**3GPP TSG RAN WG1 #122 R1-2505885**

**Bengaluru, India, Aug 25th – 29th, 2025**

**Source: Moderator (Apple)**

**Title: FL Summary #1 of NR Mobility enhancement Phase 4**

**Agenda item:** **8.9.1**

**Document for:** **Discussion and Decision**

# 1 Introduction

This document summarizes the contributions made under the “Measurement releated enhancements for LTM” agenda item of the Rel-19 work item ‘NR mobility enhancements Phase 4’.

# 2. Contact people

For potential offline discussion, companies/delegates are encouraged to enter the contact information in the table below:

|  |  |  |
| --- | --- | --- |
| Name | Company | Email address |
| Hong He | Apple (FL) | hhe5@apple.com |
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# 3. CSI acquisition

Issue 3-1: Active CSI-RS resource and Counting

To support robust early Channel State Information (CSI) acquisition, consensus was reached to enable both CSI-RS and SP-CSI-RS mechanisms. Multiple contributors—including HW [2], Nokia [4], ZTE [5], vivo [7], Ericsson [9], Lenovo [11], LGe [12], and Google [14]—raised and examined key issues related to the handling of P/SP-CSI-RS transmissions, particularly in relation to the timing and behavior before and after the CSC command MAC-CE.

The following agreements were reached during previous RAN1 meetings:

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| --- |
| **Conclusion**  For the counting of active CSI-RS ports/resources before CSC, no new UE capability is introduced. The total number of active CSI-RS ports/resources is limited by legacy capability report. The total number of active CSI-RS ports/resources is shared by serving cell and candidate cell(s).  **Agreement**  A list of interference measurement resources for candidate cells is supported for LTM CSI acquisition   * If this list is not configured, CMR is used for interference measurement   **Agreement**  CSI report configuration for CSI acquisition is determined from the field of Target Configuration ID in CSC MAC CE  **Conclusion**  For the LTM CSI acquisition after CSC until the completion of LTM procedure, CPU is not defined |

The following was agreed in RAN2 130 meeting [15]:

1. UE deactivates SP CSI-RS resource of candidate cells (other than the target cell) after cell switch. FFS on the target cell.

Additionally, distinct UE capabilities are defined based on the timing of candidate cell measurement—FG 63-6 and 63-6a apply to UEs that perform measurements after receiving the CSC MAC-CE, while FG 63-7 and 63-7a pertain to UEs capable of measuring even prior to the CSC MAC-CE.

### **Issue 3-1-1: Active P-CSI-RS counting**

**Description**:

Counting the active **periodic** CSI-RS for CSI acquisition and L1-RSRP measurements for LTM candidate cells

**Company views and analysis**

Periodic CSI-RS for candidate cells are configured by RRC signaling. In legacy configurations for the serving cell, periodic CSI-RS resources are treated as active once they are configured. The UE measures these P-CSI-RS resources and stores the results to enable periodic or on-demand CSI reporting. To manage complexity, the number of simultaneously active CSI-RS resources per BWP is limited based on UE capability. RAN1 agreed to reuse the capability to support P-CSI-RS for candidate cells in LTM.

**Table 3-1-1: Active P-CSI-RS for Candidate Cells in LTM**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Case | UE capability | How to define the duration of active P-CSI-RS resource for candidate cell? | | |
| Starting time | Ending time | |
| Target cell indicated in CSC MAC-CE | Non-Target cell |
| 1 | UE capable of CSI acquisition of performing early CSI measurement operations **before** and after LTM CSC MAC CE | * The time instance when the periodic CSI-RS is configured by higher layer signaling * Support: HW, Nokia | * Opt.1: Keep activate until the cell switch procedure completion   (Support: Nokia )   * Opt.2: Released, after receiving CSC MAC-CE (Support: HW, [Lenovo]) | After receiving CSC MAC-CE,   * Release the P-CSI-RS resouces. (Support: HW, Nokia) |
| 2 | UE capable of performing early CSI measurement operations **only after** LTM CSC MAC CE | * The time instance after receiving CSC MAC-CE * Supprot: Ericsson | * Completion of cell switch |

There is a general convergence among companies regarding the starting time for considering the P-CSI-RS as 'active' and the approach to handling resources for the non-target cell. However, further discussion is required to reach consensus on the appropriate ending time for the target cell, particularly in Case 1.

From the Feature Lead's perspective on the ending time for target cell, Option 1 appears to be more consistent with the RAN2 agreement on SP-CSI-RS behavior—specifically, that deactivation occurs following the cell switch procedure completion rather than upon reception of the CSC MAC-CE. Adopting Option 1 would also enable the definition of a unified UE behavior across both target and non-target cells in Case 1 and Case 2.

Based on the anylysis and company views, the following is the recommendation from the moderator:

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| **Moderater Proposal 3-1-1: After reception of a LTM CSC MAC-CE, the UE releases the periodic CSI-RS resources** **and ports configured for early CSI acquisition and L1-RSRP measurement in any LTM Candidate cell that is not indicated by the LTM CSC MAC-CE.** | | |
| **Company** | **View/Positions** | **Comments**  **(If a particular scheme is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia | Support | This may only be needed if the UE performs CSI acquisition measurements before the reception of the CSC. Therefore, “For a UE capable of performing CSI acquisition measurement before receiving the LTM CSC MAC CE” can be added in the starting. |
| Ericsson | Support |  |

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| --- | --- | --- |
| **Moderater Proposal 3-1-2: For a UE capable of CSI acquisition of performing early CSI measurement operations before and after LTM CSC MAC CE, the P-CSI-RS resources and ports are counted as active as follows:**   * + - **Starting from time instance when the periodic CSI-RS is configured by higher layer signaling**     - **FFS to select one of two proposed options as the ending time of P-CSI-RS for target cell indicated in the CSC MAC-CE.**        * **Opt.1: After reception of CSC MAC-CE.**       * **Opt.2: After the completion of LTM Cell Switch procedure.**          + **In other words, the P-CSI-RS resources and ports are counted as ‘active’, after receiption of CSC MAC-CE and until LTM cell switch procedure is completed.** | | |
| **Company** | **View/Positions** (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a particular scheme is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)**  **(For FFS aspect, please provide the preferred option and briefly explain the reason)**  **(Kindly also indicate which option is preferred for P-CSI-RS configured for L1-RSRP measurement)** |
| Nokia | Please check comment | We are fine with the starting point.  For the ending time for the target cell, we first need to agree on the CSI reporting procedure (issue 3-2). If the UE is allowed to report CSI after the first invalid report, then the UE may need to keep CSI-RSs active after the first report to make any further measurement and derive CSI. |
| Ericsson |  | Note that Opt. 1 and Opt. 2 has implications on Issue 3-2. If the CSI-report in the first UL resource is out-of-range, retransmission will not be possible if the resources/ports are not active. We need to decide about 3-2 first. |

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| **Moderater Proposal 3-1-3: For a UE capable of CSI acquisition of performing early CSI measurement operations only after LTM CSC MAC CE, the P-CSI-RS resources and ports are counted as active as follows:**   * + - **Starting from time instance after receiving CSC MAC-CE.**     - **FFS on exact timing at which the UE releases the P-CSI-RS configuration.** | | |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a particular scheme is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)**  **(For FFS aspect, please provide the preferred option and briefly explain the reason)** |
| Nokia | Yes | For the target cell, for the ending time, we first need to agree on the CSI reporting procedure (issue 3-2). If the UE is allowed to report CSI after the first invalid report, then the UE may need to keep CSI-RSs active after the first report. |
| Ericsson | Yes | Our concern is if UEs count configured resources/ports as active before LTM CSC MAC CE although they are not capable of performing any measurements on them until after LTM CSC MAC CE. |

### **Issue 3-1-2: Active SP-CSI-RS counting**

**Description**:

Counting the active **Semi-persistent** CSI-RS for CSI acquisition and L1-RSRP measurements for LTM candidate cells

**Company views and analysis**

Table 3-1-2 is intended to reflect company views on when SP-CSI-RS resources and ports are considered 'active,' based on the submitted contribution.

**Table 3-1-2: Active SP-CSI-RS for Candidate Cells in LTM**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Case | UE capability | How to define the duration of active SP-CSI-RS resource for candidate cell? | | |
| Starting time | Ending time | |
| Target cell indicated in CSC MAC-CE | Non-Target cell |
| 1 | UE capable of CSI acquisition of performing early CSI measurement operations **before** and after LTM CSC MAC CE | * The time instance when the SP CSI-RS activation MAC CE is applied   (Support: HW, Nokia) | * Opt.1: Keep activate until the cell switch procedure completion   (Support: Nokia, [vivo], Google)   * Opt.2: deactivated once receiving CSC MAC-CE * (Support: HW, Lenovo?) | After receiving CSC MAC-CE,   * Release the P-CSI-RS resouces. * [FL comment: This was agreed in RAN2 already and no need to discuss in RAN1] |
| 2 | UE capable of performing early CSI measurement operations **only after** LTM CSC MAC CE | * The time instance after receiving CSC MAC-CE, if the SP-CSI-RS is actived by SP CSI-RS activation MAC CE before CSC MAC-CE.   (Supprot: Ericsson) | * Completion of cell switch |

SP-CSI-RS resource largely mirrors P-CSI-RS, with the key difference being its activation via MAC-CE from the serving cell instead of an RRC signal. Similar to the periodic CSI-RS case, companies generally agree on the starting time—defined by the application of the SP-CSI-RS MAC-CE. However, the ending time for Case 1 remains a topic requiring further discussion. As with P-CSI-RS analysis, aligning the ending time with the completion of the LTM cell switch procedure offers a possibility toward a unified UE behavior across both Case 1 and Case 2. Furthurmore, RAN2 has already agreed to deactivate all SP-CSI-RS resources for candidate cells not listed in the CSC MAC-CE, so no additional discussion on this topic is required within RAN1.

TPs have been submitted by ZTE [5] and vivo [7]. As their relevance hinges on the resolution of current open issues, FL intends to discuss them once a decision has been reached.

Based on the anylysis and company views, the following is the recommendation from the moderator:

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| **Moderater Proposal 3-1-4: For a UE capable of CSI acquisition of performing early CSI measurement operations before and after LTM CSC MAC CE, the SP-CSI-RS resources and ports are counted as active as follows:**   * + - **Starting from time instance when the SP CSI-RS activation MAC CE is applied.**     - **FFS to select one of two proposed options as the ending time of SP-CSI-RS for ‘target cell’ indicated in the CSC MAC-CE.**        * **Opt.1: After reception of CSC MAC-CE.**       * **Opt.2: After the completion of LTM Cell Switch procedure.**          + **In other words, the SP-CSI-RS resources and ports are counted as ‘active’, after receiption of CSC MAC-CE and until LTM cell switch procedure is completed.** | | |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a particular scheme is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)**  **(For FFS aspect, please provide the preferred option and briefly explain the reason)**  **(Kindly also indicate which option is preferred for P-CSI-RS configured for L1-RSRP measurement)** |
| Nokia | Please check comment | We are fine with the starting point.  For the ending point, we have a similar comment as for P-CSI-RSs: the ending point will depend on how long the UE is required to perform measurements for CSI reporting (issue 3-2). In addition, the SP CSI-RS deactivation command needs to be taken into account. If a deactivation command is received before the CSC, then the UE will no longer consider those CSI-RSs as active. |
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| **Moderater Proposal 3-1-5: For a UE capable of CSI acquisition of performing early CSI measurement operations only after LTM CSC MAC CE, the SP-CSI-RS resources and ports are counted as ‘active’ as follows:**   * + - **Starting from time instance after receiving CSC MAC-CE.**     - **FFS on exact timing at which the UE deactivate the SP-CSI-RS of target cell.** | | |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a particular scheme is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)**  **(For FFS aspect, please provide the preferred option and briefly explain the reason)** |
| Nokia |  | We are fine with the starting point. For the ending point, it should be the same for both types of UEs, i.e., same solution for proposal 3-1-4 and 3-1-5. |
| Ericsson |  | Our concern is if UEs count configured resources/ports as active before LTM CSC MAC CE although they are not capable of performing any measurements on them until after LTM CSC MAC CE. |

Issue 3-2: CSI Report Retransmission

During RAN1#121, it was agreed that in cases where a valid CSI report is unavailable at the time of reporting, a CSI report with the CQI set to the lowest possible value may be transmitted instead. Three contributions—from [HW,2] [Nokia,4], and [ZTE, 5] — proposed transmitting a valid CSI report in the subsequent PUSCH transmission or retransmission. Furthermore, the TP enabling CSI report retransmission, as outlined in [HW,2] and [ZTE,5], is available for discussion once censensus is established.

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| **Moderater Question 3-2-1: Companies was invited to provide inputs for the proposal below:**   * ***If an invalid CSI report is transmitted in the first UL transmission, a valid CSI report can be multiplexed in the a subsequent transmission.*** * ***On the details of subseqeunt transmisson,***    + ***Opt.1: re-transmission of the first UL transmission [2]***   + ***Opt.2: a PUSCH scheduled by a DCI triggering aperiodic CSI report [4]*** | | |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a particular scheme is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia | Yes | We support Option 2, as it is simpler and allows utilization of the CSI determined by the UE. Without it, if the UE sends the invalid CSI, then whole early CSI acquisition will be wasted.  Option 1 is not clear to us: what is the meaning of “re-transmission”? Is it referring to the configured grant-based scenario where the UE may have multiple configured UL grants allocated? However, this approach may not work for dynamic grant-based cell switching. In contrast, Option 2 would work for any type of cell switch (DG/CG, RACH-less, or RACH-based). |
| Ericsson |  | Opt.1:  Then it is not really a re-transmission since it is another message being sent.  Opt.2: Note that in LTM-CSI-ReportConfig for early CSI-acquisition, the ltm-ReportConfigType is ignored by UE according to RRC Running CR. It follows that DCI triggered aperiodic report is not supported. |

Issue 3-3: Miscellaneous

A set of proposals from one company is outlined below to gather input. FL recommends that companies examine the associated contributions to better comprehend the reasoning behind the proposal prior to stating their positions.

Table

|  |  |  |  |
| --- | --- | --- | --- |
| Index | Proposal description | Background/Justification based on contribution | FL’s Initial Assessment |
| P1 | CRI of individual CSI-IM-Resource in LTM-CSI-IM-ResourceSet is derived from the following formula. where m is the entry index of CSI-IM-ResourceSetId in the LTM-CSI-IM-ResourceSet, k is the entry index of CSI-IM-Resource in the m:th CSI-IM-ResourceSet, K\_s is the number of CSI-IM-Resource in the s:th NZP-CSI-RS-ResourceSet  [Ericsson, 9] | * Because of the different structures, the ordering needs to be clarified and how resources for channel measurements should be associated with resources for interference measurements. |  |
| P2 | Semi-persistent CSI-IM based interference measurement should supported for the CSI acquisition for candidate cells.  [Lenovo, 11] | * Same justification for SP-CSI-RS for CMR measurement. | It appears that the current ASN.1 RRC is able to support SP-CSI-IM for early CSI as it reuses the legacy 'CSI-IM-Resource' IE. However, what's still lacking is an agreement from RAN1 to confirm its support.  From the FL standpoint, supporting SP for both CMR and IMR appears justified, given that the rationale and specification impact are identical. |
| P3 | Introduce ‘cri-RI-PMI-LI-CQI’ for the reportQuantity for CSI acquisition  [Lenovo, 11] | * LI information is needed for FR2. |  |
| P4 | Proposal 1: If the QCLed SSB for a CSI-RS from a candidate cell is not detected by the UE, the UE shall not measure the CSI-RS.  [Lenovo, 11] |  |  |
| P5 | The CSI-RS resources from different candidate cells but associated with a same LTM-CSI-ReportConfig should be configured with a same bandwidth.  [Lenovo, 11] |  |  |
| P6 | Regarding CSI measurement(s) for candidate cell(s) before receiving LTM CSC, support the UE to only keep/store CSI for a limited number of candidate cell(s) before cell switching command, subject to corresponding UE’s capabilities.  [Samsung, 8] |  |  |
| P7 | Regarding early CSI acquisition for LTM, support the UE to send the CSI report at least a time gap after reception of the LTM CSC, where the time gap is provided by the network subject to a corresponding UE’s capability.  [Samsung, 8] |  |  |

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| **Moderater Question 3-2: Which of these proposals are supported?** | | |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a particular scheme is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia |  | P1  Based on our understanding, the latest proposal in the ongoing RRC CR is to reuse the same format of *LTM-NZP-CSI-RS-ResourceSet* for NZP-CSI-RSs, where CSI-RSs from multiple candidate cells can be included in the list, and to define a different format for *LTM-CSI-IM-ResourceSet*, where CSI-IMs can be included only for one candidate cell.  For CSI acquisition, the UE only needs to consider the NZP-CSI-RSs associated with the candidate cell for which the report configuration is provided. After this filtering, each NZP CSI-RS can easily be associated with one CSI-IM, in the same order as given in the CSI-IM-ResourceSet. We propose that such a clarification be explicitly specified.  P2  Agree with FL observation that SP CSI-IM is already supported. We just need add it to the following clause in 38.214.  After a UE receives an LTM Cell Switch Command MAC CE [10, TS 38.321] providing a candidate cell (given by Target Configuration ID field), and a [*ltm-eCSI-ReportConfig*] is configured for the candidate cell, the UE can measure corresponding NZP CSI-RS resources and CSI-IM resources if configured and shall transmit a CSI report to the candidate cell. |
| Ericsson |  | P1: Note that LTM-CSI-IM-ResourceSet can include multiple CSI-IM-ResourceSet, and then the ordering of individual resources not clear. We support P1 but are open to other ways to clarify the ordering. |

Issue 3-4: Others

Companies are invited to highlight any critical issues related to the ‘early CSI report’ for the candidate cell that were proposed in contribution, but missed from FL's summary above.

* Please kindly note that the RRC parameters for all features are seperately addressed in Section 5.
* FL would like to clarify that certain proposals not included in this summary were either previously debated in depth and excluded based on prior agreements (e.g., whether to support of Aperiodic CSI-RS for measurement, whether to introduce new capability for active CSI-RS port counting), or are already supported by existing UE features, or has no specification impact (e.g., not define CPU for LTM).

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| **Company** | **Comments** |
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# 4. Conditional LTM

Two issues have been raised by the companies: one is related to the TCI-State deactivation from [Vivo, 7] and [Samsung,8], and the other involves TA determination from [Sharp, 13]. Additionally, TPs were included in the related contribution, and FL intends to address both matters once consensus has been achieved.

Issue 4-1: TCI-State De-activation

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| **Moderater Question 4-1-1: Is the following proposal from [Samsung, 8] acceptable?**  For C-LTM, after the LTM cell switch is triggered,   * For RACH-less LTM, the UE determines the TCI state in CandidateTCI-State or CandidateTCI-UL-State whose QCL RS has the same value as the RS signaled from higher layer to lower layer that meets the C-LTM execution condition. * For RACH-based LTM triggered in C-LTM, the UE determines the TCI state as the one associated with the SSB determined during RACH procedure. | | |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a particular scheme is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia |  | We are OK with RACH-less CLTM.  But for RACH-based CLTM, we may not need anything to be specified further. |
| Ericsson |  | RAN2 has agreements on which “beam” (RAN2 terminology) the UE should select for C-LTM execution. We can discuss what might need to be captured in RAN1 specification. |

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| **Moderater Question 4-1-2: Is the following proposal from [vivo, 7] acceptable?**   * Activated Candidate TCI state(s), other than the TCI state associated with the selected beam, should be deactivated upon CLTM procedure being triggered. | | |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a particular scheme is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia | Yes | Same behavior as agreed for Rel-18 LTM. |
| Ericsson | Yes |  |

Issue 4-2: TA value determination

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| **Moderater Question 4-2-1: Do you agree that RAN1 should address the following issue:**   * How to determine the subcarrier spacing for a given time alignment value,, when the TA command is received in the LTM Candidate Timing Advance Command MAC CE for conditional LTM? * If the answer is ‘yes’, please share your preferred solution, if available. | | |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a particular scheme is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia | Yes | We are open to discuss this. |
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# 5. RRC Parameters

Issue 5-1: Codebook Configuration

In RAN1#120bis, RAN1 made the following agreement:

**Agreement**

Following restrictions are introduced

* For the codebook configurations in report configuration, *typeI-SinglePanel* is supported for LTM CSI acquisition
* For report frequency configuration in report configuration, wideband CQI and wideband PMI are supported for LTM CSI acquisition
* For the report quantity in report configuration, *cri-RI-PMI-CQI* is supported for LTM CSI acquisition
  + The supported max rank is up to separate UE capability
* For the number of CSI-RS ports of CSI-RS resource(s) associated with a CSI report configuration for a candidate cell for LTM CSI acquisition
  + Up to 128 ports is supported
  + The supported max number of CSI-RS ports is up to separate UE capability

Contributions [Nokia, 4] and [Ericsson, 9] proposed introducing a new IE under the early CSI report configuration to reflect the agreement outlined above. Specifically, [Ericsson, 9] suggests adding a new IE 'codebookConfig-LTM-r19' with a 'choice' structure. In the current RRC ASN.1 framework, 'LTM-CSI-ReportConfig-r18' is reused for early CSI reporting of candidate cells, but it does not include a 'codebookConfig' IE due to pending on the ‘more than 32 ports’ codebook design in Rel-19.

Accordingly, the Feature Lead has put forward the following items for discussion:

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| **Moderater Proposal 5-1: Introduce a new RRC IE for LTM codebook configuration**  CodebookConfig-LTM-r19 ::= CHOICE {  twoToThirtyTwoPorts CodebookConfig,  moreThanThirtyTwoPorts CodebookConfig-r19  ...  }   * Add note in RRC parameter list to inform RAN2 to add ‘typeI and single panel’ restriciton. | | |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a particular scheme is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia | Yes |  |
| Ericsson | Yes |  |

Issue 5-2: Whether to add ‘Repetition’ IE for LTM-NZP-CSI-RS-ResourceSet used for beam-management?

The following was agreed in RAN1 120 meeting:

**Agreement**

* *Repetition=off* is supported for candidate cell CSI-RS in Rel-19.
* *Repetition=on* is not supported for candidate cell CSI-RS in Rel-19.

Three contributions [Nokia,4] [Ericsson,9] [OPPO, 10] explored approaches for incorporating this aspect into the specification as follows:

* Alt.1: Add the optional field ‘repetition’ to LTM-NZP-CSI-RS-ResourceSet [Ericsson, 9] [OPPO,10]
  + When LTM-NZP-CSI-RS-ResourceSet is used for beam-management, ‘repetition’ should be set to ‘off’ and when it is used for early CSI acquisition, the field should be absent.
* Alt.2: To clarify the support of ‘*repetition = off* ‘ in candidate cell CSI-RS configurations, the following assumption should be added to 3GPP TS 38.214: [Nokia,4]
  + The UE shall not assume that the CSI-RS resources within the ltm-NZP-CSI-RS-ResourceSet are transmitted with the same downlink spatial domain transmission filter.

This issue was previously discussed during the RRC parameter session, but no conclusion was reached. The concern was raised on the necessity of the RRC parameter (i.e., Alt.1), given that its only possible value is 'off’, which can already be captured within the RAN1 specification without RRC signal.

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| **Moderater Question 5-2: Which of two alterantive above is preferred?** | | |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a particular scheme is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia | Yes | The Alt.2 is simpler and does not require any RRC changes. |
| Ericsson | Yes | Support Alt.1 since it how it is done with NZP-CSI-RS-ResourceSet |

Issue 5-3: Others

A set of proposals from one company is outlined below to gather input. FL recommends that companies examine the associated contributions to better comprehend the reasoning behind the proposal prior to stating their positions.

Table 5-3: RRC parameters for CSI acqusition

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| --- | --- | --- | --- |
| Index | Proposal description | Background/Justification based on contribution | FL’s Initial Assessment |
| P1 | * Adapt LTM-CSI-ReportConfig to include cqi-Table for CQI reporting [Ericsson, 9] | * Parameter is missed. | Agree |
| P2 | * Clarify in either RAN1 specification or RRC parameters that the LTM-CandidateId-r18 in ltm-CandidateIdList-r19 of LTM-NZP-CSI-RS-ResourceSet-r19 should be same as that of LTM-Candidate-r18 under which CSI report configuration for CSI acquisition is configured. [HW,2] | - | This is necessary because the structure supports both L1-RSRP and CSI acquisition functions and restriction is required for CSI acquisition. |
| P3 | * Information needed for CQI/PMI/RI derivation, such as, BWP SCS, CP, SCS, DMRS mapping related config, should be provided to the UE in the LTM configuration, e.g., in the LTM-candidate IE (but outside of the ltm-CandidateConfig)   [Nokia, 4]. | * At the time of CQI/PMI/RI derivation, the UE may not have access to the target cell configuration, and therefore may lack critical parameters such as BWP SCS, CP, SCS, and DMRS mapping related config, which are needed for accurate derivation. |  |

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| **Moderater Question 5-3-1: Which of these proposals in Table are supported?** | | |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a particular scheme is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia | P1- Yes,  P2- Agree, but please check comment  P3- Yes | P1 – Yes  P2 – Agree, but it is not clear whether a constraint needs to be added in the RRC to only include the CSI-RSs from the candidate cell for which the report configuration is associated, or whether it is sufficient to clarify in the RAN1 specification that the UE shall ignore CSI-RSs from other candidate cells and only measure the CSI-RSs associated with the candidate cell for which the report configuration is provided. I guess the latter approach will be simpler, but we are open to discuss.  P3 – Yes.  These parameters are needed for deriving CQI, PMI, and RI as specified in 5.2.2.5.1 of TS 38.214. One simple solution would be to specify default values in the RAN1 specification, in case avoiding impact to RRC is preferred.. |
| Ericsson | Support P1, P2 |  |

# 6. Text Proposals (TPs)

This section contains a few text proposals—either editorial or straightforward technical proposals—intended to improve the clarity of the specification. FL has listed them to gather company feedback.

TP #1: Early CSI measurement before CSC MAC-CE [Google, 14]

|  |
| --- |
| **Text Proposal 1 for TS 38.214 Clause 5.2.4a**  < Unchanged parts are omitted >  If a valid CSI is not available, the UE shall transmit a CSI report which contains a CQI corresponding to the lowest CQI index. [Depending on the UE capability] the UE may ~~start~~ measure~~ing~~ ~~corresponding~~ NZP CSI-RS resources corresponding to a [*ltm-eCSI-ReportConfig*] before receiving the LTM Cell Switch Command MAC CE [10, TS 38.321]. |

|  |  |  |
| --- | --- | --- |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a TP text is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia | Yes |  |
|  |  |  |

## TP #2: QCL Source RS [Google, 14]

|  |
| --- |
| **Text Proposal 2 for TS 38.213 Clause 21**  < Unchanged parts are omitted >  A UE can be provided by an LTM Cell Switch Command MAC CE in a PDSCH reception on the serving cell [11, TS 38.321] a TCI state ID and/or an UL TCI state ID indicating a *CandidateTCI-State* and/or *CandidateTCI-UL-State* from *ltm-DL-OrJointTCI-StateToAddModList* and/or *ltm-UL-TCI-StateToAddModList* [6, TS 38.214] for applicable receptions or transmissions on a candidate cell from the number of candidate cells. The UE may assume that DM-RS antenna ports for PDCCH receptions and for PDSCH receptions are quasi co-located either with the SS/PBCH block or the TRS in the TCI state with respect to quasi co-location 'typeA' and 'typeD' properties, when applicable, or with the TRS and the CSI-RS resource~~s~~ in the CSI-RS resource set configured with *repetition* in the TCI state with respect to quasi co-location 'typeA' and 'typeD' properties, respectively, when applicable.  < Unchanged parts are omitted > |

|  |  |  |
| --- | --- | --- |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a TP text is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia | Yes |  |
|  |  |  |

## TP #3: Report Setting [CATT, 6]

|  |  |
| --- | --- |
| ***Reason for change:*** | For L1 measurement and reporting, the report quantities of the current SpCell and those of the other candidate cells should be the same. Further, there is a typo at the end of the paragraph. |
|  |  |
| ***Summary of change:*** | 1. For L1 measurement and reporting, change CSI related quantities to be reported of the candidate cells to L1 measurement results. 2. Delete the redundant period at the end of the paragraph. |
|  |  |
| ***Consequences if not approved:*** | Ambiguous on the report quantities of the current serving cell and those of the other candidate cells. |

-------------------------------------------- Start of text proposal to TS 38.214 v19.0.0 -----------------

5.2.1.1 Reporting settings

Each Reporting Setting *CSI-ReportConfig* is associated with a single downlink BWP (indicated by higher layer parameter *BWP-Id*) given in the associated *CSI-ResourceConfig* for channel measurement and contains the parameter(s) for one CSI reporting band: codebook configuration including codebook subset restriction, time-domain behavior, frequency granularity for CQI and PMI, measurement restriction configurations, and the CSI-related quantities to be reported by the UE such as the layer indicator (LI), L1-RSRP, L1-SINR, CRI, SSBRI (SSB Resource Indicator), CapabilityIndex, TDCP, L1-SRS-RSRP, L1-CLI-RSSI, SRS-RSRP-MRI, CLI-RSSI-MRI, CSI-PAI, P-CRI, P-SSBRI, P-L1-RSRP, RS-PAI, CJTC-Dd, CJTC-F, CJTC-Dd-F and CJTC-P.

Each Reporting Setting *ltm-CSI-ReportConfig* is associated with a *LTM-CSI-ResourceConfig* for channel measurement and contains the parameters(s) for time-domain behavior provided by *ltm-ReportConfigType*, the number of cells and the number of reference signals per candidate cell provided by *nrOfReportedCells,* and *nrOfReportedRS-PerCell*, respectively, when *ltm-ReportConfigType* set to ‘periodic’ or ‘semiPersistentOnPUCCH’ or ‘semiPersistentOnPUSCH’ or ‘aperiodic’, comprising L1 measurement results associated with current SpCell if *spCellInclusion* is configured, and the ~~CSI-related quantities~~ L1 measurement results to be reported by the UE provided by *reportQuantity*, if configured.~~.~~

**<<< UNCHANGED PART OMITTED >>>**

-------------------------------------------- End of text proposal to TS 38.214 v19.0.0 ----------------------------

|  |  |  |
| --- | --- | --- |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a TP text is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia | No |  |
|  |  |  |

## TP #4: CSI Report for LTM [CATT, 6]

|  |  |
| --- | --- |
| ***Reason for change:*** | For LTM CSI reporting, there are some limitations on the configuration of reporting parameters, which should be specified in TS 38.214. In addition, the descriptions of the allowed values of these parameters should be aligned with other parts of the specification. |
|  |  |
| ***Summary of change:*** | 1. Remove the bracket of the configuration of reporting parameters for LTM CSI reporting. 2. Define the values of corresponding parameters explicitly. |
|  |  |
| ***Consequences if not approved:*** | Misalignment on the description of reporting parameters for MIMO and LTM. |

-------------------------------------------- Start of text proposal to TS 38.214 v19.0.0 ---------------------------

5.2.4a CSI Reporting for LTM

A UE configured with *LTM-Config* can be provided configurations for CSI acquisition, by up to one Reporting Setting, [*ltm-eCSI-ReportConfig*], for a candidate cell. Each Reporting Setting [*ltm-eCSI-ReportConfig*] is associated with either one or two Resource Settings

- When one Resource Setting (given by higher layer parameter *ltm-ResourcesForChannelMeasurement*) is configured, it provides a list of NZP CSI-RS resources for both channel and interference measurements. The UE is not expected to be configured with more than 128 NZP CSI-RS ports in the CSI-RS resource set contained within the Resource Setting.

- When two Resource Settings are configured, the first Resource Setting (given by higher layer parameter *ltm-ResourcesForChannelMeasurement*) provides a list of NZP CSI-RS resources for channel measurement, and the second Resource Setting (given by higher layer parameter [*ltm-ResourceForInterferenceMeasurements*]), provides a list of [CSI-IM resources] for interference measurement.

~~[~~The UE shall expect the following configuration provided by [*ltm-eCSI-ReportConfig*]:

- ~~For the frequency granularity of the CSI report, the CQI format indicator~~ The higher layer parameter *cqi-FormatIndicator* is set to ~~Wideband CQI~~ ‘widebandCQI’.

- ~~For the frequency granularity of the CSI report, the PMI format indicator~~ The higher layer parameter *pmi-FormatIndicator* is ~~Wideband PMI~~ set to ‘widebandPMI’.

- ~~The codebook type~~ The higher layer parameter *codebookType* is set to *~~typeI-SinglePanel~~* ‘typeI-SinglePanel’*.*

- The *reportQuantity* is set to ‘cri-RI-PMI-CQI’.~~]~~

**<<< UNCHANGED PART OMITTED >>>**

-------------------- End of text proposal to TS 38.214 v19.0.0 ---------------------------------------

|  |  |  |
| --- | --- | --- |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a TP text is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia | No | There is currently no *cqi-FormatIndicator*, *pmi-FormatIndicator*, or *codebookType* defined in the LTM CSI report configuration. In order to accept the proposed change, we first need to agree to add such parameters. |
|  |  |  |

## TP #5: CSI Report for LTM [CATT, 6]

|  |  |
| --- | --- |
| ***Reason for change:*** | For LTM CSI reporting, both channel measurements and interference measurements would be done by UE. For interference measurement, UE could either measure NZP CSI-RS or CSI-IM depending on the configuration. In TS 38.214, the measurement on CSI-IM resources is missing. |
|  |  |
| ***Summary of change:*** | For LTM CSI reporting, UE should measure CSI-IM resources if configured. |
|  |  |
| ***Consequences if not approved:*** | UE would not measure CSI-IM resources for interference measurement. |

-------------------- Start of text proposal to TS 38.214 v19.0.0 ---------------------------------------

5.2.4a CSI Reporting for LTM

**<<< UNCHANGED PART OMITTED >>>**

After a UE receives an LTM Cell Switch Command MAC CE [10, TS 38.321] providing a candidate cell (given by Target Configuration ID field), and a [*ltm-eCSI-ReportConfig*] is configured for the candidate cell, the UE can measure corresponding NZP CSI-RS resources and CSI-IM resources if configured, and shall transmit a CSI report to the candidate cell.

**<<< UNCHANGED PART OMITTED >>>**

---------------------- End of text proposal to TS 38.214 v19.0.0 ---------------------------------------

|  |  |  |
| --- | --- | --- |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a TP text is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia | Yes |
|  |  |  |

## TP #6: CSI Report for LTM [OPPO, 10]

|  |
| --- |
| 5.2.4a CSI Reporting for LTM  <omitted text>  A UE configured with *LTM-Config* can be provided configurations for CSI acquisition, by up to one Reporting Setting, [*ltm-eCSI-ReportConfig*], for a candidate cell. Each Reporting Setting [*ltm-eCSI-ReportConfig*] is associated with either one or two Resource Settings  - When one Resource Setting (given by higher layer parameter *ltm-ResourcesForChannelMeasurement*) is configured, it provides a list of NZP CSI-RS resources for both channel and interference measurements. The UE is not expected to be configured with more than 128 NZP CSI-RS ports in the CSI-RS resource set contained within the Resource Setting.  - When two Resource Settings are configured, the first Resource Setting (given by higher layer parameter *ltm-ResourcesForChannelMeasurement*) provides a list of NZP CSI-RS resources for channel measurement, and the second Resource Setting (given by higher layer parameter [*ltm-ResourceForInterferenceMeasurements*]), provides a list of [CSI-IM resources] for interference measurement. The UE is not expected to be configured with more than 128 NZP CSI-RS ports in the CSI-RS resource set contained within the Resource Settings.  The UE shall expect the following configuration provided in each [*ltm-eCSI-ReportConfig*]:  - For the frequency granularity of the CSI report, the CQI format indicator is Wideband CQI.  - For the frequency granularity of the CSI report, the PMI format indicator is Wideband PMI.  - The codebook type is *typeI-SinglePanel.*  - The *reportQuantity* is set to ‘cri-RI-PMI-CQI’.  <omitted text> |

|  |  |  |
| --- | --- | --- |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a TP text is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia | Yes |  |
|  |  |  |

## TP #7: Inclusion of SpCell in CSI report [Samsung, 8]

In RAN1 #121, the following agreement was made:

|  |
| --- |
| **Agreement**  When *SpCellInclusion* is configured for gNB configured reporting for L1-RSRP based on CSI-RS, the following rule is used to determine the CSI-RS for current SpCell:   * NZP-CSI-RS resources in [*ltm-CSI-NZP-CSI-RS-ResourceList*] associated with the current SpCell are the entries where PCI (given by *ltm-CandidatePCI*) and frequency information (given by ssb-Frequency for the SSBs QCLed with NZP-CSI-RSs) of the candidate cell associated with the *LTM-CandidateId* (given by the corresponding entry in *ltm-CandidateIdList*) is equal to the PCI and center frequency of cell-defining SSB of the current SpCell. |

In addition to utilizing the frequency information of the QCLed SSB, Samsung proposed directly leveraging the frequency information of a candidate cell configured with NZP CSI-RS(s). However, it remains uncertain for FL whether the UE is aware of the candidate cell's ARFCN during the measurement phase, since this information is embedded in a separate container that the UE begins to interpret only after receiving the CSC MAC-CE.

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5.2.1.4.2 Report quantity configurations

<Unchanged parts are omitted>

- if the UE is configured with *spCellInclusion* with *reportQuantity* set to 'cri-RSRP’, the UE shall report in a single reporting instance *nrOfReportedRS-PerCell* different CRIfor the current SpCell and each of the *nrOfReportedCells -1* candidate cells.Otherwise, the UE shall report in a single reporting instance *nrOfReportedRS-PerCell* different CRI for each of the *nrOfReportedCells* candidate cells,

- where CRI *k* (*k* ≥ 0) corresponds to the configured (*k*+1)-th entry of the associated *[ltm-CSI-NZP-CSI-RS-ResourceList]* in the corresponding *[ltm-CSI-NZP-CSI-RS-ResourceSet]*,

- if *spCellInclusion* is configured, NZP-CSI-RS resources in [*ltm-CSI-NZP-CSI-RS-ResourceList*] associated with the current SpCell are the entries where PCI (given by *ltm-CandidatePCI*) and frequency information (given by *ssb-Frequency* for the SSBs QCLed with NZP-CSI-RSs or associated with the candidate cell) of the candidate cell associated with the *LTM-CandidateId* (given by the corresponding entry in *ltm-CandidateIdList*)) is equal to the PCI and center frequency of cell-defining SSB of the current SpCell.

<Unchanged parts are omitted>

|  |  |  |
| --- | --- | --- |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a TP text is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia | No | We have a slightly different understanding of the proposal compared to the feature lead’s observation.  Our understanding is that Samsung wants to add support for determining the frequency information from the “SSBs associated with the candidate cell”. Currently, the frequency information is determined from “SSBs that are QCLed with NZP-CSI-RSs”. Since there will always be an SSB QCLed with a CSI-RS, the proposed change is unnecessary. |
|  |  |  |

## TP #8: Determination of CSI-RS resource for measurement after receiving CSC MAC CE [ZTE, 5]

**Summary of change:**

The following changes are made in Clause 5.2.4a of TS 38.214-j00:

* **#1:** Adding “with higher layer parameter *resourceType* set to 'periodic'” after the sentence “....the UE can measure corresponding NZP CSI-RS resources”.
* **#2:** Adding the case of providing CSI-IM resources.
* **#3:** Adding the relevant description of validity of periodic CSI-RS resources after that UE receives LTM Cell Switch Command MAC CE.

**Consequence if not approved:**

The UE behavior on NZP CSI-RS and/or CSI-IM measurement is unclear, after UE receives LTM Cell Switch Command MAC CE.

***Text proposal 1:*** *Adopt the following text change in Clause 5.2.4a of TS 38.214-j00.*

|  |
| --- |
| **5.2.4a CSI Reporting for LTM**  <Unchanged part omitted>  After a UE receives an LTM Cell Switch Command MAC CE [10, TS 38.321] providing a candidate cell (given by Target Configuration ID field), and a [*ltm-eCSI-ReportConfig*] is configured for the candidate cell, the UE can measure corresponding NZP CSI-RS resources with higher layer parameter *resourceType* set to 'periodic' and/or CSI-IM resources, starting from the first slot that is after slot, where the UE would transmit a PUCCH or PUSCH with HARQ-ACK information in slot n corresponding to the PDSCH carrying the LTM Cell Switch Command MAC CE and ** is the SCS configuration for the PUCCH or PUSCH, and shall transmit a CSI report to the candidate cell.  <Unchanged part omitted> |

|  |  |  |
| --- | --- | --- |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No, or specify the preferred option.) | **Comments**  **(If a TP text is generally acceptable but requires adjustments to the specific wording, please suggest revised phrasing in the ‘comments’ column.)** |
| Nokia |  | We have not agreed on such a timeline. In addition, it is unclear why only periodic CSI-RSs are mentioned. In our view, the behavior should be the same for both P-CSI-RSs and active SP-CSI-RSs. |
|  |  |  |

# 7. Others

Issue 7-1: Joint Operation of ‘UE-Initiated LTM report’ and mTRP

The joint operation of the 'UE-initial LTM report' and the multiple-TRP feature in the source gNB was raised by [OPPO, 10]. FL notes that this topic was thoroughly discussed during the RAN1 #120 meeting. The following conclusions were made in RAN1 and conveyed in a liaison statement to RAN2:

|  |
| --- |
| **Conclusion**  The following is up to RAN2: Coexistence of LTM event triggered reporting and mTRP operation at serving cells |

In addtion, RAN2 is currently discussing this matter and intends to reach a conclusion during the upcoming August meeting as clearly indicated in the RAN2 chairman note below [15]:

1. For co-existence with mTRP, will be revisited in August. If one simple solution is not prepared / agreed until / in August meeting, we will not apply mTRP in Rel-19 event-triggered MR.

In light of the above discussion, FL intends to deprioritize this topic and defer it to RAN2, in line with the prior agreement—unless a consensus emerges to revisit and overturn the earlier conclusion.

|  |  |  |
| --- | --- | --- |
| **Moderater Proposal 7-1: Companies are invited to provide views on potential reverting the prior conclusion and to discuss the following mTRP proposals from [OPPO,10]:**   * *Support the scenario where serving cell configures both mTRP and UE-initiated LTM reporting.* * *When the serving cell has two indicated joint/DL TCI states:* * *The UE derive two RSs for serving cell evaluation and each RS is from the QCL RS or the SSB that the QCL RS is QCLed to of each indicated joint/DL TCI state.* * *The L1-RSRP measurement of serving cell for LTM event evaluation is the minimum value of the L1-RSRP measurement of those two RSs.* | | |
| **Company** | **View/Positions**  (Please indicate your support: Yes, No.) | **Comments** |
| Nokia | No | RAN1 has already reached a conclusion on this topic. Based on that, RAN2 is discussing the issue and is expected to reach a conclusion. Therefore, there is no need to re-discuss this in RAN1. |
|  |  |  |

Companies are invited to highlight any critical issues to be discussed in this meeting for LTM:

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

# References

1. 3GPP RP-242356, Revised Work Item: NR mobility enhancements Phase 4, 3GPP TSG RAN Meeting #105, September 2024.
2. R1-2505231 Maintenance on measurements related enhancements for LTM Huawei, HiSilicon
3. R1-2505160 Remaining issues on measurements related enhancements for LTM Spreadtrum, UNISOC
4. R1-2505244 Maintenance on measurement related enhancements for LTM Nokia
5. R1-2505271 Maintenance on measurements related enhancements for LTM ZTE Corporation, Sanechips
6. R1-2505333 Maintenance on measurements related enhancements for LTM CATT
7. R1-2505386 Maintenance on measurements related enhancements for LTM vivo
8. R1-2505550 Remaining issues on Rel-19 LTM including CSI-RS based measurement/reporting and early CSI acquisition Samsung
9. R1-2505623 Maintenance on NR mobility enhancements Phase 4 Ericsson
10. R1-2505740 Remaining Issues of measurement enhancement for LTM OPPO
11. R1-2505811 Maintenance on the measurements for LTM Lenovo
12. R1-2505848 Remaining issues on measurements related enhancements for LTM LG Electronics
13. R1-2506071 Maintenance on measurements related enhancements for LTM Sharp
14. R1-2506350 Maintenance on measurements related enhancements for LTM Google
15. Chairman note of RAN2 130 meeting