**3GPP TSG-RAN WG4 Meeting # 102-e R4-2207156**

**Electronic Meeting, 21 February – 03 March 2022**

**Agenda item:** 10.5.3

**Source:** Moderator (Huawei)

**Title:** Email discussion summary for [102-e][306] NR\_Repeater\_RF\_Part2

**Document for:** Information

# Introduction

This topic is spit into 3 sub topics as per the agenda and an additional topic to cover the TP’s submitted for the TS drafting.

* 1. Tx power
  2. Radiated emissions
  3. Other RF
  4. TP’s

This topic was discussed on the 1st day on the meeting in GTW (21/2/22) before any 1st round comments were received. As such some of the open issues are already resolved or the options reduced. The discussion document has been updated to cover these agreements. So only open issues require companies to contribute further.

# Topic #1: Tx Power

There is a single conribution with a proposal on clarifcations for the TX and Rx OTA directions.

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2205030 | Ericsson | **Observation 1:** It is difficult to link a Tx beam directions declaration with an RX AoAoA because the beam peak directions and RoAoA are different concepts, except for the reference direction.  **Proposal 1:** For repeater requirements, the input signal for DL should be the same as the reference direction for UL TX and vice versa. No further input directions declared for Rel-17. |

## Open issues summary

There is only 1 issue for the TX power topic addressing the OTA directions declarations.

### Sub-topic 1-1 – OTA directions

Some clarifications on the agreements on OTA directions from last meeting are proposed.

**Issue 1-1: OTA directions declarations**

* Proposals
  + Option 1: For repeater requirements, the input signal for DL should be the same as the reference direction for UL TX and vice versa. No further input directions declared for Rel-17.
  + Option 2: TBA
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 1-1 – OTA directions

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

### CRs/TPs comments collection

TP’s are handled together in topic#4

## 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

TP’s are handled together in topic#4

## Discussion on 2nd round (if applicable)

# Topic #2: Radiated Emissions

The radiated emission contributions concentrate on inside passband OBUE

## Companies’ contributions summary

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| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2204549 | NTT Docomo | **Observation 1:** For FR1, it was agreed the nominal channel bandwidth equals to [min (100MHz, passband bandwidth)].  **Observation 2:** The adjacent channel centre frequency offset can be covered by passband as nominal channel if the transmitted channel is single and occupies whole passband.  **Observation 3:** Repeaters don’t recognize whether transmitting signal is single channel.  **Proposal 1:** RAN4 use min (400MHz, passband bandwidth) to determine nominal channel bandwidth. |
| R4-2204561 | CMCC | **Proposal 1:** the channel bandwidth for FR2 UL ACLR/CACLR is suggested as *Min (BW of the highest or lowest carrier in the edge of passband, passband bandwidth)*.  **Observation 1:** the principle to define inside OBUE is to choose the more stringent limit between gNB OBUE and ACLR. Here the ACLR is the more relax one between relative ACLR and absolute ACLR.  Table 3: inside OBUE limits for 24.25-33.4GHz   |  |  |  |  | | --- | --- | --- | --- | | Prated,t,TRP  assuming 400MHz BW | Inside OBUE  dBm/MHz | | | | WA | MR | LA | | <23 | -20 | -20 | -20 | | 23~30 | P-43 | -20 | -20 | | 30~34 | -13 | -20 | -20 | | 34~41 | -13 | -13 | -13 | | >41 | -13 | -13 | -13 |   Table 4: inside OBUE limits for 37-52.6GHz   |  |  |  |  | | --- | --- | --- | --- | | Prated,t,TRP  assuming 400MHz BW | Inside OBUE  dBm/MHz | | | | WA | MR | LA | | <21 | -20 | -20 | -20 | | 21~28 | P-41 | -20 | -20 | | 28~32 | -13 | -20 | -20 | | 32~39 | -13 | -13 | -13 | | >39 | -13 | -13 | -13 |   **Proposal 2:** it’s suggested to define inside OBUE as in above table 3 and table 4 for DL.  **Proposal 3:** it’s suggested to reuse the same approach to define inside OBUE as conducted part for UL. |
| R4-2205029 | Ericsson | **Proposal 1:** For FR2, set the “Passband emissions” requirement to be -13dBm/MHz for all repeater classes and both DL and UL. |
| R4-2205973 | Huawei | **Proposal 3:** Use the BS OBUE limits for the FR2 inside passband OBUE limits. |

## Open issues summary

There are 2 issues connected to emissions, the nominal channel BW and the OBUR requirement.

### Sub-topic 2-1 – Nominal channel BW

2 proposals for nominal channel BW were proposed.

**Issue 2-1: Nominal channel BW**

* Proposals
  + Option 1: min (400MHz, passband bandwidth) to determine nominal channel bandwidth.
  + Option 2: min (BW of the highest or lowest carrier in the edge of passband, passband bandwidth).
* Recommended WF
  + TBA

Issue was discussed in GTW (21/2/22) and agreement reached (option1 here). No need to further discuss in this topic area (or at all).

### Sub-topic 2-2 – OBUE value

There are 3 proposals for the level requirement for OBUE (with no input signal)

**Issue 2-2: OBUE level**

* Proposals
  + Option 1: More stringent between OBUE and ACLR (based on nominal BW) UL and DL
  + Option 2: -13dBm/MHz all classes UL and DL (i.e. WA BS OBUE limit)
  + Option 3: Use class dependent BS OBUE limits
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 2-1 – Nominal channel BW

Nominal channel BW was discussed in GTW (21/2/22) under issue 3-2-1 and an agreement was made. No need to further discuss under this topic in 1st round.

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Sub topic 2-2 - OBUE level

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

### CRs/TPs comments collection

TP’s are handled together in topic#4

## 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** | GTW agreement reached under issue 3-2-1 the nominal channel BW is min (400MHz, passband bandwidth) |
| **Sub-topic#2-2** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

### CRs/TPs

TP’s are handled together in topic#4

## 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: Other RF requirements

There are a couple of other RF requirements in this topic area

* + OOB gain and ACRR
  + EVM
  + Inputs IMD

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203946 | CATT | **Observation 1:** BS OBUE requirements are absolute power level which leads different rejection level for different CBW with same output power.  **Observation 2:** BS OBUE performance is dominated by the digital filter, so the frequency offset is not proper to be used for RF repeater.  **Proposal:** Use Option 2: Half of minimum CHBW supported by bands i.e. 25MHz to define FR2 out of band gain requirement. |
| R4-2205028 | Ericsson | **Proposal 1:** Adopt option 2, with maximum gain above the cutoff 60dB, under the assumption that the ACRR baseline assumption is confirmed.  **Proposal 2:** For the minimum power at which EVM is valid, follow the same approach as FR1. |
| R4-2205466 | ZTE | **Proposal 1:** to support option 1 with modulated signal to 50MHz;  **Proposal 2:** in-band gain for FR2 could be 80dBc at most;  **Proposal 3:** to specify the OOBB limit for FR2 as following:  Table 1: Out of band gain limits   |  |  | | --- | --- | | Frequency offset, f\_offset\_CW | Maximum gain | | 0.1\*BWcontiguous ≤ Δf < ΔfB | 65 dB | | ΔfB ≤ Δf < Δfmax | 57dB | | NOTE 1: ΔfB = 2\*BWcontiguous when BWcontiguous ≤ 500 MHz, otherwise ΔfB = BWcontiguous + 500 MHz. | |   For Δfmax ≤ f\_offset\_CW the out of band gain shall not exceed the maximum gain of table 2 or the maximum gain stated in table 1 whichever is lower.  Table 2: Out of band gain limits 2   |  |  | | --- | --- | | Frequency offset, f\_offset\_CW | Maximum gain | | Δfmax ≤ f\_offset\_CW | Out of band gain ≤ minimum donor coupling loss |     **Proposal 4: to specify the OOBB limit for FR2 as following:**   |  |  |  |  | | --- | --- | --- | --- | | Co-existence with other systems | Repeater maximum output power | Channel offset from the centre frequency of the first or last 50MHz channel within the pass band. | ACRR limit | | NR | Declared maximum output power | 50 MHz | 28 (Note 1)  26 (Note 2) | | Declared maximum output power | 100 MHz | 28 (Note 1)  26 (Note 2) | | NOTE 1: Applicable to bands defined within the frequency spectrum range of 24.25 – 33.4 GHz.  NOTE 2: Applicable to bands defined within the frequency spectrum range of 37 – 52.6 GHz. | | | | |
| R4-2205972 | Huawei | **Proposal 1:** The BS FR2 OBUE offset is used for the frequency offset i.e. 0.1\* BWcontiguous  **Proposal 2:** For WA and MR OOB gain id 55dB  **Proposal 3:** For LA OOB gain is 45dB  **Proposal 4:** Use the baseline assumption ACRR equals ACLR |
| R4-2205973 | Huawei | On EVM  **Proposal 1:** Rx antenna gain is a declarable parameter (with the same limits as the BS)  **Proposal 2:** The minimum power EVM requirement is as follows:  The EVM requirement is valid from the input level that produces the maximum *rated output power* (Prated,in) to the minim input power for a 5MHz channel shown in table x.x-1  Table : x.x-1 Minimum input power for EVM   |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | BS class | Minimum input power for a 50MHz channel (dBm) | | | | | | | 24.25 – 33.4 GHz | | | 37 – 52.6 GHz | | | | Up to 16 QAM | 64QAM note 1 | 256QAM note 2 | Up to 16 QAM | 64QAM note 1 | 256QAM note 2 | | WA, MR, LA | -64- GRX\_ANT | -60- GRX\_ANT | -53- GRX\_ANT | -62- GRX\_ANT | -58- GRX\_ANT | -51- GRX\_ANT | | Note 1: 64 QAM optional by manufacturers declaration  Note 2: 256 QAM optional by manufacturers declaration | | | | | | |   For input IMD  **Proposal 4:** Use 2 CW signals to specify input IMD  **Proposal 5:** the FR2 input IMD power level is -53 dBm - GANT\_RX |
| R4-2206046 | Nokia | **Observation 1:** In maximum output power case thermal noise has minor impact on EVM with the given assumptions (40 dBm EIRP output power, 80 dB gain, 400 MHz bandwidth)  **Proposal 1:** Specify 16QAM EVM of 12.5% to be applicable down to -74 dBm/MHz input PSD levels, excluding repeater antenna gain.  **Observation 2:** Reasonable selection for separation distance and antenna configurations needs to be done when deriving the OOB gain requirement.  **Proposal 2:** Take full antenna gain into account when deriving OOB gain requirement.  **Proposal 3:** Sufficiently large frequency offsets need to be set before tightening of the OOB gain requirement in FR2.  **Proposal 4:** Consider using mask in table 6 for discussion for OOB gain in FR2-1.  Table 6: Proposed OOB gain for FR2-1   |  |  | | --- | --- | | Frequency offset, f\_offset\_CW | Maximum gain | | 50 MHz  f\_offset\_CW < 150  150 MHz  f\_offset\_CW < 400  400 MHz  f\_offset\_CW < f\_offset\_max | 68 dB  55 dB  35 dB |   **Observation 3:** Proposal 4 does not take into account other signal sources than donor BS and does not guarantee protection immediately outside passband, and therefore there is a risk that the requirements are not stringent enough.  **Proposal 5:** Apply same requirement also for uplink  **Proposal 6:** ACRR in FR2 is set to 28 dB at 28 GHz and 26 dB at 39 GHz.  **Proposal 7:** ACRR is specified over 400 MHz bandwidth immediately adjacent to repeater passband.  **Proposal 8:** Apply same requirement also for uplink |

## Open issues summary

In this Topic we look at the OOB gain, ACRR , min power EVM and the input IMD requirements.

### Sub-topic 3-1 – OOB gain

2 proposals for nominal channel BW were proposed.

**Issue 3-1-1: OOB gain Frequency offset (lowest breakpoint)**

Both the options in the WF from last meeting remain in the submitted contributions.

* Proposals
  + Option 1: Half of minimum CHBW supported by bands i.e. 25MHz
  + Option 2: The BS FR2 OBUE offset is used for the frequency offset i.e. 0.1\* BWcontiguous
  + Option 3: 50MHz
* Recommended WF
  + TBA

GTW discussion:

Agreement:

0.1\*Minimum {400MHz, passband BW}

**Issue 3-1-2: OOB gain below lowest Frequency offset (lowest breakpoint)**

* Proposals
  + Option 1: No limit
  + Option 2: TBA
* Recommended WF
  + TBA

Agreement: option 1: No limit

**Issue 3-2-4: OOB limits**

It was discussed in GTW that the number of breakpoints and the limits should be discussed together as such issue 3-2-3 and 3-2-4 are merged.

* Proposals
  + Option 2: 65 then 57dB (ZTE)
  + Option 4: 68dB/55dB/35dB Nokia (150MHz, 400MHz as 2nd, 3rd breaking points)
* Recommended WF
  + TBA

Agreement: Further discuss among option 2 and option 4.

**Issue 3-2-5: OOB in UL**

* Proposals
  + Option 1: Apply same OOB gain limit in U (as DL)
  + Option 2: TBA
* Recommended WF
  + TBA

### Sub-topic 3-2 – ACRR

**Issue 3-2-1: ACRR value**

* Proposals
  + Option 1: 28/26 dB (28GHz/39GHz) i.e, same as BS ACLR
  + Option 2: TBA
* Recommended WF
  + TBA

GTW discussion:

ZTE: What’s the assumption of 1st and 2nd adjacent channel BW for ACRR?

Agreement:

ACRR values: Option 1: 28/26 dB (28GHz/39GHz) i.e, same as BS ACLR

ACRR range: ACRR is specified over minimum {400MHz, passband BW} immediately adjacent to repeater passband.

**Issue 3-2-2: ACRR range**

* Proposals
  + Option 1: ACRR is specified over 400 MHz bandwidth immediately adjacent to repeater passband.
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 3-2-3: ACRR in UL**

* Proposals
  + Option 1: ACRR in UL same as DL
  + Option 2: TBA
* Recommended WF
  + TBA

Agreement:

For WA: same as DL side i.e. same as BS ACLR

For LA: same as UE ACLR

### Sub-topic 3-3 – EVM

**Issue 3-3-1: Minimum Power for EVM**

There are a number of values proposed which vary due to some different assumptions in the calculations which are difficult to list as proposals. The major difference between the Nokia and Huawei calculation seems to be the distribution of EVM degradation (50% vs 20%), Ericsson propose to follow the method used for FR1.

* Proposals
  + Option 1: Follow same approach as FR1.
  + Option 2: TBA
* Recommended WF
  + Wait for agreement on FR1 and calculate appropriate FR2 values

**Issue 3-3-2: Antenna gain for EVM**

* Proposals
  + Option 1: EVM value excludes antenna gain (antenna gain is declarable parameter)
  + Option 2: TBA
* Recommended WF
  + TBA

### Sub-topic 3-4 – Input IMD

**Issue 3-4-1: Input IMD signals**

* Proposals
  + Option 1: Use 2 CW signals to specify input IMD
  + Option 2: TBA
* Recommended WF
  + TBA

**Issue 3-4-2: Input IMD Power level**

* Proposals
  + Option 1: FR2 input IMD power level is -53 dBm - GANT\_RX
  + Option 2: TBA
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

Sub topic 3-1 – OOB gain

OOB gain was discussed in G+TW (21/2/22) only modified issue 2-2-4 remains to be further discussed in 1st round.

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| **Company** | **Comments** |
| XXX | Issue 3-2-4: OOB limit |

Sub topic 3-2 – ACRR

ACRR issue were agree in GTW (21/2/22) no need to further discuss in 1st round.

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Sub topic 3-2 - EVM

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| **Company** | **Comments** |
| XXX | Issue 3-3-1: Minimum Power for EVM:  Issue 3-3-2: Antenna gain for EVM: |

Sub topic 3-4 – Input IMD

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| **Company** | **Comments** |
| XXX | Issue 3-4-1: Input IMD signals:  Issue 3-4-2: Input IMD Power level: |

### CRs/TPs comments collection

TP’s are handled together in topic#4

## Summary for 1st round

### Open issues

Some agreements reached in GTW 21/2/22 1st round discussion continues after the GTW

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|  | **Status summary** |
| **Sub-topic#3-1-1** | GTW Agreement : OOB gain Frequency offset (lowest breakpoint) is 0.1\*Minimum {400MHz, passband BW} |
| **Sub-topic#3-1-2** | GTA Agreement : No OOB limit below the frequency breakpoint |
| **Sub-topic#3-1-4** |  |
| **Sub-topic#3-2-1** | GTW Agreement:  ACRR values: Option 1: 28/26 dB (28GHz/39GHz) i.e, same as BS ACLR |
| **Sub-topic#3-2-2** | GTW Agreement: ACRR range: ACRR is specified over minimum {400MHz, passband BW} immediately adjacent to repeater passband. |
| **Sub-topic#3-2-3** | GTW Agreement:  For WA: same as DL side i.e. same as BS ACLR  For LA: same as UE ACLR |
| **Sub-topic#3-3** |  |
| **Sub-topic#3-4** |  |

### CRs/TPs

TP’s are handled together in topic#4

## 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 #4: Radiated Emissions

There are 4 TP’s submitted by the allocated section authors for TS drafting which have been grouped in this topic.

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2204560 | CMCC | TP to TS 38.106 radiated EVM and input IMD |
| R4-2205204 | Nokia | TP to TS 38.106 clause 7.5 Unwanted emissions radiated |
| R4-2205467 | ZTE | TP to TS 38.106 clause 9.9 ACRR requirement |
| R4-2205974 | Huawei | TP to TS 38.106 clause 9.1 and 9.2 |

## Open issues summary

Only TP’s are discussed in this topic area, no issues list is provided.

### CRs/TPs comments collection

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| R4-2204560 | Company A |
| Company B |
|  |
| R4-2205204 | Company A |
| Company B |
|  |
| R4-2205467 | Company A |
| Company B |
|  |
| R4-2205974 | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

Only TPs are discussed in this topic area.

### CRs/TPs

TP’s are handled together in topic#4

## 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** |
| R4-22xxxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-2203946 | Discussion on out of band gain and ACRR requirements for FR2 | CATT |  |  |
| R4-2204549 | Views on the ACLR requirements for NR repeater for FR2 | NTT DOCOMO, INC. |  |  |
| R4-2204560 | TP to TS 38.106 radiated EVM and input IMD | CMCC |  |  |
| R4-2204561 | Discussion on repeater emission related radiated requirements | CMCC |  |  |
| R4-2205028 | Repeaters radiated requirements | Ericsson |  |  |
| R4-2205029 | Repeaters radiated emissions requirements | Ericsson |  |  |
| R4-2205030 | Repeater radiated power requirements | Ericsson |  |  |
| R4-2205204 | TP to TS 38.106 clause 7.5 Unwanted emissions radiated | Nokia, Nokia Shanghai Bell |  |  |
| R4-2205466 | Further discussions on other requirements of radiated repeater | ZTE Corporation |  |  |
| R4-2205467 | TP to TS 38.106 clause 9.9 ACRR requirement | ZTE Corporation |  |  |
| R4-2205972 | Repeater FR2 OOB gain and ACRR | Huawei |  |  |
| R4-2205973 | Repeater FR2 other RF | Huawei |  |  |
| R4-2205974 | TP to TS 38.106 clause 9.1 and 9.2 | Huawei |  |  |
| R4-2206046 | EVM, OOB gain and ACRR for FR2 NR Repeaters | Nokia, Nokia Shanghai Bell |  |  |

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** |
| R4-22xxxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-22xxxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-22xxxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

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

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email address** |
| Huawei | Richard Kybett | richard.kybett@huawei.com |

Note:

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