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

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

**Agenda item:** 10.9.3

**Source:** Moderator (Nokia, Nokia Shanghai Bell)

**Title:** Email discussion summary for [102-e][212] NR\_HST\_FR2\_RRM\_1

**Document for:** Approval

# Introduction

*Briefly introduce background, the scope of this email discussion (e.g. list of treated agenda items) and provide some guidelines for email discussion if necessary.*

*List of candidate target of email discussion for 1st round and 2nd round*

* 1st round: TBA
* 2nd round: TBA

## Background and scope

This T-doc will be used to guide and summarize the email discussion for the topic of Rel-17 NR HST FR2 enhancements RRM core requirements, with the email thread identifier “[102-e][212] NR\_HST\_FR2\_RRM\_1”.

In this email thread, the following agenda items are discussed:

* 10.9.4 RRM core requirements
  + 10.9.3.1 General
  + 10.9.3.2 RRC Idle/Inactive and connected state mobility requirements
  + 10.9.3.4 Signalling characteristics requirements
  + 10.9.3.5 Measurement procedure requirements

The following WFs were approved previously:

* R4-2103679, WF on Rel-17 NR HST FR2 enhancements, RRM requirements, Nokia, Nokia Shanghai Bell, RAN4#98-e.
* R4-2105794, WF on FR2 HST RRM requirements, Nokia, Nokia Shanghai Bell, RAN4#98-bis-e.
* R4-2115334, WF on FR2 HST RRM requirements (part 1), Nokia, Nokia Shanghai Bell, RAN4#100-e.
* R4-2115335, WF on FR2 HST RRM requirements (part 2), Samsung, RAN4#100-e.
* R4-2120292, WF on FR2 HST RRM requirements (part 1), Nokia, Nokia Shanghai Bell, RAN4#101-e.
* R4-2120416, WF on FR2 HST RRM requirements (part 2), Samsung, RAN4#101-e.
* R4-2202594, WF on FR2 HST RRM (part 1), Nokia, Nokia Shanghai Bell, RAN4#101-bis-e.
* R4-2202767, WF on FR2 HST RRM (part 2), Samsung, RAN4#101-bis-e.

As a moderator for FR2 HST enhancements RRM discussion, we would like to suggest the following candidate target of 1st and 2nd round email discussion:

* 1st round:
  + Converge in the most critical open issues, such as 1-1-1 Lightweight network assisting signaling, 2-2-1, Time period for PSS/SSS detection, 2-3-2 Interference at TCI switching.
  + Collect comments on the draft CRs so that they could be revised in the most efficient way in the 2nd round.
* 2nd round:
  + Achieve agreements on the open issues as much as possible since it is the last RAN4 meeting on NR\_HST\_FR2\_Core requirements.
  + Endorse as many draftCRs as possible to combine those in the bigCR for the post-meeting endorsement.

## Email discussion guidelines

The moderator would like to ask companies to adhere to the following guidelines, when taking part in [102-e][212] NR\_HST\_FR2\_RRM\_1.

Please also check the “RAN4#102-e meeting arrangements and guidelines”, available on the reflector, for fundamental guidelines and deadlines.

The preferred method of commenting is to add/update your company’s view directly in this email summary document (use change marks whenever appropriate) and upload it to [102 -e][212] NR\_HST\_FR2\_RRM\_1 draft folder corresponding to the stage of the meeting, e.g., pre-meeting, first round, second round.

* Draft folder:  
  [[102 -e][212] NR\_HST\_FR2\_RRM\_1](https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_102-e/Inbox/Drafts/%5B102-e%5D%5B212%5D%20NR_HST_FR2_RRM_1)  
  <https://www.3gpp.org/ftp/tsg_ran/WG4_Radio/TSGR4_102-e/Inbox/Drafts/%5B102-e%5D%5B212%5D%20NR_HST_FR2_RRM_1>
* It is expected that delegates will download the latest version (including other companies’ versions) of the summary document, insert comments and upload it again.
* To ensure the comments are captured timely and correctly, delegates are encouraged to:
  + Rename the file by adding your company name and changing the file version.  
    Example: “Summary\_212\_HST\_FR2\_RRM\_1\_v0\_1st\_round\_**v05\_CATT\_Nokia**.docx” -> “Summary\_212\_HST\_FR2\_RRM\_1\_v0\_1st\_round\_**v06\_Nokia\_QC**.docx”
  + There is no need to send e-mails in the reflector when comments in the summary are added.
  + Please, check for updated base document versions, right before uploading your updates.
* Please, do not hesitate to mark your company as supporting a certain option directly in this document.  
  Please refrain from rewriting existing options and proposed WFs; ask the moderator (in your company’s comment) to modify/add.
* It is encouraged to give a short reasoning for each view expressed (1-2 sentences are recommended).  
  Please avoid statements like “Option X”, without further explication or reasoning.
* **Please, update your company contact information in the Annex.**It is also recommended to explicitly mention delegate’s name next to company name in the comments if multiple delegates from the same company are commenting.  
  An alternative way is to identify different delegates in the Track changes username.

# Topic #1: General

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203711 | Qualcomm, Inc. | **On NR FR2 HST RRM Requirements**  **Proposal 1**: Capture the following description of set 1 requirements applicability in TR:  When 2Rx beam sweep based requirement (set 1) applies to the deployment scenario with Dmin > 10m or Hdiff (height difference between train rooftop mounted CPE and RRH) > 10m, performance degradation is expected.  **Proposal 2**: Add a MAC-CE command to inform UE of the TCI state switch is across RRH and send an LS to RAN2.  [Moderator]: Observation 1 – Observations 3 below shall be treated in RRM-2.  **Observation 1**: The proposed aperiodic L1-RSRP request can prevent false alarm and miss detection in large DL timing detection by enabling UE to use the updated SSB timing from the latest SSB occasion instead of stale SSB timing from SSB detection.  **Observation 2**: The aperiodic L1-RSRP report approach for enabling large timing adjustment is more efficient than RACH procedure from throughput impact and network/UE implementation perspective.  **Proposal 3**: Apply the following procedure to cross-RRH TCI state switch:   * Network schedules an aperiodic L1-RSRP report to trigger DL timing difference detection before cross-RRH TCI state switch. * RAN4 imposes UL and DL scheduling restriction after cross-RRH TCI state switch before first TRS reception. UE performs the large UL timing adjustment on the first UL transmission after the first TRS reception, and this timing adjustment is allowed to exceed the Tq requirement in 38.133 clause 7.1.2.1.   The text proposal for capturing the above procedure in RAN4 spec is in draft CR[4].  **Observation 3**: Propagation delay difference between two RRHs can cause large UL to DL interference when two UEs are close two each other and an RRH.  **Proposal 4**: Network applies different offsets to DL frame boundaries of different RRHs to pre-compensate the propagation delay difference across different RRHs to eliminate UL to DL interference across UEs. Network then inform UE the TA change needed after TCI state change across RRHs.  [Moderator]: Proposal and observation below are treated in Topic#2.  **Observation 4**: The additional pathloss for option 2 (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps =24) is within 5dB and SINR is kept above 10dB during the cell identification time, which is more than sufficient to maintain connection.  **Proposal 5**: For FR2 HST neighboring cell search enhancement, set scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) equal 10 for Set 1 and 24 for Set 2.  **Proposal 6**: Introduce a UE capability for one shot large UL timing adjustment.  **LS Draft (TCI State Switch Across RRHs)** |
| R4-2203714 | Qualcomm, Inc. | **TP to TR 38.854 on the Number of Rx beams** |
| R4-2203898 | CATT | **Discussion on general issues for FR2 HST**  **Proposal 1**: We slightly prefer to have the network assisted signalling of SSB index and order per RRH, if Rel-17 schedule is allowed.  **Proposal 2**: Power class shall be used to identify the feature support. From RRM perspective, Per-UE type is enough. But for RF and demod feature, it depends on conclusion from other session. |
| R4-2204715 | Ericsson | **General requirements for HST FR2**  **Proposal 1**: Only list or highlight benchmark of performance obtained when Dmin = [10] m, but don’t note performance difference or degradation when Dmin > [10] m.  **Proposal 2**: Support Option 3: Introduce inter-RRH indication, because of easy implementation.  **Proposal 3**: In Rel-17, Configure a different mobility parameter, e.g., offset in HO and BM for opposite direction to abbreviate SNR drop duration. Further enhancement can be studied in next release.  **Proposal 4**: Power class can be used to identify the feature support at least in Rel17.  **Proposal 5**: Because the UE type in FR2 HST scenario only comprises FR2 CPE type, per UE is enough. |
| R4-2204720 | Ericsson | **LS on network signalling for Rel-17 NR HST RRM** |
| R4-2204721 | Ericsson | **draft CR On RRC\_CONNECTED state mobility for HST FR2 RRM** |
| R4-2205008 | ZTE Corporation | **General RRM requirements for HST FR2**  **Proposal 1**: The applicability restriction of 2 Rx beam requirements is necessary. For the detailed range of Dmin, a typical value such as no larger than 50 m can guarantee no significant performance degradation.  **Proposal 2**: If only starting from RRM-1, we can not see strong request to introduce network assisted signalling. However in order to address the large propagation delay difference issue in RRM-2, we prefer Option 3 since the Uni-directional and bi-directional deployment flag has been approved.  **Proposal 3**: The inter-RRH indication should keep consistent with active TCI state switching indication. Adding 1 bit to differentiate whether inter-RRH happening on top of the RRC signaling/MAC CE/DCI based active TCI state switching. |
| R4-2205895 | Samsung | **Discussion on capability and feature list for FR2 HST UE**  **Proposal 1**: FR2 HST relevant feature(s) should be per-band type.  **Proposal 2**: “Support of one shot large UL timing adjustment” can be listed as another feature from “Support of FR2 HST operation”.  **Proposal 3**: For one shot large UL timing adjustment, it is proposed that the feature is mandatorily supported with capability signaling.  Accordingly, the feature list components for FR2 HST UE is provided in Table 1. |
| R4-2205896 | Nokia, Nokia Shanghai Bell | TP to TR 38.854 – beam coverage for FR2 HST |
| R4-2205900 | Nokia, Nokia Shanghai Bell | **Link simulation assumptions for L1 and L3 measurement accuracy for FR2 HST scenarios**  For L3 measurement accuracy, the CDF curves to be provided are as follows:  Delta SS-RSRP   = (estimated SS-RSRP – ideal SS-RSRP) [dB]  Delta SS-RSRQ   = (estimated SS-RSRQ – ideal SS-RSRQ) [dB]  Delta SS-SINR   = (estimated SS-SINR – ideal SS-SINR) [dB]  For L1 measurement accuracy, the CDF curves to be provided are as follows:  Delta L1-RSRP   = (estimated L1-RSRP – ideal L1-RSRP) [dB]  Delta L1-SINR   = (estimated L1-SINR – ideal L1-SINR) [dB] |
| R4-2206008 | Intel Corporation | **Discussion on applicability of enhanced requirements for HST in FR2**  **Proposal 1**: RAN4 will not capture any strict deployment limitations for enhanced RRM requirements applicability. |

## Open issues summary

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

### Sub-topic 1-1: General

*Sub-topic description*

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

#### Issue 1-1-1: Lightweight network assistance signaling

* Background

At the previous RAN4#101-bis-e meeting no agreement was achieved on the need an type of network assistance signaling:

|  |
| --- |
| **Way forward:**  Discuss further which NWA signaling is needed:   * Option 1: Enable network assisted signaling of SSB index and order per RRH. * Option 2: The network assistance signaling of SSB configuration shall not be introduced in Rel-17. * Option 3: Introduce inter-RRH indication * Option 4: Other options are not precluded |

Below proposals on signaling submitted to RRM-2 email discussion thread on larger one-shot UL timing adjustment are listed:

* R4- 2203754 by Apple:
  + Proposal 1: Enable light weight inter-RRH signaling to UE.
  + Proposal 2: Support network assisted information, i.e., enable network assisted signaling of SSB index and order per RRH.  For example:
    - The signaling can reuse current SSB signaling by reinterpretation of the bit field when FR2 HST deployment flag is set.
    - Group represent RRH, max 8 RRH per cell. SSB index is in order along the track.
    - No additional signaling overhead.
  + Proposal 3: RAN4 can determine max number of RRH per cell supported in SIB1 signaling and leave detailed signaling design to RAN2.
* R4-2205959, by Nokia:
  + Observation: Network signalling indicating inter-RRH TCI state switch to the UE can be beneficial to mitigate UL transmit timing error that appears due to a need to synchronize to the target beam in the case of intra-RRH TCI state switch.
  + Proposal: RAN4 to introduce lightweight network signaling for the indication of inter-RRH TCI state switch to the UE, e.g., in the form of the one-bit flag in the TCI state switch command.
* Proposals and/or Observations
  + Proposal 1 (QC): Add a MAC-CE command to inform UE of the TCI state switch is across RRH and send an LS to RAN2.
  + Proposal 2 (CATT): We slightly prefer to have the network assisted signalling of SSB index and order per RRH, if Rel-17 schedule is allowed.
  + Proposal 3 (Ericsson): Support Option 3: Introduce inter-RRH indication, because of easy implementation.
  + Proposal 3 (ZTE): If only starting from RRM-1, we can not see strong request to introduce network assisted signalling. However in order to address the large propagation delay difference issue in RRM-2, we prefer Option 3 since the Uni-directional and bi-directional deployment flag has been approved.
  + Proposal 4 (ZTE): The inter-RRH indication should keep consistent with active TCI state switching indication. Adding 1 bit to differentiate whether inter-RRH happening on top of the RRC signaling/MAC CE/DCI based active TCI state switching.
* Candidate options:
  + Option 1 (CATT, QC): Enable network assisted signaling of SSB index and order per RRH
  + Option 3a (QC, Ericsson, ZTE): Introduce inter-RRH indication in TCI state switch MAC CE
  + Option 3b (ZTE): Introduce inter-RRH indication in TCI state switch RRC signaling/MAC CE/DCI
* Recommended WF
  + Companies are encouraged to identify acceptable signaling types to converge to a single option in the 1st round.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We support Option1. It benefits several issues under discussions and practical implementation, not only timing adjustment. Signaling of SSB index and order per RRH can help UE to utilize spatial characteristics of SSBs.  Opiton3a or 3b can be fallback solution if overhead of SSB index signaling is questionable. |
| Intel | We prefer not to have network assisted signaling, since we consider it as an enhancement and the system can work without it. However, for the sake of WI progress we can compromise if the group will decide that the signaling is still necessary.  Our preferences are prioritized in the following order:   1. No to have network assisted signaling 2. Option 1 3. Option 3a |
| ZZZ |  |

#### Issue 1-1-2: LS on network signaling to RAN2

* Background

Two LS on network signaling to RAN4 were submitted to the meeting

* + LS Draft (TCI State Switch Across RRHs) in the appendix of R4-2203711 by Qualcomm
    - The signaling methods include but not limited to either RRC based signaling which indicates the set of SSB index and order along the track belongs to each RRH, or through dynamic signaling via MAC-CE comes with TCI state switch.
  + [Draft] LS on network signalling for Rel-17 NR HST RRM, R4-2204720, by Ericsson.
    - Signalling to inform the UE that a TCI state switch is across RRH.
* Recommended WF
  + The preparation of the LS should be based on the discussion and agreement in the previous issue.
  + The companies are still invited to share their opinions about which of the LSs could be used as a baseline.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We’re fine with either of LS based on agreements on Issue 1-1-1. |
| Intel | Prefer to discuss the Issue after an agreement on Issue 1-1-1. |
| ZZZ |  |

#### Issue 1-1-3: Applicability of enhanced Set-1 RRM requirements

* Background

At RAN4#101-bis-e the following WF was agreed [R4-2202594]:

|  |
| --- |
| **Way forward:**   * FFS, whether it should be clarified in the TR that 2Rx beam sweep based requirement (set 1) applies to the deployment scenario with Dmin > [10] m or Hdiff (height difference between train rooftop mounted CPE and RRH) > [10] m, performance degradation is expected. * The proponents are encouraged to bring a TP to the TR, where the discussion can focus on the TP. |

* Proposals
  + Proposal 1 (QC): Capture the following description of set 1 requirements applicability in TR:   
    When 2Rx beam sweep based requirement (set 1) applies to the deployment scenario with Dmin > 10m or Hdiff (height difference between train rooftop mounted CPE and RRH) > 10m, performance degradation is expected.
  + Proposal 2 (Ericsson): Only list or highlight benchmark of performance obtained when Dmin = [10] m, but don’t note performance difference or degradation when Dmin > [10] m.
  + Proposal 3 (ZTE): The applicability restriction of 2 Rx beam requirements is necessary. For the detailed range of Dmin, a typical value such as no larger than 50 m can guarantee no significant performance degradation.
  + Proposal 4 (Intel): RAN4 will not capture any strict deployment limitations for enhanced RRM requirements applicability.
* Recommended WF
  + Discuss the proposals in 1st first round.
  + In the 1st round, it is recommended to focused on this issue rather than on the TP itself (R4-2203714 in Section 1.2.3).

Companies’ views collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Support proposal 2. We don’t need to specify any/all performance deviation compared to [10]m. Practical performance degradation may rely on antenna configurations, angles and etc. which are configurable. At the most, a note, such as ‘performance deviation is expected when Dmin> [10] m’, can be added in TR. |
| Intel | Support Proposals 2 and 4.  If the group will decide that the recommendation on applicability of 2 Rx beam requirements is still necessary then we can compromise to Proposal 3, which is generally aligned with our observations. |
| ZZZ |  |

#### Issue 1-1-4: Train travelling opposite to the serving beam

* Background

At RAN4#101-bis-e the following WF was agreed [R4-2202594]:

|  |
| --- |
| **Agreement:**  The DRX upper bound = 80 ms applies both to Sets 1 (Scenario-A) and 2 (Scenario-B).  **Way forward:**   * The companies are encouraged to provide the analysis of Scenario-A where the train is travelling in the direction opposite to the serving beam orientation in the TR. |

* Proposals:
  + Proposal 1 (Ericsson): In Rel-17, Configure a different mobility parameter, e.g., offset in HO and BM for opposite direction to abbreviate SNR drop duration. Further enhancement can be studied in next release.
* Recommended WF
  + Discuss the proposal in the 1st round.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | We think that proper configurations in beam management can mitigate the issue also, similar to offset configurations in HO. |
| YYY |  |
| ZZZ |  |

#### Issue 1-1-5: Link simulation assumptions for L1 and L3 measurement accuracy

* Background

One of the companies have brought link simulation assumptions for L1 and L3 measurement accuracy for FR2 HST scenarios [R4-2205900]:

**L3 simulation assumptions**

In the simulation, two cells are considered, which are Cell 1 (serves as an interfering cell and unknown to UE) and Cell 2 (serves as the cell under measurement and known to UE).

Table 1: General parameters

|  |  |
| --- | --- |
| **Simulation parameters** | **Comments/values** |
| Carrier frequency for Cell 1 and Cell 2 | 30 GHz |
| DRX | No |
| RRH transmit antenna configuration for SS blocks | 1 tx or single layer transmissions |
| UE receive antenna configuration | 2 rx |
| Data and control channel subcarrier spacing | SSB SCS 240 kHz/120 kHz, data SCS 120 kHz |
| Measurement period (in number of measurement samples) | 5 (other values should be considered such as 1 and 3) |
| * Subcarrier spacing SSB | 240 kHz/120 kHz |
| * Number of SS blocks per SS burst set, K | 1 up to 8 is possible (a subset can be used) |
| * SS burst periodicity | 5 ms and other values, e.g., 10ms, 20 ms |

Table 2: Cell-specific parameters

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Unit | Cell 1 | Cell 2 |
| NR RF Channel number | - | Channel 1 | Channel 1 |
| NR-PSS and NR-SSS sequences | - | To be indicated by companies | To be indicated by companies |
| PBCH and DMRS power offset with respect to NR-PSS and NR-SSS | dB | 0 | 0 |
| Data and control PSD relative to NR-PSS and NR-SSS | dB | 0 | 0 |
| RB Utilization | % | 100 | 100 |
| Data Modulation | - | QPSK | QPSK |
| Slot length | - | 14 symbols | 14 symbols |
| CP Length | - | Normal | Normal |
| Frequency Offset relative to UE frequency reference | Hz | 0 | 0 |
| 1)Relative Delay of 1st Path (synchronous) | µs | 0 | [CP/2] |
| Es/IoT | dB | 6.4 | 1.25; FSS: -0.75, 0.25;  (SINR: -6dB;  FFS: -8dB, -7dB) |
| Propagation conditions | - | AWGN with 9722 Hz offset between desired and interfering cells for uni-directional Scenario A and bi-directional Scenario B | |

**L1 simulation assumptions**

In the simulation, one cell is considered.

Table 3: General parameters

|  |  |
| --- | --- |
| **Simulation parameters** | **Comments/values** |
| Carrier frequency for Cell 1 | 30 GHz |
| channel | AWGN |
| BS transmit antenna configuration | 1 tx |
| UE receive antenna configuration | 2 rx |
| Subcarrier spacing | 120 kHz |
| Carrier frequency offset | 9722 Hz for uni-directional Scenario A and bi-directional Scenario B |
| Frequency tracking | TRS with periodicity = 10 ms |

Table 4: L1-SINR accuracy evaluation simulation assumptions for CMR only

|  |  |
| --- | --- |
| **Simulation parameters** | **Comments/values** |
| Data channel subcarrier spacing | The same as CSI-RS subcarrier spacing |
| Measurement period (in number of measurement samples) | 1 sample |
| CSI-RS periodicity | 80 slots |
| Number of PRBs | 48 |
| Density | 3 |
| Side condition (SNR) on CMR | -3 dB |

The simulation assumptions in Table 4 are also applicable to SSB and CSI-RS based L1-RSRP accuracy evaluation.

Table 5: L1-SINR accuracy evaluation simulation assumptions for SSB-based CMR + NZP-IMR

|  |  |
| --- | --- |
| **Simulation parameters** | **Comments/values** |
| Data channel subcarrier spacing | The same as SSB and CSI-RS subcarrier spacing |
| Measurement period (in number of measurement samples) for CMR/IMR | 1 sample |
| Channel measurement resource (CMR) | SSB |
| Interference measurement resource (IMR) configuration | CSI-RS |
| periodicity | CMR periodicity (80 slots) = IMR periodicity |
| Ideal SINR | -3dB |
| Number of PRBs for IMR | 48 |
| Density for IMR | 3 |
| Side condition (SNR) on CMR | 0 dB |
| Side condition (SNR) on IMR | 0 dB |

Table 6: L1-SINR accuracy evaluation simulation assumptions for SSB-based CMR + ZP-IMR

|  |  |
| --- | --- |
| **Simulation parameters** | **Comments/values** |
| Data channel subcarrier spacing | The same as SSB and CSI-RS subcarrier spacing |
| Measurement period (in number of measurement samples) for CMR/IMR | 1 sample |
| Channel measurement resource (CMR) | SSB |
| Interference measurement resource (IMR) configuration | CSI-RS |
| periodicity | CMR periodicity (80 slots) = IMR periodicity |
| Ideal SINR | -3dB |
| Number of PRBs for IMR | 48 |
| Density for IMR | 3 |
| Side condition (SNR) on CMR | -3 dB |
| Side condition (SNR) on IMR | N/A |

Table 7: L1-SINR accuracy evaluation simulation assumptions for CSI-RS-based CMR + NZP-IMR

|  |  |
| --- | --- |
| **Simulation parameters** | **Comments/values** |
| Data channel subcarrier spacing | The same as SSB and CSI-RS subcarrier spacing |
| Measurement period (in number of measurement samples) for CMR/IMR | 1 sample |
| Channel measurement resource (CMR) | CSI-RS |
| Interference measurement resource (IMR) configuration | CSI-RS |
| periodicity | CMR periodicity (80 slots) = IMR periodicity |
| Ideal SINR | -3dB |
| Number of PRBs for IMR | 48 |
| Density for CMR/IMR | 3 |
| Side condition (SNR) on CMR | 0 dB |
| Side condition (SNR) on IMR | 0 dB |

Table 8: L1-SINR accuracy evaluation simulation assumptions for CSI-RS-based CMR + ZP-IMR

|  |  |
| --- | --- |
| **Simulation parameters** | **Comments/values** |
| Data channel subcarrier spacing | The same as SSB and CSI-RS subcarrier spacing |
| Measurement period (in number of measurement samples) for CMR/IMR | 1 sample |
| Channel measurement resource (CMR) | CSI-RS |
| Interference measurement resource (IMR) configuration | CSI-RS |
| periodicity | CMR periodicity (80 slots) = IMR periodicity |
| Ideal SINR | -3dB |
| Number of PRBs for IMR | 48 |
| Density for CMR/IMR | 3 |
| Side condition (SNR) on CMR | -3 dB |
| Side condition (SNR) on IMR | N/A |

* Proposal
  + For L3 measurement accuracy, the CDF curves to be provided are as follows:
  + Delta SS-RSRP = (estimated SS-RSRP – ideal SS-RSRP) [dB]
  + Delta SS-RSRQ = (estimated SS-RSRQ – ideal SS-RSRQ) [dB]
  + Delta SS-SINR = (estimated SS-SINR – ideal SS-SINR) [dB]
  + For L1 measurement accuracy, the CDF curves to be provided are as follows:
  + Delta L1-RSRP = (estimated L1-RSRP – ideal L1-RSRP) [dB]
  + Delta L1-SINR = (estimated L1-SINR – ideal L1-SINR) [dB]
* Recommended WF
  + It is recommended to postpone the discussion of L1 and L3 measurement accuracy and focus on the HST FR2 core requirements at this meeting.
  + In the 1st round, early comments can be provided by the interested companies.

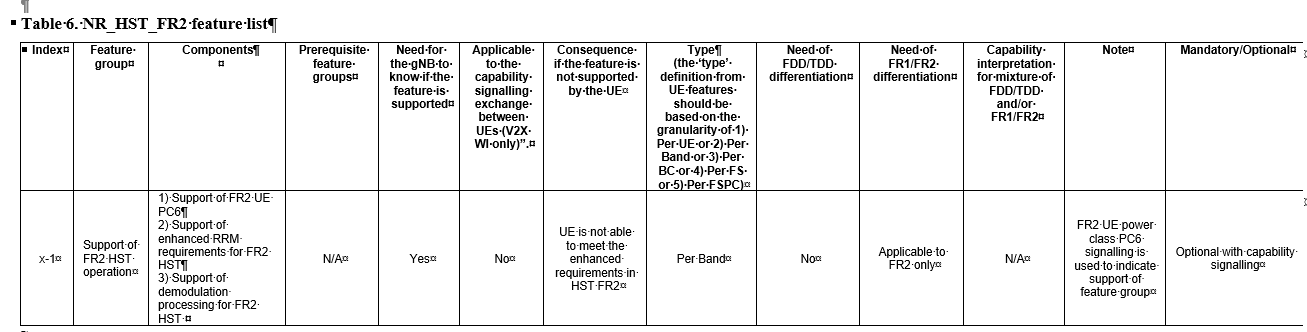
Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | The assumption looks fine. |
| Intel | Prefer to focus on core requirements first |
| ZZZ |  |

### Sub-topic 1-2: UE capabilities and features

*Sub-topic description*

The following UE features were discussed for the Rel-17 NR FR2 HST WI at RAN4#101-bis-e:



Component (2) “Support of enhanced RRM requirements for FR2 HST” is relevant to HST FR2 RRM.

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

#### Issue 1-2-1: Type definition for HST FR2 RRM features

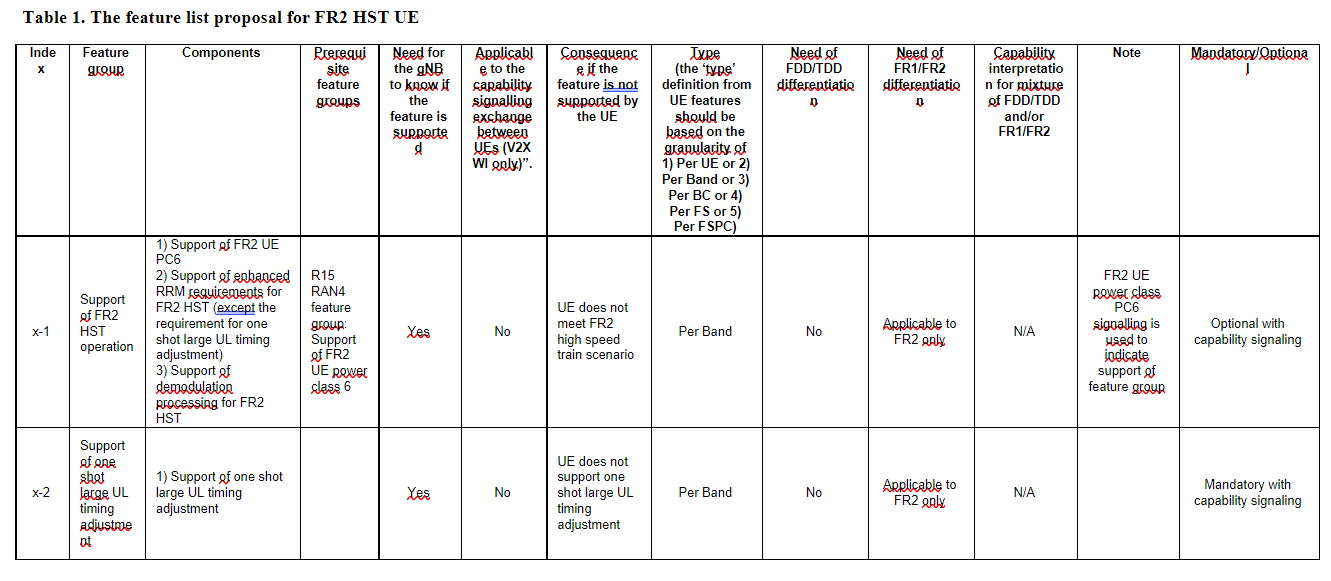
* Proposals and/or Observations:
  + Proposal 1 (Ericsson): Because the UE type in FR2 HST scenario only comprises FR2 CPE type, per UE is enough.
  + Proposal 3 (CATT): Power class shall be used to identify the feature support. From RRM perspective, Per-UE type is enough. But for RF and demod feature, it depends on conclusion from other session.
  + Proposal 2 (Samsung): FR2 HST relevant feature(s) should be per-band type.
* Candidate options:
  + Option 1(Ericsson, CATT): Per UE
  + Option 2 (Samsung): Per Band
* Recommended WF:
  + Collect companies’ views in the 1st round.
  + It is recommended to focus on RRM features.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Per-UE is enough for Rel17. But we’re open to the question in case of other foreseeable possibilities in the future. |
| Intel | Option 2 |
| Huawei | Support option 2. Although from RRM perspective, per UE is fine, the RF requirements shall distinguish different band. UE can support FR2 HST and satisfy RF requirements on certain band, but not on other bands. We think supporting FR2 HST capability shall considers RF, RRM and demodulation together. |

#### Issue 1-2-2: Capability for one shot large UL timing adjustment

* Background
  + At RAN4#101-e it was agreed [R4-2120416]:  
    “Introduce a mechanism for one shot large uplink timing adjustment for FR2 HST scenarios with UE allowed to adjust uplink timing beyond Tq.”
  + At RAN4#101-bis-e it was additionally agreed [R4-2202767]:  
    “Dedicated new RRC based network signalling flag will be specified to enable/disable one shot large UL timing adjustment
  + One of the companies is proposing to use the table below to define the new feature group:



* Proposals and/or Observations
  + Proposal 1(QC): Introduce a UE capability for one shot large UL timing adjustment.
  + Proposal 2 (Samsung): “Support of one shot large UL timing adjustment” can be listed as another feature from “Support of FR2 HST operation”.
  + Proposal 3 (Samsung): For one shot large UL timing adjustment, it is proposed that the feature is mandatorily supported with capability signaling.
* Candidate options:
  + Option 1: Introduce a new feature group and capability for one shot large UL timing adjustment) as mandatory with capability signaling.
  + Option 2: Introduce a new feature group and capability for one shot large UL timing adjustment) as optional with capability signaling
  + Other Options are not precluded
* Recommended WF
  + Companies are invited discuss candidate options in the 1st round.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | One shot large UL timing adjustment is mandatory to FR2 CPE for HST. If no UE capability for one shot large UL timing adjustment, what will be the effect caused?  Thus, we prefer Proposal 2 (Samsung): “Support of one shot large UL timing adjustment” can be listed as another feature from “Support of FR2 HST operation”. |
| Intel | Support Option 1  Two comments for the proposed Table 1:   * For x-1 consider removing prerequisite feature group since Support of FR2 UE power class 6 is x-1 feature group component * For x-2 consider adding prerequisite feature group (x-1) since one shot large UL timing adjustment is applicable only to PC6 UEs. |
| ZZZ |  |

#### Issue 1-2-3: Indication of HST FR2 RRM feature support and Applicability of enhanced RRM requirements (PC 6)

* Background

At the previous RAN4#101-bis-e the following agreements and WFs were listed:

* + Agreement:  
    FR2 HST UE (power class 6 UE) shall mandatorily support both Set 1 and Set 2 enhanced RRM requirements, in terms of different RX beams (i.e., RX beam sweeping scaling factor) per UE.
  + Way forward:  
    Companies are encouraged to check further UE feature needed for the support of enhanced RRM requirements for FR2 HST:
    - **FFS, whether power class shall be used to identify the feature support**
    - FFS, whether per-band type is necessary or per-UE type is enough
  + Way forward on the Applicability of requirements to non-PC6 UE
    - **FFS, whether enhanced requirement should be applied to other than PC6 UEs even when HST FR2 flags are configured.**
* Proposals and/or Observations:
  + Proposal 1 (CATT): Power class shall be used to identify the feature support. From RRM perspective, Per-UE type is enough. But for RF and demod feature, it depends on conclusion from other session.
  + Proposal 2 (Ericsson): Power class can be used to identify the feature support at least in Rel17.
  + Proposal 3 (Apple): Enhanced requirement should be NOT applied to other than PC6 UEs even when HST FR2 flags are configured.
  + Proposal 4 (CATT): The enhanced RRM requirements are only applicable to PC6 UEs. For other UEs, even when HST FR2 flags are configured, the enhance RRM requirements are not applicable.
  + Proposal 5 (Ericsson): No enhanced requirement should be applied to other than PC6 UEs even when HST FR2 flags are configured.
* Candidate options:
  + Option 1:
    - No enhanced requirement should be applied to other than PC6 UEs even when HST FR2 flags are configured.
    - PC6 shall be used to identify the feature support of HST FR2 operation.
* Recommended WF:
  + Companies are invited to check whether Option 1 is agreeable.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Support Option1. |
| Intel | Support Option 1 |
| Huawei | Option 1 is agreeable. |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **R4-2203714,** TP to TR 38.854 on the Number of Rx beams**,** by Qualcomm | |
| **Company** | **Comments** |
| Ericsson | Depends on agreements of Issue 1-1-3 |
|  |  |
|  |  |

|  |  |
| --- | --- |
| **R4-2204721,** draft CR On RRC\_CONNECTED state mobility for HST FR2 RRM, by Ericsson | |
|  |  |
|  |  |
|  |  |

|  |  |
| --- | --- |
| **R4-2205896,** TP to TR 38.854 – beam coverage for FR2 HST, by Nokia, Nokia Shanghai Bell | |
|  |  |
|  |  |
|  |  |

## 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.*

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

### CRs/TPs

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

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

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

TBA

### Sub-topic 1-2: TBA

#### Issue 1-2-2: TBA

*Agreements from round 1:*

TBA

*Candidate options:*

* Option 1:
* Option 2:

*Recommendations for 2nd round:*

TBA

*Contributor Comments:*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| YYY |  |
| ZZZ |  |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: Mobility, Measurement procedure and Signaling characteristics

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2203756 | Apple | **Discussion on measurement procedure requirement for FR2 HST**  **Proposal 1:**   * Mpss/sss\_sync\_w/o\_gaps = 6 for set 1 and 18 for set 2. * Mmeas\_preriod\_w/o\_gaps = 6 for set 1 and 18 for set 2.   **Proposal 2:** Enhanced requirement should be NOT applied to other than PC6 UEs even when HST FR2 flags are configured. |
| R4-2203902 | CATT | **Discussion on measurement procedure requirements for FR2 HST**  **Proposal 1:** Scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) equal 6 for Set 1 and 18 for Set 2. When 80ms< DRX cycle≤ 320ms, 600ms or 400ms lower bounds are useless. The lower bounds of 600ms and 400ms can be removed from the formula when 80ms< DRX cycle≤ 320ms.  **Proposal 2:** The enhanced RRM requirements are only applicable to PC6 UEs. For other UEs, even when HST FR2 flags are configured, the enhance RRM requirements are not applicable. |
| R4-2204254 | CMCC | **Discussion on mobility requirements for FR2 HST**  **Observation 1:**according to existing intra-frequency measurement requirements for non-HST scenario, the number of samples is 5 for power class 1 or 5 (fixed wireless access UE) and 3 for power class 2, 3 or 4 (moving UE).  **Observation 2:** For FR2 HST, considering it is for the high speed train, it is reasonable to take the samples of moving UE type as baseline (i.e. 3 samples for power class 2, 3, 4).  **Proposal 1:** scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) are proposed to be 6 for Set 1 and 18 for Set 2. |
| R4-2204489 | ZTE Corporation | **Draft CR for Cell re-selection for HST FR2** |
| R4-2204490 | ZTE Corporation | **Draft CR for L1-RSRP measurements for Reporting for HST FR2** |
| R4-2204629 | Nokia, Nokia Shanghai Bell | **CR to TS 38.133: intra-frequency measurements without gaps for for FR2 NR HST** |
| R4-2204716 | Ericsson | **RRC Idle/Inactive and connected state mobility requirements**  **Proposal 1**: No need to consider more types of enhancement, besides of [highSpeedMeasFlag-FR2]. |
| R4-2204717 | Ericsson | **Measurement procedure requirements for HST FR2**  **Proposal 1:** support Option1. Scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) equal 6 for Set 1 and 18 for Set 2.  **Proposal 2:** No enhanced requirement should be applied to other than PC6 UEs even when HST FR2 flags are configured. |
| R4-2204892 | Huawei, Hisilicon | **Discussion on RRC Idle/Inactive and connected state mobility requirements for HST in FR2**  **Proposal 1:** The below requirements for Cell reselection in IDLE/INACTIVE mode shall apply to power class 6 UE when highSpeedMeasFlag-r17 is configured.   |  |  |  |  |  | | --- | --- | --- | --- | --- | | **DRX cycle length [s]** | **Scaling Factor (N1)** | **Tdetect,NR\_Intra [s] (number of DRX cycles)** | **Tmeasure,NR\_Intra [s] (number of DRX cycles)** | **Tevaluate,NR\_Intra**  **[s] (number of DRX cycles)** | |  |  |  |  |  | | 0.32 | 2 or 6Note1 | 2.56 x M2 (8 x M2) | 0.32 x M3 (1 x M3) | 0.96 x M4 (3 x M4) | | 0.64 | 5 | 17.92 x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) | | 1.28 | 4 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) | | 2.56 | 3 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) | | Note 1: N1 refers to the number of Rx beams and equals 2 for Set 1, and 6 for Set 2  Note 2: when SMTC < = 40 ms, M2 = M3 = M4 = 1; and when SMTC > 40 ms, M2 = 1.5, M3 = M4 = 2  Note 3: [When *highSpeedMeasFlag-r17* is configured, the requirements shall apply to power class 6 UE*].* | | | | | |
| R4-2204894 | Huawei, Hisilicon | **Discussion on RRM requirements for high speed train scenario in FR2**  **Proposal 1:** In connected mode, Mpss/sss is at least 10 and 24 for set 1 and set 2 respectively.  **Proposal 2:** 600ms lower bound is kept unchanged when 80ms< DRX cycle≤ 320ms. |
| R4-2204895 | Huawei, Hisilicon | **Scheduling restriction for L1-SINR for FR2 HST** |
| R4-2205898 | Nokia, Nokia Shanghai Bell | **On remaining RRM measurement open issues for FR2 HST**  **Observation 1**: In Option 2, the scaling factor (Mpss/sss\_synch\_w/o\_gaps = Mmeas\_period\_w/o\_gaps = 24) for Set 2 is equal to non-HST scenarios for UE supporting power classes 3 and 4.  **Observation 2**: For Set 2 in Option 2, the PSS/SSS detection and measurement time is not faster than the non-HST case for UE supporting power classes 3 and 4, which corresponds to no enhancements and not suitable for HST.  **Proposal 1**: In connected mode, the scaling factor for PSS/SSS detection and measurements should be Option 1: Scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) equal 6 for Set 1 and 18 for Set 2.  [Moderator]: The Proposal below is treated in Topic#1.  **Proposal 2**: For the enhanced requirements for Cell reselection in IDLE/INACTIVE mode, Note 2 in the table is not needed. |
| R4-2205960 | Nokia, Nokia Shanghai Bell | **TP to TR 38.854 on Legacy RRM Requirement Mobility Performance in HST FR2 Deployment Scenarios** |
| R4-2205961 | Nokia, Nokia Shanghai Bell | **TP to TR 38.854 on Analysis of Mobility Performance in HST FR2 Deployment Scenarios** |
| R4-2203755 | Apple | **Discussion on signalling characteristics requirements**  **Proposal 1**: Reuse current TCI state switching delay requirement. It is further study whether TOk can be 0. |
| R4-2203900 | CATT | **Discussion on TCI switching delay for FR2 HST**  **Proposal 1**: When TCI is switched in FR2 HST, ISI really exists. We think one symbol for scheduling restriction can resolve the ISI issue during TCI switching. |
| R4-2203901 | CATT | **Draft CR on RLM/BFD requirement for FR2 HST** |
| R4-2204718 | Ericsson | **Signalling characteristics requirements for HST FR2**  **Proposal 1**: Performance degradation is expected upon inter-symbol interference during TCI switching for FR2 HST scenario. No necessity to limit receiving in RRM requirements. |
| R4-2204893 | Huawei, Hisilicon | **Discussion on signaling characteristics requirements for high speed train scenario in FR2**  **Proposal 1**: The legacy known condition of TCI state can be reused for FR2 HST.  **Proposal 2**: Prefer to only consider known TCI switching in FR2 HST.  **Proposal 3**: Introduce one slot interruption during TCI state switching due to inter-symbol interference |
| R4-2205009 | ZTE Corporation | **Discussion on Signaling characteristics for HST FR2**  **Proposal 1:** The ISI issue really exists between inter-RRH TCI state switching. To address this issue, introducing one symbol length scheduling restriction right after the end of slot n+ THARQ + is enough. |
| R4-2205893 | Samsung | **Remaining Issues on signaling characteristics requirements for FR2 HST**  [Moderator]: Proposal 1 ca be discussed in the 2.2.4 CR/TP comments collection.  **Proposal 1**: The exemplary text proposal for FR2 HST UE SSB-based RLM evaluation period is provided as:  **Proposal 2**: For CSI-RS based RLM and BFD, no standard impact is expected for Rel-17 FR2 HST UE (i.e., FR2 PC6 UE).  **Observation 1**: If the target TCI state is known, and the target TCI state is in the active TCI state list for PDSCH, there is no interruption allowed during MAC-CE based TCI state switching.  **Observation 2**: During TCI switching between RRHs in FR2 HST scenario, it is possible to have inter-symbol interference which cannot be accommodated by the CP length of the OFDM symbol from the target RRH.  **Proposal 3**: One more slot is allowed for interruption during TCI switching for FR2 HST scenario. |
| R4-2205894 | Samsung | **Draft CR to introduce active TCI state switching delay requirement for FR2 HST UE** |

## Open issues summary

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

### Sub-topic 2-1: RRC CONNECTED and IDLE state mobility requirements

*Sub-topic description:*

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

#### Issue 2-1-1: Cell reselection in IDLE/INACTIVE mode

* Background

Only one issue left open after the previous RAN4#101-bis-e:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Agreement:**  Defined enhanced requirements for Cell reselection in IDLE/INACTIVE mode for DRX 320 ms in HST FR2 deployments:   |  |  |  |  | | --- | --- | --- | --- | | **DRX cycle length [s]** | **Tdetect,NR\_Intra [s] (number of DRX cycles)** | **Tmeasure,NR\_Intra [s] (number of DRX cycles)** | **Tevaluate,NR\_Intra**  **[s] (number of DRX cycles)** | |  | | 0.32 | 2.56 x N1 x M2 (8 x N1 x M2) | 0.32 x N1 x M3 (1 x N1 x M3) | 0.96 x N1 x M4 (3 x M4) |  | | Note 1: when SMTC < = 40 ms, M2 = M3 = M4 = 1; and when SMTC > 40 ms, M2 = 1.5, M3 = M4 = 2  Note 2: [When *highSpeedMeasFlag-r16* is configured, the requirements apply only to UE supporting either *measurementEnhancement-r16* or *intraRAT-MeasurementEnhancement-r16].* | | | |  |   N1 refers to the number of Rx beams and equals 2 for Set 1, and 6 for Set 2.  **Way forward:**  The companies are encouraged to check the Notes and to reformulate Note 2. |

At the meeting RAN4#100-e [R4-2120292] it was agreed that

|  |
| --- |
| **Agreements:**   * Defined enhanced requirements for DRX 320 ms only. * Requirements for longer DRX cycles are left without changes. |

* Proposals and/or Observations
  + Proposal 1 (Ericsson): No need to consider more types of enhancement, besides of [highSpeedMeasFlag-FR2].
  + Proposal 2 (Huawei): The below requirements for Cell reselection in IDLE/INACTIVE mode shall apply to power class 6 UE when highSpeedMeasFlag-r17 is configured.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **DRX cycle length [s]** | **Scaling Factor (N1)** | **Tdetect,NR\_Intra [s] (number of DRX cycles)** | **Tmeasure,NR\_Intra [s] (number of DRX cycles)** | **Tevaluate,NR\_Intra**  **[s] (number of DRX cycles)** |
|  |  |  |  |  |
| 0.32 | 2 or 6Note1 | 2.56 x M2 (8 x M2) | 0.32 x M3 (1 x M3) | 0.96 x M4 (3 x M4) |
| 0.64 | 5 | 17.92 x N1 (28 x N1) | 1.28 x N1 (2 x N1) | 5.12 x N1 (8 x N1) |
| 1.28 | 4 | 32 x N1 (25 x N1) | 1.28 x N1 (1 x N1) | 6.4 x N1 (5 x N1) |
| 2.56 | 3 | 58.88 x N1 (23 x N1) | 2.56 x N1 (1 x N1) | 7.68 x N1 (3 x N1) |
| Note 1: N1 refers to the number of Rx beams and equals 2 for Set 1, and 6 for Set 2  Note 2: when SMTC < = 40 ms, M2 = M3 = M4 = 1; and when SMTC > 40 ms, M2 = 1.5, M3 = M4 = 2  Note 3: [When *highSpeedMeasFlag-r17* is configured, the requirements shall apply to power class 6 UE*].* | | | | |

* + Proposal 3 (Nokia): For the enhanced requirements for Cell reselection in IDLE/INACTIVE mode, Note 2 in the table is not needed.
* Recommended WF
  + Check that that the first two Notes from Proposal 2 are agreeable, i.e.,  
    Note 1: N1 refers to the number of Rx beams and equals 2 for Set 1, and 6 for Set 2   
    Note 2: when SMTC < = 40 ms, M2 = M3 = M4 = 1; and when SMTC > 40 ms, M2 = 1.5, M3 = M4 = 2
  + Companies are ecnouraged to reply the following two questions:
    - Q1: Whether it is necessary to list DRX cycle above 0.32 s (i.e., without enhancements) in the table with enhanced HST FR2 requirements:
      * Option 1.1 (Huawei): Yes
      * Option 1.2: No
    - Q2: Whether Notes 3 [When highSpeedMeasFlag-r17 is configured, the requirements shall apply to power class 6 UE] is needed
      * Option 2.1 (Ericsson, Huawei): Yes
      * Option 2.2 (Nokia): No
      * Other formulations of the Note 3 are not precluded.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Q1, support Option 1.1  Q2, Support Option 2.1, it indicates that highSpeedMeasFlag-r17 can only be applied to power class 6 UE. |
| Intel | Q1: support Option 1.1  Q2: support Option 2.1 in accordance with Issue 1-2-3 |
| Huawei | Q1: support 1.1, as we did in FR1 HST. For the DRX above 0.32s, no any enhancements are made. It means that if network configures DRX above 0.32s, UE is not required to satisfy the enhanced requirements.  Q2: support option 2.1. |

### Sub-topic 2-2: Measurement procedure requirements

*Sub-topic description*

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

#### Issue 2-2-1: Time period for PSS/SSS detection and Measurement period for intra-frequency measurements

* Background

At the previous RAN4#101-bis-e meeting WF [R4-2202594]:

**Agreement:**

PSS/SSS detection

Set 1:

Table 1: Time period for PSS/SSS detection when [flag1] is configured, (Frequency range FR2)

|  |  |
| --- | --- |
| **DRX cycle** | **TPSS/SSS\_sync\_intra** |
| No DRX | max(600ms, ceil([6] x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 80 ms | max(600ms, ceil([6] x M2Note 2 x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra |
| 80ms< DRX cycle≤ 320ms | max(600ms, ceil(M2 x Mpss/sss\_sync\_w/o\_gaps  x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_w/o\_gaps  x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2 = 1 | |

Set 2:

Table 2: Time period for PSS/SSS detection when [flag2] is configured, (Frequency range FR2)

|  |  |
| --- | --- |
| **DRX cycle** | **TPSS/SSS\_sync\_intra** |
| No DRX | max(600ms, ceil([18] x Kp x Klayer1\_measurement)x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 80ms | max(600ms, ceil([18] x M2Note 2 x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra |
| 80ms< DRX cycle≤ 320ms | max(600ms, ceil(M2 x Mpss/sss\_sync\_w/o\_gaps  x Kp x Klayer1\_measurement)x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(Mpss/sss\_sync\_w/o\_gaps  x Kp x Klayer1\_measurement) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2 = 1 | |

SSB measurement period

Set 1:

Table 3: Measurement period for intra-frequency measurements without gaps when [flag1] is configured (FR2)

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_intra** |
| No DRX | max(400ms, ceil([6] x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ 80ms | max(400ms, ceil([6] x M2Note 2 x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| 80ms< DRX cycle≤ 320ms | max(400ms, ceil(M2x Mmeas\_period\_w/o\_gaps x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(Mmeas\_period\_w/o\_gaps xKp x Klayer1\_measurement ) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2 = 1 | |

Set 2:

Table 4: Measurement period for intra-frequency measurements without gaps when [flag2] is configured (FR2)

|  |  |
| --- | --- |
| **DRX cycle** | **T SSB\_measurement\_period\_intra** |
| No DRX | max(400ms, ceil([18] x Kp x Klayer1\_measurement) x SMTC period)Note 1 x CSSFintra |
| DRX cycle≤ [80ms] | max(400ms, ceil([18] x M2Note 2 x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| 80ms< DRX cycle≤ 320ms | max(400ms, ceil(M2x Mmeas\_period\_w/o\_gaps x Kp x Klayer1\_measurement) x max(SMTC period,DRX cycle)) x CSSFintra |
| DRX cycle>320ms | ceil(Mmeas\_period\_w/o\_gaps xKp x Klayer1\_measurement ) x DRX cycle x CSSFintra |
| NOTE 1: If different SMTC periodicities are configured for different cells, the SMTC period in the requirement is the one used by the cell being identified  NOTE 2: M2 = 1.5 if SMTC periodicity > 40 ms; otherwise M2 = 1 | |

**Way forward:**

* Discuss the following options to define the scaling factors:
  + Option 1: Scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) equal 6 for Set 1 and 18 for Set 2
  + Option 2: Scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) equal 10 for Set 1 and 24 for Set 2
* Companies are encouraged to check, whether 600ms lower bound is makes sense when 80ms< DRX cycle≤ 320ms
* Proposals and/or Observations
  + Proposal 1 (Apple):
    - Mpss/sss\_sync\_w/o\_gaps = 6 for set 1 and 18 for set 2.
    - Mmeas\_preriod\_w/o\_gaps = 6 for set 1 and 18 for set 2.
  + Proposal 2 (CATT): Scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) equal 6 for Set 1 and 18 for Set 2. When 80ms< DRX cycle≤ 320ms, 600ms or 400ms lower bounds are useless. The lower bounds of 600ms and 400ms can be removed from the formula when 80ms< DRX cycle≤ 320ms.
  + Observation 1 (CMCC): according to existing intra-frequency measurement requirements for non-HST scenario, the number of samples is 5 for power class 1 or 5 (fixed wireless access UE) and 3 for power class 2, 3 or 4 (moving UE).
  + Observation 2 (CMCC): For FR2 HST, considering it is for the high speed train, it is reasonable to take the samples of moving UE type as baseline (i.e. 3 samples for power class 2, 3, 4).
  + Proposal 3 (CMCC): scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) are proposed to be 6 for Set 1 and 18 for Set 2.
  + Proposal 4 (Ericsson): support Option1. Scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) equal 6 for Set 1 and 18 for Set 2.
  + Proposal 5 (Huawei): In connected mode, Mpss/sss is at least 10 and 24 for set 1 and set 2 respectively.
  + Observation 3 (Nokia): In Option 2, the scaling factor (Mpss/sss\_synch\_w/o\_gaps = Mmeas\_period\_w/o\_gaps = 24) for Set 2 is equal to non-HST scenarios for UE supporting power classes 3 and 4.
  + Observation 4 (Nokia): For Set 2 in Option 2, the PSS/SSS detection and measurement time is not faster than the non-HST case for UE supporting power classes 3 and 4, which corresponds to no enhancements and not suitable for HST.
  + Proposal 6 (Nokia): In connected mode, the scaling factor for PSS/SSS detection and measurements should be Option 1: Scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) equal 6 for Set 1 and 18 for Set 2.
  + Observation 5 (Qualcomm): The additional pathloss for option 2 (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps =24) is within 5dB and SINR is kept above 10dB during the cell identification time, which is more than sufficient to maintain connection.
  + Proposal 7 (Nokia): For FR2 HST neighboring cell search enhancement, set scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) equal 10 for Set 1 and 24 for Set 2.
* Candidate options:
  + Option 1 (Apple, CATT, CMCC, Ericsson, Nokia): Scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) equal 6 for Set 1 and 18 for Set 2
  + Option 2 (Huawei, Qualcomm): Scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) equal 10 for Set 1 and 24 for Set 2
* Recommended WF
  + Discuss the candidate options in the 1st round, identifying a possible compromise.
  + A candidate for the GtW.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Support Option1, 3 samples \*RX beam number shall be applicable. |
| Intel | Support Option 1.  In our understanding Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps extension to 40 for PC1 and PC5 can be explained by the fact that PC1 and PC5 UE are Fixed wireless access UEs for which the following is applicable:   * They can have more than 8 Rx beams * They don’t have mobility issues, so they can collect more samples to increase SNR   Both abovementioned point are not applicable for FR2 HST CPE, so PC2/3/4 assumption of 3\*NRX\_beam can be used |
| Huawei | In legacy, 3 samples are needed for PC 2, 3, 4 assuming RX beam is 8. In FR2 HST, especially for scenario B, considering in practical deployment the UE Rx sweeping range is large (e.g., RRH are installed in two sides of railway). Based on the agreed 6 RX beams, the beam gain may be decreased compared with legacy 8 Rx beams. With reduced RX beam gain, 3 samples may not be sufficient for measurement. Therefore we can compromise that Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps is 6 for set 1, but we still have concern on 18 for set 2. |

#### Issue 2-2-2: Lower bound for 80ms< DRX cycle≤ 320ms

* Background

At the previous meeting companies were encouraged to check, whether 600ms lower bound makes sense when 80ms< DRX cycle≤ 320ms. See the previous issue for the Tables.

* Proposals and/or Observations
  + Proposal 1 (CATT): Scaling factors (Mpss/sss\_synch\_w/o\_gaps and Mmeas\_period\_w/o\_gaps) equal 6 for Set 1 and 18 for Set 2. When 80ms< DRX cycle≤ 320ms, 600ms or 400ms lower bounds are useless. The lower bounds of 600ms and 400ms can be removed from the formula when 80ms< DRX cycle≤ 320ms.
  + Proposal 2 (Huawei): 600ms lower bound is kept unchanged when 80ms< DRX cycle≤ 320ms.
* Candidate options:
  + Option 1 (CATT): The lower bounds of 600ms and 400ms can be removed from the formula when 80ms< DRX cycle≤ 320ms.
  + Option 2 (Huawei): 600 ms lower bound is kept unchanged when 80ms< DRX cycle≤ 320ms
  + Other Options are not precluded
* Recommended WF
  + Companies are encouraged to discuss the candidate options.
  + Please, clarify in Option 1, whether the whole row in tables shall be removed, i.e., the last row shall be updated to use DRX cycle>80ms.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei | Depending on the conclusion of issue 2-2-1 |
| YYY |  |
| ZZZ |  |

### Sub-topic 2-3: Signaling characteristics

*Sub-topic description:*

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

#### Issue 2-3-1: TCI switching delay

* Background

Agreement from RAN4#101-e:

The existing 1280ms duration for known condition is applied for FR2 HST scenario

Current requirements are defined in Clause 8.10 of TS 38.133:

TOk = 1 if target TCI state is not in the active TCI state list for PDSCH, 0 otherwise.

* Proposals and/or Observations
  + Proposal 1 (Apple): Reuse current TCI state switching delay requirement. It is further study whether TOk can be 0.
  + Proposal 2 (Huawei): The legacy known condition of TCI state can be reused for FR2 HST.
  + Proposal 3 (Huawei): Prefer to only consider known TCI switching in FR2 HST.
* Candidate options:
  + Option 1 (Apple): TOk can be 0
  + Option 2 (Apple, Huawei): The legacy known condition of TCI state can be reused for FR2 HST
* Recommended WF
  + It is recommended to use the former agreement from RAN4#101-e and discontinue further discussion.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | To our understanding, keeping current requirements isn’t controversial with Option1 and Option2. |
| Intel | Agree with Recommended WF |
| Huawei | Fine with the recommended WF. |

#### Issue 2-3-2: Inter-symbol interference during TCI switching

* Background

WF from RAN4#101-bis-e:

FFS how to avoid inter-symbol interference during TCI switching for FR2 HST scenario.

* Proposals and/or Observations
  + Proposal 1 (CATT): When TCI is switched in FR2 HST, ISI really exists. We think one symbol for scheduling restriction can resolve the ISI issue during TCI switching.
  + Proposal 2 (Ericsson): Performance degradation is expected upon inter-symbol interference during TCI switching for FR2 HST scenario. No necessity to limit receiving in RRM requirements.
  + Proposal 3 (Huawei): Introduce one slot interruption during TCI state switching due to inter-symbol interference
  + Proposal 4 (ZTE): The ISI issue really exists between inter-RRH TCI state switching. To address this issue, introducing one symbol length scheduling restriction right after the end of slot n+ THARQ + is enough.
  + Observation 1 (Samsung): If the target TCI state is known, and the target TCI state is in the active TCI state list for PDSCH, there is no interruption allowed during MAC-CE based TCI state switching.
  + Observation 2 (Samsung):: During TCI switching between RRHs in FR2 HST scenario, it is possible to have inter-symbol interference which cannot be accommodated by the CP length of the OFDM symbol from the target RRH.
  + Proposal 5 (Samsung): One more slot is allowed for interruption during TCI switching for FR2 HST scenario.
* Candidate options:
  + Option 1 (CATT, Huawei, ZTE, Samsung): One more slot is allowed for interruption during TCI switching for FR2 HST scenario, i.e., right after the end of slot n+ THARQ + .
  + Option 2(Ericsson): No necessity to limit receiving in RRM requirements.
* Recommended WF
  + Discus candidate options in the 1st round.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | When inter-RRH TCI state transition, ISI does not always occur. The realistic performance degradation depends on practical Ds, and even in the worst-case scenario, the ISI duration is less than 1 symbol. Meanwhile, it's unclear how PDCCH receiving will be affected. We don’t prefer one slot interruption for a nonconstant interference. |
| Intel | The propagation delay difference is smaller than symbol length, so there is no need to waste the whole slot while only one symbol is affected. We may just restrict one symbol by extending the TCI state switching delay. An example of spec change is as follows:  *If the target TCI state is known, upon receiving PDSCH carrying MAC-CE activation command in slot n, UE shall be able to receive PDCCH with target TCI state of the serving cell on which TCI state switch occurs at* ***symbol #m of*** *the first slot that is after slot n+ THARQ + + TOk\*(Tfirst-SSB + TSSB-proc) / NR slot length****, where m = 1 for power class 6 and m = 0 for other power classes****. The UE shall be able to receive PDCCH with the old TCI state until slot n+ THARQ + .Where THARQ is the timing between DL data transmission and acknowledgement as specified in TS 38.213 [3];* |
| Huawei | Prefer option 1. The one trip delay difference is larger than CP length may happen at the inter-RRH scenario. |

#### Issue 2-3-3: CSI-RS based RLM and BFD requirements

* Background
* Proposals
  + Proposal 1 (Samsung): For CSI-RS based RLM and BFD, no standard impact is expected for Rel-17 FR2 HST UE (i.e., FR2 PC6 UE).
* Recommended WF
  + Check in the 1st round whether Proposal 1 is agreeable.

Companies views’ collection for 1st round:

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Huawei | Fine with proposal 1. |
| YYY |  |
| ZZZ |  |

### CRs/TPs comments collection

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

|  |  |
| --- | --- |
| **R4-2204489**, Draft CR for Cell re-selection for HST FR2, by ZTE Corporation | |
| **Company** | **Comments** |
| XXX |  |
| YYY |  |
| ZZZ |  |

|  |  |
| --- | --- |
| **R4-2204490**, Draft CR for L1-RSRP measurements for Reporting for HST FR2, by ZTE Corporation | |
| **Company** | **Comments** |
| XXX |  |
| YYY |  |
| ZZZ |  |

|  |  |
| --- | --- |
| **R4-2204629,** CR to TS 38.133: intra-frequency measurements without gaps for for FR2 NR HST, by Nokia, Nokia Shanghai Bell | |
| **Company** | **Comments** |
| XXX |  |
| YYY |  |
| ZZZ |  |

|  |  |
| --- | --- |
| **R4-2204895**, Scheduling restriction for L1-SINR for FR2 HST, by Huawei, Hisilicon | |
| **Company** | **Comments** |
| XXX |  |
| YYY |  |
| ZZZ |  |

|  |  |
| --- | --- |
| **R4-2205960**, TP to TR 38.854 on Legacy RRM Requirement Mobility Performance in HST FR2 Deployment Scenarios, by Nokia, Nokia Shanghai Bell | |
| **Company** | **Comments** |
| XXX |  |
| YYY |  |
| ZZZ |  |

|  |  |
| --- | --- |
| **R4-2205961**, TP to TR 38.854 on Analysis of Mobility Performance in HST FR2 Deployment Scenarios, by Nokia, Nokia Shanghai Bell | |
| **Company** | **Comments** |
| XXX |  |
| YYY |  |
| ZZZ |  |

|  |  |
| --- | --- |
| **R4-2203901**, Draft CR on RLM/BFD requirement for FR2 HST, by CATT | |
| **Company** | **Comments** |
| **Ericsson** | RX beam number is 8 with respect to previous agreements.  Suggest changing to ‘The value of TEvaluate\_CBD\_SSB is defined in Table 8.5.5.2-2 for FR2 power class 6, scaling factor N=8 when [enable high speed measurement for FR2] is configured’ |
| YYY |  |
| ZZZ |  |

|  |  |
| --- | --- |
| **R4-2205894,** Draft CR to introduce active TCI state switching delay requirement for FR2 HST UE, by Samsung | |
| **Company** | **Comments** |
| XXX |  |
| YYY |  |
| ZZZ |  |

|  |  |
| --- | --- |
| **R4-2205893**, Remaining Issues on signaling characteristics requirements for FR2 HST, by Samsung   * text proposal for FR2 HST UE SSB-based RLM evaluation period * text proposal for MAC-CE based TCI state switching delay | |
| **Company** | **Comments** |
| XXX |  |
| YYY |  |
| ZZZ |  |

## 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.*

|  |  |
| --- | --- |
| **Sub-topic** | **Status summary** |
| **Sub-topic #2-X:** TBA | **Issue 2-x-x: TBA**  *Background:*  TBA  *Tentative agreements:*  TBA  *Candidate options:*   * Option 1: * Option 2:   *Recommendations for 2nd round:*  TBA |
| **Sub-topic #2-1: TBA** | **Issue 2-1-1: TBA**  *Background:*  TBA  *Tentative agreements:*  TBA  *Candidate options:*   * Option 1: * Option 2:   *Recommendations for 2nd round:*  TBA  **Issue 2-1-2: TBA**  *Background:*  TBA  *Tentative agreements:*  TBA  *Candidate options:*   * Option 1: * Option 2:   *Recommendations for 2nd round:*  TBA |

### CRs/TPs

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

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

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

TBA

### Sub-topic 2-2: TBA

#### Issue 2-2-2: TBA

*Agreements from round 1:*

TBA

*Candidate options:*

* Option 1:
* Option 2:

*Recommendations for 2nd round:*

TBA

*Contributor Comments:*

|  |  |
| --- | --- |
| **Company** | **Comments** |
| XXX |  |
| YYY |  |
| ZZZ |  |

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# 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

**Contact information**

|  |  |  |
| --- | --- | --- |
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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 making comments, i.e., Company A (XX, XX)