is the maximum number of slots for BWPs for 120kHz SCS before the introduction of FR2-2. It results in a measurement interval of 2.5ms / 1.25ms for 480kHz / 960kHz subcarrier spacing. (Rohde & Schwarz)
	+ Option 2: Limit the measurement interval to 1ms explicitly for FR2-2. (Rohde & Schwarz)
* Recommended WF
	+ TBA

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| **Company** | **Comments** |
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| CATT | We’re ok with both options and slightly prefer option 1. |
| Keysight | We also have the same concern. RAN4 should agree to reduce measurement period for FR2-2. For which option to choose, needs more study. |
| Nokia | We support measurement time reduction; other options could also be considered, e.g. could use number of samples (varying according to SCS) instead of number of slots (which result in different number of samples of different SCS). |
| Ericsson | Interesting point found by R&S, we would like to have some more time to look into details on how the specifications will be impacted. Further information regarding the new proposed measurement intervals would be appreciated i.e. how were they arrived at. |
| ZTE | Both options for for us, if Rohde & Schwarz could show that with 80 slots, EVM measurement is stable enough, it’s also fine for us.  |
| Huawei  | In general the test time reduction for FR2-2 and new SCS seems as good direction, but more analyses may be needed for those particular proposals. This topic belongs to the Performance part - no need to rush the decisions. |
| QCOM | We think the number of slots and interval needs to be further studied. Note that the proposal affects the UE also. |
| Anritsu | We prefer option 1 to be on the safe side in terms of accuracy. |

### Sub-topic 1-5 Signal quality – TAE

**Issue 1-5: Signal quality – TAE**

* Proposals
	+ Option 1: to discuss the simulation assumptions to further evaluate acceptable TAE requirements for 60GHz 480kHz and 960kHz SCS. (ZTE)
	+ Option 2: Remove TAE requirements for MIMO and rely on EIRP BS conformance to verify that TAE is within a working range. (Ericsson)
	+ Option 3: Remove TAE requirements for contiguous intra band CA and non-contiguous intra band CA and rely on EIRP BS conformance to verify that TAE is within a working range. (Ericsson)
	+ Option 4: Keep TAE = 3 µs for inter band CA for extension to 71 GHz WI. (Ericsson)
	+ Option 5: The MIMO time alignment error requirement for BS type 1-O and BS type 2-O should be applicable for NR operation in 52.6 – 71 GHz range. Moreover, shorter CA time alignment error requirements (than that for BS type 2-O) may be considered for NR operation in 52.6 – 71 GHz range with larger SCS (than that for BS type 2-O). (Nokia)
* Recommended WF
	+ TBA

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| **Company** | **Comments** |
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| CATT | More analysis is needed. |
| Nokia | Propose Option 5; Option 2 and Option 3 need further study as TAE is the accuracy between two beams instead of the accuracy of a single beam. |
| Ericsson | We prefer option 2 and 3, since the requirement is indirectly fulfilled as consequence of doing beam forming in an AAS BS as described in R4-2113316. We also support option 4. |
| ZTE | Option 1, I also copy the following context from TR 38.808 for 52.6-7GHz in SI phase,Current BS OTA TAE requirements in clause 9.6.3 of TS 38.104 specify 65 ns for MIMO transmission [99]. It has been discussed in [100] that the current requirement has been in place since UMTS and is the same as quarter of the UMTS chip rate time, i.e. 65 ns matches to 1/(4x3.84) Mcps rate. Improvement in performance has taken place in the past 20 years, and therefore it would be reasonable to consider improvements to TAE requirements.To Ericsson, what you proposed is for within sub-antenna subarray, however here we are discussing the TAE between different digital branches in FR2, for sub-antenna sub-array, offline calibration in the OTA chammber could be done very well with limited degree for remaining uncertainty. |
| Huawei  | It is not clear if options 2/3 shall be taken into consideration, having the TAE agreements so far. Arguments on the beam coherence were also used in the past discussion for FR2, while the TAE requirements were kept. More analysis needed. |
| QCOM | In order to derive the TAE requirements, agreement on different simulation assumptions needs to be considered.  |

### Sub-topic 1-6 Emissions – OBUE and ACLR

**Issue 1-6: Emissions – OBUE and ACLR**

* Proposals for OBUE
	+ Option 1: to agree OBUE limit in Table 3 for 60GHz (ZTE)



* + Option 2: Due to diverse emission mask requirements applicable in different regions and the flexibility in terms of both supported SCS and carrier bandwidths for NR in 52.6 to 71 GHz, further discussions and analysis is needed in RAN4 before defining the OBUE/transmitter emission masks. (Ericsson)
	+ Option 3: The out-of-band emissions specified in ETSI EN 303 722 and/or ETSI EN 303 753 should be considered for unlicensed NR operation in 52.6 – 71 GHz range at least in Europe. (Nokia)
	+ Option 4: The issue of low emission PSD is handled by specifying an absolute requirement level for each relative emission requirement considering both adjacent channel protection and implementation feasibility of test equipment. (Nokia)
	+ Option 5: To agree the boundary for the OBUE mask is set at ΔfOBUE = 4,500 MHz for 52.6 – 71 GHz. (NEC)
	+ Option 6:If ACLR is reduced by x dB relative to 26dBc for 37 – 52.6 GHz, OBUE limit need to be increased by x dB relative to 37 – 52.6 GHz. (CATT)
* Proposal for OBUE for licensed operation only
	+ Option 1: The unwanted emissions for licensed operation can be further discussed when related regulatory requirements become available in the regions. (Nokia)
	+ Option 2: For licensed operation supporting higher EIRP levels, RAN4 should re-use the FR2 approach and adapt the FR2 OBUE/emission mask or alternatively ETSI BRAN emission mask for c2 for NR in 52.6 to 71 GHz and make adaptations e.g. ΔfOBUE taking to account larger carrier bandwidths. (Ericsson)
	+ Option 3: Add maximum offset ΔfOBUE for 4000 MHz ≤ FDL,high – FDL,low ≤ 5000MHz in 52.6-71GHz for licensed band. (CATT)
* Proposal for ACLR
	+ Option 1: to propose to discuss the simulation assumptions for 52.6-71GHz for ACLR/ACS evaluation firstly (ZTE)
		- *Moderator comment: This discussion is taking place in parallel in thread 139*
	+ Option 2: Taking to account both co-existence studies in TR 38.803, existing emission masks and feasibility analysis of power amplifiers, the BS ACLR shall be set to 21 dB. (Ericsson)
	+ Option 3:The results in TR 38.803 can be reused to decide the required ACLR and ACS values for NR operation in 52.6 – 71 GHz range. (Nokia)
* Recommended WF
	+ TBA

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| **Company** | **Comments** |
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| CATT | **OBUE:More analysis is needed to consider the ACLR requirement and the regulations.****OBUE for licensed operation: First of all, we think we can take 66-71 GHz as an example to see if there can be some common consideration for the OBUE requirements.****ACLR: Wait the co-existence simulation.** |
| Nokia | **OBUE: Propose Option 3; ok with Option 2 to align with ACLR decision; for Option 1, it is equivalent to 2 dB relaxation compared to 39 GHz requirements, does this mean the ACLR should also have 2 dB compared to 39 GHz requirements to be aligned?****OBUE for licensed operation: Propose Option 1; for Option 2, BRAN emission mask for C2 is aimed towards unlicensed operation, we do not quite see how it would be directly applicable for licensed operation.****ACLR:** **Propose Option 3; for Option 2, there is no room to relax ACLR requirement to be less than that in TR 38.803 according to our simulation results.** |
| Ericsson | **OBUE: We prefer option 2. In Europe we need to follow ETSI masks, but for other regions other masks may be relevant to consider. To better understand the ETSI mask its good to parameterize it. Then it would be more convenient to compare the masks with other proposed masks based on the FR2 concept. At a quick comparison it seems that proposed masks are not very different.** **OBUE for licensed operation: We prefer option 2. A new mask for c2 devices has been agreed in ETSI BRAN, that mask may be suitable for BS intended for licensed operation with high EIRP power capability together with adjustments of fOBUE to be suitable for larger carrier bandwidths.****ACLR: We are ok to use the results in TR 38.803 as baseline. Eventually we need to do some small adaptations to account for larger carrier bandwidths.** |
| ZTE | **OBUE:** more analysis might be needed since ACLR is not determined yet, in addition, agreed TRP for OBUE is not discussed yet.**ACLR:** prefer to wait for coexistence simulation. In TR 38.803, coexistence simulation is not done appropriately, companies are encouraged to check the following parameters from TR 38.803, in the WI phase, BS max Tx power is identified as wrong assumption and UE max Tx power is also not correct.Again, we have concerns that TR 38.803 simulation results could be reused without any further considerations; |
| Huawei | **OBUE:** We need more time to further check Option 1/4.Option 2/3 seems ok.Option 5 seems to assume 2 CC for CA: this does not seem to be agreed so far, and requires further verification. Furthermore, the approach for the deltaOBUE in the ETSI spec was not really used in the past in 3gpp. We may need further discussion. See also related CATT proposal.**OBUE for licensed operation:**Option 1 seems reasonable. Options 2 is unclear, as unlicensed mask applicability for licensed operation is not considered as valid. The “higher EIRP” may also require more clarifications. Option 3: we shall wait for the bands to be defined first. See also related NEC proposal (option 5 above and comments).**ACLR:** It seems that this topic will not be able to conclude until the co-ex simulations are done (even if not officially agreed to re-run the simulations). Better to postpone the decision in such situation. |
| QCOM | OBUE: We support option 2. Regulatory requirements will impact OBUE decision and this requires more analysis in RAN4. OBUE for licensed operations: FR2 approach can be reused. Methodologies and work in ETSI BRAN should be considered as well. This needs more analysis within RAN4. ACLR: We support option 1. Derivation of requirements is currently being considered in detail in thread 139. It is still under discussion whether new requirements will be set or reusing of requirements from TR 38.803 for 60GHz. |

### Sub-topic 1-7 Emissions – spurious emissions

**Issue 1-7: Emissions – spurious emissions**

* Proposals
	+ Option 1: For licensed operation and unlicensed operation, RAN4 should re-use the FR2 approach and use FR2 spurious emission requirements for NR in 52.6 to 71 GHz and make adaptations with respect Fstep,X taking to account larger carrier bandwidths. (Ericsson)
	+ Option 2: The unwanted emissions in the spurious domain specified in ETSI EN 303 722 and/or ETSI EN 303 753 should be considered for unlicensed NR operation in 52.6 – 71 GHz range at least in Europe. (Nokia)
* Recommended WF
	+ TBA

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| **Company** | **Comments** |
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| CATT | Agree the two directions of both option 1 and option 2. The exact requirement needs more study. |
| Nokia | Propose Option 2. |
| Ericsson | We prefer to use the FR2 concept adapted for 52 to 71 GHz as proposed in R4-2113316 as the general requirement. |
| ZTE | Fine with option 1 as starting point. |
| Huawei | Both option 1 and 2 sounds reasonable. Spur is based on regulatory limits (e.g. SM.329, or other ECC decision) – so this shall be rather straightforward. For option 1: those “adaptations” were band-specific so far – probably this requires clarification.  |
| QCOM | Our understanding is the two options are not contradictory as option 1 for licensed and 2 for unlicensed. We are ok with both. |

## 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 #1-1 EIRP and TRP requirements** | Out of the six companies who commented five support recommended WF and one company wants to consider FBW further especially for unlicensed band. Also for EIRP and TRP accuracy the one company would prefer to have values in square brackets.*Tentative agreements:*Re-use both current EIRP and TRP accuracy requirements from FR2-1 to FR2-2 and re-use 6% limit to allow two EIRP values to be declared.*Candidate options:**Recommendations for 2nd round:*Confirm the tentative agreement. |
| **Sub-topic #1-2 transient times** | Five out of six companies either support or are ok with the option 1. Two out of six companies mention that further analysis could be beneficial.*Tentative agreements:*The current FR2 BS transient period should be applicable for NR operation in 52.6 – 71 GHz range.*Candidate options:*Given the comments from 2/6 companies, the transient period could be put in square brackets*Recommendations for 2nd round:*Confirm the tentative agreement and/or candidate option. |
| **Sub-topic #1-3 Signal quality – EVM** | There is clear alignment that EVM-% from FR2-1 can be re-used for QPSK, 16QAM and 64 QAM. Most companies are also ok to consider 50% EVM length as starting point, and it could be agreed in square brackets. For PT-RS no agreements in first round, and PT-RS details were also proposed to be left to performance part.*Tentative agreements:*EVM-% from FR2-1 can be re-used for QPSK, 16QAM and 64 QAM.50% EVM window length is used as starting point*Candidate options:*PT-RS for EVM is discussed in performance part.*Recommendations for 2nd round:*Confirm tentative agreements and/or candidate options. |
| **Sub-topic #1-4 Signal quality – EVM measurement period** | Overall the proposal to limit measurement time was well-received but most companies also requested more time to study the details further.*Tentative agreements:*Continue discussion on limiting EVM measurement time in next meeting.*Candidate options:**Recommendations for 2nd round:*Confirm tentative agreement. |
| **Sub-topic #1-5 Signal quality – TAE** | No clear majority supports any proposal and further discussion is clearly needed. *Tentative agreements:**Candidate options:**Recommendations for 2nd round:*Continue discussion in second round.  |
| **Sub-topic #1-6 Emissions – OBUE and ACLR** | Majority view for OBUE is that further analysis is needed and also the dependency to ACLR and possibly also to maximum output power is observed. OBUE for licensed operation has both seen not necessary right now due to missing regulations but in addition also re-use of ETSI BRAN and current FR2 requirement approaches were mentioned.For ACLR there is equal support to use the outcome from TR 38.803 or to wait for the outcome of discussions from thread 139.*Tentative agreements:**Candidate options:*For ACLR, consider TR 38.803 requirements to be used for FR2-2 in case discussion in thread 139 end up being inconclusive.*Recommendations for 2nd round:*For OBUE, discuss opportunities to re-use or adapt either ETSI BRAN or FR2-1 OBUE requirements to be used for FR2-2.For ACLR, discuss further the candidate option. |
| **Sub-topic #1-7 Emissions – Spurious emissions** | There is support for both options, and further discussion on downselection would be useful.*Tentative agreements:**Candidate options:*Option 1: Use FR2 approach with necessary adaptations on step size for spurious emissionsOption 2: Use ETSI EN 303 722 and/or 303 753 for spurious emissions*Recommendations for 2nd round:*Discuss candidate options further. |

### CRs/TPs

No CR or TP submitted.

## 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** |
| R4-2111973 | CATT | **Proposal 1:** Re-use FR2 EISREFSENS\_50M for reference sensitivity declaration for 52.6-71GHz.**Proposal 2:** Re-use the FR2 EISREFSENS\_50M declared range for 52.6-71GHz.**Proposal 3:** Define G-FR2-A1-6 and G-FR2-A1-7 for sensitivity for 400MHz/480kHz and 400MHz/960kHz respectively.**Proposal 4:** Define G-FR2-A1-8 and G-FR2-A1-9 for ICS for 400MHz/480kHz and 400MHz/960kHz respectively.**Proposal 5:** The Simulation assumptions in R4-1801031[2] for FR2 FRC simulation can be as starting point for 52.6-71GHz. |
| R4-2112279 | Nokia, Nokia Shanghai Bell | **Proposal 1:** The BS assumptions and parameters in the approved WF on 60 GHz coexistence, ACLR, and ACS can be used as a starting point for further discussion on the suitable set of operation parameters to decide the specified ranges of reference sensitivity level for NR operation in 52.6 – 71 GHz range.**Proposal 2:** Some FR2 parameters (like modulation and coding rate) can be reused for NR operation in 52.6 – 71 GHz range, while other parameters (like allocated resource blocks) and thus they should be finalized when the parameters they depend on (like maximum SU for each SCS and channel bandwidth combination) are finalized.**Proposal 3:** The results in TR 38.803 can be reused to decide the required ACLR and ACS values for NR operation in 52.6 – 71 GHz range.**Proposal 4:** Use 100MHz channel bandwidth with 120kHz SCS for the ACS and in-band blocking interferer signal for NR operation in 52.6 – 71 GHz range, and reuse DFT-s-OFDM to ease test equipment implementation.**Proposal 5:** ΔfOOB can be specified depending on the bandwidth of the operating band in 52.6 – 71 GHz range.**Proposal 6:** The receiver unwanted emissions in the spurious domain specified in ETSI EN 303 722 and/or ETSI EN 303 753 should be considered for unlicensed NR operation in 52.6 – 71 GHz range at least in Europe.**Proposal 7:** The interferer levels for general receiver intermodulation for NR operation in 52.6 – 71 GHz range can be derived by applying an offset below the in-band blocking levels.**Proposal 8:** Specify the BS ICS requirement as 10dB for NR operation in 52.6 – 71 GHz range. |
| R4-2113317 | Ericsson | **Observation 1:** The antenna gain difference between antenna geometries considered relevant for 52.6 to 71GHz and FR2 is similar**Proposal 1:** Re-use the BS type 2-O concept (including FR2 base station class declared EIS ranges) for OTA reference sensitivity requirement using 50 MHz carrier bandwidth as reference for the frequency range 52.6 to 71 GHz.**Proposal 2:** For OTA reference sensitivity add new FRC for 480 kHz SCS and 400 MHz carrier bandwidth.**Proposal 3:** For OTA reference sensitivity add new FRC for 960 kHz SCS and 400 MHz carrier bandwidth.**Proposal 4:** For OTA reference sensitivity add new FRC for 960 kHz SCS and [2000] MHz (maximum supported) carrier bandwidth.**Proposal 5:** For ACS and in-band blocking re-use interferer signal level from FR2.**Proposal 6:** For ACS and in-band blocking define interferer signal type based on minimum supported carrier bandwidth and sub-carrier spacing.**Proposal 7:** For receiver blocking further consider fOBUE and decide if fOOB needs to be aligned or not.**Proposal 8:** Re-use FR2 receiver spurious emission requirement concept with adaptations for the frequency range 52.6 to 71 GHz. |
| R4-2113923 | ZTE Corporation | **Observation 1**:the existing range specified for EISREFSENS\_50M or EISREFSENS\_100M are both feasible for 52.6-71GHz REFSENS definition. **Proposal 1**: the existing PT-RS configuration in FR2 FRC could also been applied for 52.6-71GHz.**Proposal 2**: for BW with 120kHz SCS, the existing G-FR2-A1-3 could be reused; for BW with 480kHz and 960kHz, new FRCs for minimum BW 400MHz with 480kHz and 400MHz with 960kHz should be defined. **Proposal 3:** to propose to discuss the simulation assumptions for 52.6-71GHz for ACLR/ACS evaluation firstly; **Proposal 4**: 33dB offset from the reference sensitivity for interfering signal of IBB needed to be checked again based on the agreeable simulation assumption for 52.6-71GHz**Proposal 5:** to propose to discuss the simulation assumptions for 52.6-71GHz for ICS IoT level evaluation firstly;  |

## 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: Re-use FR2 EISREFSENS\_50M for reference sensitivity declaration for 52.6-71GHz. (CATT, Ericsson, ZTE)
	+ Option 2: Re-use the FR2 EISREFSENS\_50M declared range for 52.6-71GHz. (CATT, Ericsson, ZTE)
	+ Option 3: The BS assumptions and parameters in the approved WF on 60 GHz coexistence, ACLR, and ACS can be used as a starting point for further discussion on the suitable set of operation parameters to decide the specified ranges of reference sensitivity level for NR operation in 52.6 – 71 GHz range. (Nokia)
* Recommended WF
	+ TBA

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| **Company** | **Comments** |
|  |  |
| CATT | Support option 1-2 and also can see the alignment with co-existence study. |
| Nokia | Propose Option 3; ok with Option 1 and Option 2. |
| Ericsson | We support option 1 and 2. As we showed in R4-2113317 the differences between FR2-1 and FR2-2 will be small and can be handled since the requirement is based on a declared EIS level. |
| ZTE | We support option 1 and 2. |
| Huawei | More time needed to analyze option 1 and 2 implications. Even if the 50MHz FRC is propose to be reused as reference for simplicity reasons, it may create confusion to the reader. 50MHz does not have to be supported by FR2-1 BS, but it is defined for FR2-1, but not for FR2-2. We may need to consider products, which will only support FR2-2.  |
| QCOM | We support option 1. Option2 we are not sure we understand the proposal. We can’t agree values for the range because the parameters need to be determined. If the proposal is to re-use the equation for range and the values are FFS then this document should be updated to make that clear.  |

### Sub-topic 2-2 FRC

**Issue 2-2: FRC**

* Proposals
	+ Option 1: Define [G-FR2-A1-6] and [G-FR2-A1-7] for sensitivity for 400MHz/480kHz and 400MHz/960kHz respectively. (CATT, Ericsson, ZTE)
	+ Option 2: Define G-FR2-A1-8 and G-FR2-A1-9 for ICS for 400MHz/480kHz and 400MHz/960kHz respectively. (CATT)
	+ Option 3: The Simulation assumptions in R4-1801031[2] for FR2 FRC simulation can be as starting point for 52.6-71GHz. (CATT)
	+ Option 4: Some FR2 parameters (like modulation and coding rate) can be reused for NR operation in 52.6 – 71 GHz range, while other parameters (like allocated resource blocks) and thus they should be finalized when the parameters they depend on (like maximum SU for each SCS and channel bandwidth combination) are finalized. (Nokia)
	+ Option 5: Existing G-FR2-A1-3 can be re-used for 120 kHz SCS (ZTE)
	+ Option 6: For OTA reference sensitivity add new FRC for 960 kHz SCS and [2000] MHz (maximum supported) carrier bandwidth. (Ericsson)
	+ Option 7: the existing PT-RS configuration in FR2 FRC could also been applied for 52.6-71GHz. (ZTE)
* Recommended WF
	+ TBA

Due to large number of options comments can concentrate on which FRC are needed and are simulations needed. 2nd round can then concentrate more in details like simulation assumptions and PT-RS configs after the bigger picture is clear.

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| **Company** | **Comments** |
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| CATT | We think option 1-7 are reasonable. |
| Nokia | Propose Option 4; for Option 3, L1 parameters for 480 and 960 kHz SCS like TBS needs to be checked against RAN1 decision; for Option 7, PT-RS configuration should wait for and align with RAN1 decision. |
| Ericsson | We prefer option 1, 5 and 6. With this we have the basic tools in term of FRC needed. When new FRC(s) are designed its appropriate to follow the FR2 concepts as far as possible. |
| ZTE | It might be no urgent to agree on this FRC since RAN1 input, SU input are necessary. |
| Huawei | Option 1/2 seems to repeat agreement from previous meeting – there is not much values in agreeing FRC’s name (number).Similar for Option 5.Option 4 requires more clarification to be more specific.Option 6 needs to wait for the conclusions on the max CBW.Agree with ZTE that there is no urgency on FRC. |
| QCOM | We are ok with the listed options. For option 6, recall that in the ongoing coexistence work for 60GHz (i.e., thread 139), we agreed on considering 120KHz for 100MHz and 960KHz for 400MHz.  |

### Sub-topic 2-3 ACS and in-band blocking

**Issue 2-3: ACS and in-band blocking**

* Proposals
	+ Option 1: The results in TR 38.803 can be reused to decide the required ACLR and ACS values for NR operation in 52.6 – 71 GHz range. (Nokia)
	+ Option 2: Use 100MHz channel bandwidth with 120kHz SCS for the ACS and in-band blocking interferer signal for NR operation in 52.6 – 71 GHz range, and reuse DFT-s-OFDM to ease test equipment implementation. (Nokia, Ericsson)
	+ Option 3: ΔfOOB can be specified depending on the bandwidth of the operating band in 52.6 – 71 GHz range. (Nokia)
	+ Option 4: For receiver blocking further consider ΔfOBUE and decide if ΔfOOB needs to be aligned or not. (Ericsson)
	+ Option 5: to propose to discuss the simulation assumptions for 52.6-71GHz for ACLR/ACS evaluation firstly (ZTE)
		- *Moderator comment: The discussion on necessity on simulation and the assumptions is takin place in parallel in thread 139*
	+ Option 6: 33dB offset from the reference sensitivity for interfering signal of IBB needed to be checked again based on the agreeable simulation assumption for 52.6-71GHz (ZTE)
		- *Moderator comment: The discussion on necessity on simulation and the assumptions is takin place in parallel in thread 139*
* Recommended WF

Use 100MHz channel bandwidth with 120kHz SCS for the ACS and in-band blocking interferer signal for NR operation in 52.6 – 71 GHz range, and reuse DFT-s-OFDM to ease test equipment implementation

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| **Company** | **Comments** |
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| CATT | Wait the co-existence simulation discussion. |
| Nokia | Propose Option 3; for Option 6, any suggestion on what metric to use to further check 33dB offset for IBB? |
| Ericsson | We support option 1 and 4 as a starting point, maybe we need to do small adaptations to consider larger bandwidths as for ACLR. Regarding the exclusion zone, we need to consider that very large bands and very wide carriers will be defined, which will have impact on the exclusion zone size. Before we have aligned fOBUE and fOOB, which may be reasonable here too. |
| ZTE | Fine with option 2 for interfering signal type, for ACS and IBB interfering signal power level, this should depend on the coexistence study. |
| Huawei | Same comments as for ACLR – there is coex discussion in parallel…Option 4 seems ok. |
| QCOM | Support option 5. Thread 139 is currently discussing ACS requirements.  |

### Sub-topic 2-4 Spurious emissions

**Issue 2-4: Spurious emissions**

* Proposals
	+ Option 1: The receiver unwanted emissions in the spurious domain specified in ETSI EN 303 722 and/or ETSI EN 303 753 should be considered for unlicensed NR operation in 52.6 – 71 GHz range at least in Europe. (Nokia)
	+ Option 2: Re-use FR2 receiver spurious emission requirement concept with adaptations for the frequency range 52.6 to 71 GHz. (Ericsson)
* Recommended WF

TBA

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| **Company** | **Comments** |
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| CATT | Option 1 and 2 are reasonable, the detail requirements needs more study. |
| Nokia | Propose Option 1; for Option 2, it is not clear what adaptions are required for receiver spurious emission requirement, similar to transmitter spurious emission requirement? |
| Ericsson | We prefer option 2. For FR2 we decided to have the same emission requirement for TX and RX since for an AAS BS using TDD, RX and TX emission cannot really be separated. This is in line with the latest revision of ERC Recommendation 74-01 (2019). We need to check if this alignment exits in ETSI. If not, we need to understand why. For this reason, we prefer to re-use FR2 concept and align TX and RX spurious emission requirements. |
| ZTE | Fine with option 2 as starting point. |
| Huawei | Both option 1 and 2 sounds reasonable. Spur is based on regulatory limits (e.g. SM.329, or other ECC decision) – so this shall be rather straightforward. For option 1: those “adaptations” were band-specific so far – probably this requires clarification.  |
| QCOM | For option 1 ‘should be considered’ we agree with that. Should be considered means that we should ensure our requirements meets or exceeds that requirement. For option 2 we are ok with that. |

### Sub-topic 2-5 Others

**Issue 2-5: Others**

* Proposals
	+ Option 1: The interferer levels for general receiver intermodulation for NR operation in 52.6 – 71 GHz range can be derived by applying an offset below the in-band blocking levels. (Nokia)
	+ Option 2: Specify the BS ICS requirement as 10dB for NR operation in 52.6 – 71 GHz range. (Nokia)
	+ Option 3: discuss the simulation assumptions for 52.6-71GHz for ICS IoT level evaluation firstly (ZTE)
* Recommended WF

TBA

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| **Company** | **Comments** |
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| CATT | More analysis is needed. |
| Nokia | Propose Option 1 and Option 2; for Option 3, we see no need to perform further simulation. |
| Ericsson | We prefer option 1, Regarding option 2 we need some further discussions on the offset value. 10 dB is probably a good starting point, but further analysis is required. |
| ZTE | For RX IMD, we are fine with option 1;For RX ICS, we would like to further analyze based on agreed simulation assumption. |
| Huawei | More analysis is needed. |
| QCOM | We need further study |

### CRs/TPs comments collection

No CR or TP submitted.

## 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#2-1****EIS** | There is majority support to re-use FR2 EISREFSENS\_50M sensitivity declaration. Some companies request further clarifications which can be worked out in 2nd round.*Tentative agreements:*Re-use FR2 EISREFSENS\_50M sensitivity declaration, i.e. BS sensitivity for FR2-2 is declared based on 50 MHz reference and allowed power level to be declared for each class is according to TS 38.104, clause 10.3.3*Candidate options:**Recommendations for 2nd round:*Confirm tentative agreement and discuss necessary clarifications further in 2nd round in the WF. |
| **Sub-topic#2-2****FRC** | There is no convergence on FRCs to build on top of agreements from previous meeting, as further agreements appear to be pending on further agreements in system parameters. However, there was some support to re-use the exact FRC from FR2-1 for 120 kHz also in FR2-2 so that is listed as candidate option to be confirmed in 2nd round.*Tentative agreements:**Candidate options:*Existing G-FR2-A1-3 can be re-used for 120 kHz SCS*Recommendations for 2nd round:*Discuss candidate option in WF in 2nd round |
| **Sub-topic#2-3****ACS and in-band blocking** | There is no convergence on ACS and in-band blocking, some companies also see dependency on discussions taking place in thread 139*Tentative agreements:**Candidate options:**Recommendations for 2nd round:*Aim for further progress in the WF |
| **Sub-topic#2-4****Spurious emissions** | Both options receive support and further discussion is needed to downselect.*Tentative agreements:**Candidate options:*Option 1: Use FR2 approach with necessary adaptations on step size for spurious emissionsOption 2: Use ETSI EN 303 722 and/or 303 753 for spurious emissions*Recommendations for 2nd round:*Discuss candidate options further. |
| **Sub-topic#2-5****Others** | For other proposals more analysis is needed. Three companies supported option 1, which is listed as candidate option.*Tentative agreements:**Candidate options:*The interferer levels for general receiver intermodulation for NR operation in 52.6 – 71 GHz range can be derived by applying an offset below the in-band blocking levels.*Recommendations for 2nd round:*Discuss candidate option in WF in 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”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
|  |  |  |
|  |  |  |
| WF on BS TX RF requirements | Nokia, Nokia Shanghai Bell |  |
| WF on BS RX RF requirements | Ericsson |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation**  | **Comments** |
|  |  |  |  |  |
| R4-2111749 | Discussion on limitation of the measurement interval for the determination of the averaged EVM for FR2-2 and possible test time improvements | ROHDE & SCHWARZ | Noted |  |
| R4-2111972 | Discussion on BS TX RF requirements for 52 6-71GHz | CATT | Noted |  |
| R4-2112278 | Proposals on BS transmitter requirements for extending current NR operation to 71 GHz | Nokia, Nokia Shaghai Bell | Noted |  |
| R4-2113316 | On BS RF transmitter requirements for the frequency range 52 to 71 GHz | Ericsson | Noted |  |
| R4-2113857 | Discussion on the OBUE mask boundary for 52.6 - 71 GHz | NEC | Noted |  |
| R4-2113922 | Discussion on BS Tx requirements for 60GHz | ZTE Corporation | Noted |  |
| R4-2111973 | Discussion on BS RX RF requirements for 52 6-71GHz | CATT | Noted |  |
| R4-2112279 | Proposals on BS receiver requirements for extending current NR operation to 71 GHz | Nokia, Nokia Shanghai Bell | Noted |  |
| R4-2113317 | On BS RF receiver requirements for the frequency range 52 to 71 GHz | Ericsson | Noted |  |
| R4-2113923 | Discussion on BS Rx requirements for 60GHz | ZTE Corporation | Noted |  |

Notes:

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

## 2nd round

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