**3GPP TSG RAN WG1 Meeting #120 R1-25xxxxx**

**Athens, Greece, February 17th-21st, 2025**

**Source: Moderator (Fujitsu)**

**Title: FL summary 1 of Measurements related enhancements for LTM**

**Agenda Item: 9.9.1**

**Document for: Information**

# Introduction

This contribution is a Feature Lead (FL) summary for A.I. 9.9.1: Measurements related enhancements for LTM

# Plan for Online discussion

##### [Proposals for Monday Online]

Order may be changed depending on the input from companies

[[FL proposal 1-3-1-v1]](#_[FL_proposal_1-3-1-v1]) SP CSI-RS for gNB scheduled reporting (Confirming WA)

[[FL proposal 1-3-2-v1]](#_[FL_proposal_1-3-2-v1]) SP CSI-RS for event triggered reporting

[[FL proposal 1-3-3-v1]](#_[FL_proposal_1-3-3-v1]) AP CSI-RS for gNB scheduled reporting

[[FL proposal 1-6-v1]](#_[FL_proposal_1-6-v1]) CSI-RS resource set and the constraint of configurations

[[FL proposal 3-4-1-v1]](#_[FL_proposal_3-4-1-v1]) RS type identification for event LTM2

[[FL proposal 3-4-2-v1]](#_[FL_proposal_3-4-2-v1]) support of mTRP for serving cell

##### [Proposals for Tuesday & Thursday Offline]

[[FL proposal 5-1-1-v1]](#_[FL_proposal_5-1-1-v1])[[FL proposal 5-1-2-v1]](#_[FL_proposal_5-1-2-v1]) CSI-acquisition framework

[[FL Proposal 3-5-v1]](#_[FL_Proposal_3-5-v1]) filtering for event evaluation and reporting

##### [Proposals for Thursday Online]

[[FL Proposal 3-5-v1]](#_[FL_Proposal_3-5-v1]) filtering for event evaluation and reporting

[[FL proposal 5-1-1-v1]](#_[FL_proposal_5-1-1-v1])[[FL proposal 5-1-2-v1]](#_[FL_proposal_5-1-2-v1]) CSI-acquisition framework

##### [Proposals for Friday Online]

[[FL proposal 1-5-v1]](#_[FL_proposal_1-5-v1]) timing reference for CSI-RS measurement

[[FL proposal 5-2-v1]](#_[FL_proposal_5-2-v1]) time domain property on CSI-RS resource for CSI-acquisition

# Contact people

The following table is reused from the previous meeting. Please update it if necessary.

|  |  |  |
| --- | --- | --- |
| Name | Company | Email address |
| Yosuke Akimoto | Fujitsu (FL) | akimoto.yosuke@fujitsu.com |
| Taewoo Lee | Fujitsu | lee.taewoo@fujitsu.com |
| Paul Marinier | InterDigital | paul.marinier@interdigital.com |
| Frank Zhang, Caroline Liang, Zhen He | NEC | zhang\_bohang@nec.cn, Caroline.Liang@emea.nec.com, he\_zhen@nec.cn |
| Yu Yang | Spreadtrum | yu.yang2@unisoc.com |
| Didi Zhang | TCL | didi.zhang@tcl.com |
| Jaenam Shim | LG Electronics | jaenam.shim@lge.com |
| Minwoo Song | LG Electronics | minwoo1.song@lge.com |
| Hyunsoo Ko | LG Electronics | hyunsoo.ko@lge.com |
| Sanjay Goyal | Nokia | sanjay.goyal@nokia.com |
| Ling YANG | ZTE Corporation, Sanechips | yang.ling17@zte.com.cn |
| Jiayin Zhang | Huawei, HiSilicon | zhangjiayin@huawei.com |
| Yan LI | CMCC | liyanwx@chinamobile.com |
| Ren Da | CATT | renda@catt.cn |
| Naoki Kusashima | Sony | naoki.kusashima@sony.com |
| Dalin Zhu | Samsung | dalin.zhu@samsung.com |
| Alex Liou | Google | alexliou@google.com |
| Bingchao Liu | Lenovo | liubc2@lenovo.com |
| Yongsun Kim | ETRI | doori@etri.re.kr |
| Kapseok Chang | ETRI | kschang@etri.re.kr |
| Nanxi Li | China Telecom | linanxi@chinatelecom.cn |
| Jerome Vogedes | AT&T | [Jerome.vogedes@att.com](mailto:Jerome.vogedes@att.com)  (CN: [jov\_travel1024@outlook.com](mailto:jov_travel1024@outlook.com)) |
| Hanjun Kim | KT Corp. | hj0704.kim@kt.com |
| Claes Tidestav | Ericsson | claes.tidestav@ericsson.com |
| Gustav Lindmark | Ericsson | gustav.lindmark@ericsscon.com |
| Mingju LI | Xiaomi | limingju@xiaomi.com |

# List of Contributions

## Contributions under AI 5 (LS)

|  |  |  |
| --- | --- | --- |
| [**R1-2500011**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500011.zip) | RAN2 agreements on Inter-CU LTM and Conditional LTM | RAN2, Lenovo |
| [**R1-2500027**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500027.zip) | Reply LS for LS on the support of semi-persistent CSI-RS resource for LTM candidate cells | RAN3, CATT |

FL view is that no LS reply is needed.

## Contributions under 9.9.1

|  |  |  |
| --- | --- | --- |
| [R1-2500081](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500081.zip) | Measurements related enhancements for LTM | Huawei, HiSilicon |
| [R1-2500180](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500180.zip) | Discussion on measurements related enhancements for LTM | Spreadtrum, UNISOC |
| [R1-2500238](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500238.zip) | Views on measurements related enhancements for LTM | CATT |
| [R1-2500245](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500245.zip) | Discussion on measurements related enhancements for LTM | ZTE Corporation, Sanechips |
| [R1-2500253](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500253.zip) | Discussion on measurements related enhancements for LTM | LG Electronics |
| [R1-2500299](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500299.zip) | Discussion on measurements related enhancements for LTM | CMCC |
| [R1-2500318](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500318.zip) | Measurements enhancements for LTM | TCL |
| [R1-2500364](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500364.zip) | Discussion on measurements related enhancements for LTM | vivo |
| [R1-2500415](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500415.zip) | Measurement related enhancements for LTM | Nokia |
| [R1-2500475](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500475.zip) | Discussions on measurement enhancement for LTM | OPPO |
| [R1-2500562](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500562.zip) | Discussion on measurement related enhancements for LTM | Lekha Wireless Solutions |
| [R1-2500624](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500624.zip) | Discussion on measurements related enhancements for LTM | NEC |
| [R1-2500631](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500631.zip) | Discussion on measurement related enhancements for LTM | Fujitsu |
| [R1-2500641](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500641.zip) | Measurements related enhancements for LTM | InterDigital, Inc. |
| [R1-2500662](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500662.zip) | Measurements related enhancements for LTM | Sony |
| [R1-2500703](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500703.zip) | Measurements related enhancements for LTM | Lenovo |
| [R1-2500744](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500744.zip) | Discussion on measurements related enhancements for LTM | Xiaomi |
| [R1-2500803](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500803.zip) | Measurement related enhancements for LTM | Apple |
| [R1-2500864](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500864.zip) | Views on Rel-19 measurement related enhancements for LTM | Samsung |
| [R1-2500918](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500918.zip) | Discussion on measurements related enhancements for LTM | ETRI |
| [R1-2500992](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500992.zip) | Measurement related enhancements for LTM | Ericsson |
| [R1-2501086](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2501086.zip) | Measurement Enhancements for LTM | Meta |
| [R1-2501091](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2501091.zip) | Discussion on measurements related enhancements for LTM | KDDI Corporation |
| [R1-2501170](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2501170.zip) | Measurements related enhancement for LTM | Qualcomm Incorporated |
| [R1-2501214](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2501214.zip) | Discussion on measurement related enhancements for LTM | NTT DOCOMO, INC. |
| [R1-2501244](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2501244.zip) | Discussion on measurements related enhancements for LTM | Sharp |
| [R1-2501315](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2501315.zip) | LTM measurements related enhancements | MediaTek |
| [R1-2501337](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2501337.zip) | Discussion on measurements related enhancements for LTM | Google |
|  |  |  |

|  |  |  |
| --- | --- | --- |
| [R1-2500419](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120/Docs/R1-2500419.zip) | FL plan for mobility enhancements in RAN1#120 | Moderator (Fujitsu) |
| R1-2500420 | FL summary 1 of Measurements related enhancements for LTM | Moderator (Fujitsu) |
| R1-2500421 | FL summary 2 of Measurements related enhancements for LTM | Moderator (Fujitsu) |
| R1-2500422 | FL summary 3 of Measurements related enhancements for LTM | Moderator (Fujitsu) |
| R1-2500423 | Final FL summary of Measurements related enhancements for LTM | Moderator (Fujitsu) |

# Discussion

## L1 measurement based on CSI-RS

### [No issue] Measurement quantity

##### [Agreements in previous meetings]

**Agreement (RAN1#118)**

* Support L1-RSRP measurement based on CSI-RS
* FFS: Support L1-SINR measurement based on CSI-RS

**Conclusion (RAN1#118bis)**

* There is no consensus in RAN1 on the support L1-SINR measurement based on CSI-RS for candidate cells

##### [Conclusion]

No new issues are identified in this meeting.

### [No issue] Support of intra- and inter frequency measurement

##### [Agreements in previous meetings]

**Agreement (RAN1#118bis)**

* From RAN1 perspective, there is no restriction with regards to the frequency location of CSI-RS used for L1-measurement

##### [Conclusion]

No issues are identified in this meeting.

### [High] Time domain property of CSI-RS for measurement

##### [Agreements in previous meetings]

**Agreement(RAN1#118)**

For gNB scheduled reporting and event triggered reporting

* At least periodic CSI-RS is supported for L1-RSRP measurement for candidate cell
  + FFS: aperiodic and semi-persistent CSI-RS
* At least CSI-RS for beam management is supported for L1-RSRP measurement for candidate cell
  + FFS: CSI-RS for mobility

**Working Assumption(RAN1#118bis)**

In addition to periodic CSI-RS, semi-persistent CSI-RS is supported for candidate cell L1-RSRP measurement for gNB scheduled reporting from RAN1 perspective

* Send an LS to RAN3 (CC RAN2) to ask for the feasibility of specifying the signalling for coordination between serving cell and candidate cell(s) on the transmission of semi-persistent CSI-RS(s) and any other potential issues (e.g. RAN3 workload).

Support of semi-persistent CSI-RS is subject to UE capability.

##### [Summary of contributions]

The following 3issues are identified in this meeting.

**Issue 1: Confirming the WA: Semi persistent CSI-RS resource for gNB scheduled reporting**

* Yes (OK to confirm the WA): Huawei, Spreadtrum, CATT, CMCC, Nokia, Fujitsu, IDC, Lenovo, Apple, KDDI, Qualcomm, DOCOMO, MediaTek
* No companies showed concern

It is also pointed out that the signaling mechanism is also needs to be discussed, which may have no impact in RAN1 but RAN2.

* The legacy activation/deactivation mechanism for a serving cell by MAC CE is reused for candidate cells
  + The CSI-Resource configuration for LTM should indicate the resourceType semi-persistent
  + MAC CE is used to indicate when transmission is turned ON/OFF
  + Reporting is a separate configuration.
* It is suggested to send an LS to RAN2 to request MAC CE signaling to activating/deactivating SP CSI-RSs for candidate cell(s)

**Issue 2: Semi-persistent CSI-RS resource for event triggered reporting**

* Support(5): CATT, Nokia, Fujitsu, ETRI, KDDI
  + For event-triggered reporting configured with an SP CSI-RS, the event evaluation mechanism should only begin after the activation of the SP CSI-RS.
  + Event monitoring can be activated / deactivated in accordance with that of SP CSI-RS
* Concern(2): Samsung, Ericsson
  + Implementation complexity, specification impact
  + Motivation for event triggered reporting is UE takes care of the measurements itself. The benefit is lost if the network takes care of on/off for SP CSI-RS transmission.
* Postpone(1): Qualcomm
  + Wait for a further progress in the UE-initiated beam reporting agenda item.

**Issue 3: Aperiodic CSI-RS resource for gNB scheduled reporting and/or event triggered reporting**

* Support(7): Huawei, CATT, Lekha (gNB scheduled reporting), Lenovo, KDDI, Qualcomm (at least for gNB scheduled reporting), Google (gNB scheduled reporting)
  + Prompt measurement result with less overhead
  + Power consumption reduction for UE and gNB
  + Send LS to RAN3 is needed: asking feasibility of coordination between serving cell and candidate cells in inter-DU and inter-CU scenarios.
* Not support/Concern (5): Spreadtrum, Fujitsu(Event triggered), Samsung, Ericsson, MediaTek
  + Significant impacts on implementation complexity and specifications - over-optimization
  + For event triggered, the benefit is lost if the network takes care of on/off for AP CSI-RS transmission.
* Postpone(1): Qualcomm
  + wait for a further progress in the UE-initiated beam reporting agenda item.

##### [FL observation]

For issue 1, FL thinks the WA can be confirmed. Also, it would be necessary to discuss the mechanism for SP CSI-RS activation/deactivation for candidate cells, which may be the legacy mechanism for the serving cell. If so, RAN1 can ask RAN2 to define the details of the MAC CE signaling.

For issue 2, companies have different views on semi persistent CSI-RS resource for event triggered reporting. Even though the benefit of turning on-off the CSI-RS is understandable (e.g. energy saving for both UE and network side), there is a risk that the benefit of event triggered reporting is lost (i.e. the network needs to take care of the measurement activities at UE side). Given the pros and cons provided companies, FL would suggest supporting SP CSI-RS for event triggered reporting conditioned that “If a SP CSI-RS associated with an LTM event is deactivated, (1) the UE is not required to measure the SP CSI-RS, or (2) the LTM event evaluation is deactivated.”. Otherwise, the UE needs to monitor SP-CSI-RS resources which is not actually transmitted by candidate cells. This is definitely inefficient.

For issue 3, considering the pros and cons provided by companies, the only available proposal in this meeting is “Aperiodic CSI-RS resource is supported at least for gNB scheduled reporting in intra-DU scenario”. FL would like to check if this is acceptable to the group.

##### [FL proposal 1-3-1-v1]

* Confirm the following working assumption made in RAN1#118bis

***Working Assumption(RAN1#118bis)***

*In addition to periodic CSI-RS, semi-persistent CSI-RS is supported for candidate cell L1-RSRP measurement for gNB scheduled reporting from RAN1 perspective*

* *Send an LS to RAN3 (CC RAN2) to ask for the feasibility of specifying the signalling for coordination between serving cell and candidate cell(s) on the transmission of semi-persistent CSI-RS(s) and any other potential issues (e.g. RAN3 workload).*

*Support of semi-persistent CSI-RS is subject to UE capability.*

* MAC CE is used to activate/deactivate the semi-persistent CSI-RS resource similarly to the legacy mechanism for a serving cell, i.e. SP CSI-RS/CSI-IM Resource Set Activation/Deactivation MAC CE, which will be specified in RAN2
* Send an LS to RAN2 to inform this agreement

##### [FL proposal 1-3-2-v1]

Discuss and down-select the following options

* Option 1: SP CSI-RS is not supported for event triggered reporting
* Option 2: SP CSI-RS is supported for event triggered reporting
  + Semi-persistent CSI-RS resource for event triggered reporting is supported
    - For the signaling between serving and candidate cell(s), RAN1 assumes that the same mechanism as gNB scheduled reporting is used. The final decision is up to RAN3.
    - For the signaling of SP CSI-RS activation/deactivation, RAN1 assumes that at least the same mechanism as gNB scheduled reporting can be used.
  + RAN1 assumes that deactivated SP-CSI-RS resources are not used for the event evaluation by a UE. The detailed mechanism is defined in RAN2.
  + Send an LS to RAN2 and RAN3 to inform this agreement

##### [FL proposal 1-3-3-v1]

Discuss and down-select the following options

* Option 1: Aperiodic CSI-RS resource is not supported for gNB scheduled reporting or event triggered reporting
* Option 2: Aperiodic CSI-RS resource is supported at least for gNB scheduled reporting in intra-DU scenario

*FL note: Aperiodic CSI-RS resource for event triggered reporting is excluded from this discussion as it is too controversial.*

##### [Comments to 1-3-1-v1, 1-3-2-v1, 1-3-3-v1]

|  |  |
| --- | --- |
| Company | Comment |
| FL | 1-3-1-v1 is important and has high priority. Meanwhile, FL thinks that this work item can be closed without 1-3-2-v1, 1-3-3-v1, i.e. these are low priority issue. |
| Fujitsu | For FL proposal 1-3-1-v1, we support FL proposal. Since the current mechanism for the SP CSI-RS activation/deactivation is only for serving cell, it is required to discuss how to enhance the activation/deactivation in RAN2 by sending LS.  For FL proposal 1-3-2-v1, we support Option2 to adopt SP CSI-RS in the event triggered reporting in order to achieve network energy saving and to avoid redundant interference. RAN3 already addressed that SP CSI-RS can be supported in the gNB scheduled reporting, and we believe no RAN3 impact is expected since the mechanism of the coordination between serving cell and candidate cells is same with that of the gNB scheduled reporting. Therefore, we need to send LS to RAN2 to ask the detailed mechanism.  For FL proposal 1-3-3-v1, since the serving cell should trigger the CSI-RS transmission at every time when the UE measures, it causes increasing signalling overhead together with coordination with candidate cells. Therefore, we support Option1 not to support aperiodic CSI-RS. |
|  |  |

### [No issue] Type of CSI-RS for L1 measurement

##### [Agreements in previous meetings]

**Agreement**

For gNB scheduled reporting and event triggered reporting

* At least periodic CSI-RS is supported for L1-RSRP measurement for candidate cell
  + FFS: aperiodic and semi-persistent CSI-RS
* At least CSI-RS for beam management is supported for L1-RSRP measurement for candidate cell
  + FFS: CSI-RS for mobility

**Conclusion (RAN1#119)**

* No consensus to support CSI-RS for mobility for L1 measurement in Rel-19 LTM
* Note: From the actual gNB transmission viewpoint, CSI-RS for mobility and CSI-RS for BM may be the same

##### [Conclusion]

No new issue is identified in this meeting.

### [Mid] Timing reference of CSI-RS

##### [Agreement of previous meetings]

Discussion performed only in FL summary. No agreements yet.

##### [Summary of contributions]

Similar to the previous meeting, some companies proposed the issue on measurement timing requirement

* Samsung: To support CSI-RS measurements for LTM procedures, support UE to measure the CSI-RS based on the timing of the associated candidate cell if the associated SSB in the candidate cell is provided for the CSI-RS.
* CATT: CSI-RS of a candidate cell should be associated with SSB of the corresponding candidate cell for obtaining the CSI-RS measurement timing.
* Lenovo: 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.
* TCL: Support CSI-RS based L1 measurements aligned with the timing of the candidate cell(s).
* Apple: A reference serving cell maybe configured for CSI-RS resource measurement on candidate cells, which provides the timing reference for CSI-RS without ‘associated SSB’.
  + For CSI-RS measurement in LTM, legacy procedure and function based on ‘associated SSB’ shall be reused.

##### [FL observations]

Even though companies have a common understanding that UE measures the CSI-RS based on the timing of the associated candidate cell using associated SSB, majority companies saw no RAN1 spec impact on this behaviour at RAN1#119. In FL’s understanding, CSI-RS as TRS for a candidate cell has already been introduced in Rel-18, but there was no RAN1 spec impact.

It is also clarified by one company that refServCellIndex and associatedSSB are used in the legacy mechanism and included in the RRC signaling for L3 mobility.

Given the analysis above, FL thinks a good approach is to make a conclusion to clarify the RAN1 assumption, which may or may not have any RAN1 spec impact but useful for other WGs.

##### [FL proposal 1-5-v1]

Conclusion:

* RAN1 assumes the legacy procedure and function based on the associated SSB (i.e., QCLed SSB) are reused for timing reference of candidate cell CSI-RS measurement in LTM

##### [Comments to 1-5-v1]

|  |  |
| --- | --- |
| Company | Comment |
| Fujitsu | We agree to use QCLed SSB for timing reference of candidate cell CSI-RS measurement. |
|  |  |
|  |  |

### [Mid] High level design of CSI-RS configuration

##### [Agreements in previous meetings]

**Agreement**

* Explicit configuration of CSI-RS resource(s) for candidate cell(s) for L1-measurement is supported

RAN2#127b made the following agreements

**Agreements on L1 event triggered MR**

1. For measurement resource configuration, R18 LTM CSI resource configuration is reused if possible. If CSI-RS resource only IE needs to be defined, we can revisit it in the stage 3.  
2. For measurement reporting configuration, R18 LTM-CSI-ReportConfig is reused if possible. We can revisit it in the stage 3 if needed.  
3. For association between measurement resource configuration and measurement reporting configuration, R18 LTM way is reused if possible. We can revisit it in the stage 3 if needed.

##### [Summary of contributions]

FL thinks it is not necessary to discuss the structure of RRC for CSI-RS because it is handled in RAN2 “[POST128][108][MOB] (Huawei) “. Instead, FL would like to focus on the necessary RRC parameters and the restrictions for them. Instead, the discussions on the following issue would be relevant at this point of time.

**Issue: Restriction on the CSI-RS configuration for L1 measurement to achieve a fair comparison among cells**

* Alt 1: Some parameters defined under NZP-CSI-RS resource, such as below, should be common
  + For the fair comparison between candidate/serving cells.
* Alt 2: No restriction is introduced
  + Applying the same configuration is too restrictive.

Related to this issue, it would be helpful to agree on the resource set concept for CSI-RS.

##### [FL proposal 1-6-v1]

* An LTM report configuration for L1-RSRP is associate with a single resource config that includes:
  + Alt.A: a single resource set containing CSI-RS resources corresponding to multiple candidate cells. i.e., the same design as that of SSB in Rel-18 LTM.
  + Alt.B: multiple resource sets*, where each resource set is associated with a candidate cell,* containing CSI-RS resources.
  + FFS: how to associate between the measurement CSI-RS resources and candidate cells
    - explicit or implicit signaling of candidate cells
* Alt.1: The following parameters shall be the same for all CSI-RS resources associated with the same resource set
  + repetition(same as legacy) – note support of “*repetition=on*” is separately discussed
  + bandwidth – *note: FL thinks achieving the same bandwidth of CSI-RS is Rel-19 LTM needs to support inter-frequency scenario*
  + periodicity
  + frequency domain density
  + number of ports
* Alt.2: The parameters defined in legacy *NZP-CSI-RS-resource* can be different for CSI-RS resources associated with the same resource set

*FL note: it might be better to split this proposal into 2. FL will make the decision after seeing the companies’ view.*

##### [Comments to 1-6-v1]

|  |  |
| --- | --- |
| Company | Comment |
| Fujitsu | We support Alt.A for a single resource set containing CSI-RS resources corresponding to multiple candidate cells as the parameter configuration (e.g., *repetition* and *trs-info*) can be simpler than Alt.B.  For common parameters, we agree with the necessity of the fair comparison. However, we have to further discuss how to set the common parameters, especially for inter-frequency scenario. |
|  |  |
|  |  |

### [Closed] Other issues

##### [Summary of contributions]

The are proposals on the UE capability and restriction on candidate cells for measurement. For UE capability, it would be too early to start this discussion before seeing the whole picture of this functionality. Also, restriction on candidate cells for measurement was not agreed in RAN plenary and hence there is no reason to prioritize in this meeting.

##### [Conclusion]

The discussion of this section is closed without any FL proposal.

## gNB scheduled reporting

### [Paused] Further details of report framework

##### [Agreement in previous meetings]

**Agreement(RAN1#118)**

* CSI-RS based L1-RSRP report is supported for gNB scheduled measurement reporting
* FFS: CSI-RS based L1-SINR report is supported for gNB scheduled measurement reporting
* Rel-18 LTM CSI reporting framework is the baseline for CSI-RS based L1-measurement report by gNB scheduled measurement reporting

**Agreement(RAN1#118bis)**

The agreement “Rel-18 LTM CSI reporting framework is the baseline for CSI-RS based L1-measurement report by gNB scheduled measurement reporting” made in RAN#118 is further clarified for L1-RSRP as follows:

* UCI format defined in Table 6.3.1.1.2-8C of TS38.212 can be used by replacing SSBRI with CRI.
* Whether the L1-RSRP(s) of serving cell is always included is configurable (in line with Rel-18)
* The quantization method defined in clause 5.2.1.4.3 of TS38.214 and bit width defined in Table 6.3.1.1.2-6 of TS38.212 can be used
* No L1 specified filtering for time and spatial domain is introduced
* No enhancement on how to report L cells x M beams
* Periodic reporting on PUCCH is supported
  + FFS: semi-persistent reporting on PUCCH/PUSCH, and aperiodic reporting on PUSCH

**Agreement(RAN1#118bis)**

For CSI-RS based L1-measurement report by gNB scheduled measurement reporting, semi-persistent reporting on PUCCH/PUSCH and aperiodic reporting on PUSCH are supported

##### [Summary of contributions]

The following formula for the definition of CRI is proposed by Huawei

* CRI of individual NZP-CSI-RS-Resource reported in CSI report can be derived from the following formula.
* where
  + m is the entry index of NZP-CSI-RS-ResourceSet in the ltm-NZP-CSI-RS-ResourceSetList,
  + k is the entry index of NZP-CSI-RS-Resource in the mth NZP-CSI-RS-ResourceSet,
  + K\_s is the number of NZP-CSI-RS-Resource in the sth NZP-CSI-RS-ResourceSet.

##### [FL observation]

FL’s understanding is that the proposal above assumes to have multiple resource sets in a resource config, which is also covered under the discussion [[FL proposal 1-6-v1]](#_[FL_proposal_1-6-v1]). Thus, FL would like to suggest waiting for the decision there.

With this understanding, the discussion of this section is paused.

### [Closed] Other issues

##### [Summary of contributions]

**Priority rule**

* LGE: LTM CSI report carrying L1-RSRP is prioritized to the LTM CSI report not carrying L1-RSRP.

**Support of mTRP for target cell**

* Lenovo: group based reporting should be supported
* Vivo, ETRI: the number of indicated TCI states is 2

##### [FL observation]

For priority rule, RAN1 should discuss this issue, if necessary, after the whole picture of Rel-19 functionality (including CSI acquisition) is clarified. For mTRP operation at the target cell, this issue has been well understood from Rel-18 but not supported yet. More supporting companies are necessary to commence the discussion in Rel-19.

##### [Conclusion]

The discussion of this section is closed without any discussion.

## Event triggered reporting

### [No issue] Report container

##### [Agreement in previous meetings]

RAN2 agreed to support MAC CE for the container of event triggered reporting. Therefore, RAN1 discussion on this aspect is not necessary anymore.

##### [Conclusion]

No further discussion is planned unless requested by RAN2

### [No issue] Report quantity

##### [Agreements in previous meetings]

**Agreement(RAN1#118)**

* SSB based L1-RSRP measurements is supported for event triggered reporting
* CSI-RS based L1-RSRP measurements is supported for event triggered reporting
* FFS: CSI-RS based L1-SINR measurements is supported for event triggered reporting

##### [Conclusion]

No further discussion is necessary as no consensus was achieved to introduce L1-SINR

### [Low] Report format and contents

##### [Summary of the contributions]

The following proposal was made by Ericsson, which is related to the ongoing RAN2 email discussion (see email discussion [POST128][108][MOB] RRC running CR (Huawei)) - *Ask RAN1 what should be the maximum number of beam measurement results that can be reported in event-triggered measurement report.*

The proposal by Ericsson is below:

* For event triggered L1 measurement reports, support UE to include up to 4 beams per cell, for up to 4 cells.
  + By including multiple beams from the same LTM Candidate Cell, the network can learn if there are multiple beams with high RSRP in the cell or not.
  + By including measurements from additional LTM candidate cells, the network can learn if there is another LTM candidate cell that has several beams with high RSRP.
* For event-triggered L1 LTM measurement reporting, keep the option to configure up to four nrOfReportedCells, up to four nrOfReportedRS-PerCell and spCelInclusion.

Also, vivo provided their view as follow:

* The value of N (the maximum number of reported beams in a measurement report MAC CE) is 1 for Event LTM2, and 16 for Event LTM3, Event LTM3, and Event LTM5.

Other than that, a couple of companies propose the contents included in event triggered reporting. However, FL believes that this is something RAN2 can do.

##### [FL proposal 3-3-v1]

The maximum number of beam measurement results that can be reported in event-triggered measurement report is:

* Alt 1: [4] beams per cell and [4] cells
* Alt 2: [1] for event LTM 2 and [16] for event LTM3, 4 and 5

*FL note: assuming that an LS is sent from RAN2, FL believes this issue is not urgent in this meeting. Also, the discussion on “numbers” are not easy. Therefore, FL suggest gathering companies view in this meeting.*

##### [Comments to 3-3-v1]

|  |  |
| --- | --- |
| Company | Comment |
| Fujitsu | As RAN2 is discussing the maximum number of the total beam measurement results, RAN1 just determines the maximum value, and the details should be discussed in RAN2. Therefore, we support 16 as the maximum number of the total beam measurement results which is same value as that of Rel-18 LTM. |
|  |  |
|  |  |

### [Mid] RS of serving cell for event evaluation

##### [Agreement in previous meetings]

**Agreement(RAN1#118)**

* For the identification of the serving cell RS for event evaluation,
  + At least the following options are further studied in RAN1, where different options could apply to different LTM event
    - Option. 1: Derived from QCL (type-D) RS(s) of the indicated joint/DL TCI state for the serving cell
    - Option. 2: Derived from QCL RS(s) or SSB QCLed with the QCL RS of the indicated joint/DL TCI state for the serving cell
      * QCL RS or SSB is configured by the network
    - Option. 3: Measurement RS(s) is/are explicitly configured
    - Option. 4: Derived from QCL RSs of activated TCI states with the best quality, or SSB which is QCLed with the QCL RSs of activated TCI states with the best quality.
    - Option 6: Derived from QCL RSs of activated TCI states, or SSB which is QCLed with the QCL RSs of activated TCI states
  + The RSs of the candidate cell(s) for event evaluation are explicitly configure
* Note: Companies are encouraged to take into account the RAN2 agreement (i.e current beam rather than best beam) for their further study.

**Agreement(RAN1#118bis)**

* The serving cell RS for event evaluation is at least derived from QCL RS or SSB QCLed with the QCL RS of the indicated joint/DL TCI state for the serving cell
  + QCL RS above is the RS w.r.t. QCL-TypeD when the indicated joint/DL TCI state is configured with two QCL RSs
  + FFS: Details on determination of QCL RS or SSB QCLed with QCL RS
* Note: This does not imply the support of mTRP scenarios

Agreement(RAN1#119)

For the identification of the serving cell RS for event evaluation,

If the RS(s) for candidate cell(s) are CSI-RS configured in a CSI-RS resource set configured with repetition, QCL RS of the indicated TCI-state is used for the serving cell; otherwise, SSB QCLed with QCL RS of the indicated TCI-state is used for the serving cell.

* UE does not expect the following configuration:
  + CSI-RS resource in the indicated TCI state of serving cell is NOT configured in a CSI-RS resource set configured with repetition, and
  + CSI-RS is configured as measurement resource for the candidate cell(s).

For info: LTM events in RAN2:

* Event LTM2: Beam of serving cell becomes worse than absolute threshold;
* Event LTM3: Beam of candidate cell becomes amount of offset better than beam of serving cell;
* Event LTM4: Beam of candidate cell becomes better than absolute threshold;
* Event LTM5: Beam of serving cell becomes worse than absolute threshold1 AND Beam of candidate cell becomes better than another absolute threshold2.

##### [Summary of contributions]

Two issues are identified in this meeting on top of our agreement so far:

Issue 1: details of event LTM2

For the RS type identification rule which we have agreed, the configuration for candidate cell is required. On the other hand, event LTM2 does not require any candidate cell RSs for its evaluation, resulting in the contradiction. This issue is pointed out by two companies below.

* Huawei: For Event LTM2, the RS type of serving cell should be explicitly configured by gNB
  + While there is no comparison between serving cell and candidate cell for Event LTM2 so that the RS type of serving cell cannot be determined by candidate cells.
* Ericsson: The NW configures at least one candidate RS for LTM2, and the UE determines the serving cell RS using the already agreed mechanism.

Issue 2: Support of mTRP operation at a serving cell

* CATT, OPPO: The L1-RSRP measurement of serving cell for event evaluation is the minimum value of the L1-RSRP measurement of those two RSs.
* Vivo: For the case that the source cell is configured with mTRP, how to determine the measurement RS of the serving cell beam based on the two indicated TCI states should be discussed.
* DOCOMO: Support that current beam is determined from a fixed TCI state from the two indicated TCI states.

##### [FL observation]

For issue 1, FL thinks the approach by two companies works, and the group can choose either one (other approach is also fine), while other solution are welcome.

For issue 2, FL agrees that the consensus is still unclear because the description on mTRP was removed at the online discussion in the last meeting. In FL’s recollection, Chair asked a question on the necessity to support mTRP but nobody strongly pushed this scenario at that time. Hence it is good to clarify it to avoid the same discussion in RAN2 (i.e. coexistence discussion).

Given the analysis above, we have 2 FL proposals for this section

##### [FL proposal 3-4-1-v1]

For the RS type determination for event triggered reporting with event LTM2,

* Alt 1-1: RS type is RRC configured
* Alt 1-2: At least one candidate RS shall be configured

*FL note: choose one from the option above. Other solutions are not precluded. FL wants to solve this issue in this meeting.*

##### [FL proposal 3-4-2-v1]

* Alt.2-1: It is not expected that LTM event triggered reporting and mTRP operation at serving cells are simultaneously configured.
* Alt 2-2: Simultaneous operation of LTM event triggered reporting and mTRP operation at serving cells are supported
  + FFS: how to identify the serving cell beam for event evaluation event LTM2, 3 and 5

##### [Comments to 3-4-1-v1 and 3-4-2-v1]

|  |  |
| --- | --- |
| Company | Comment |
|  | For FL proposal 3-4-1-v1, it seems to us that both alternatives configure the RS type for serving cell in the RRC. We slightly prefer Alt1-1 since it is more straightforward.  For FL proposal 3-4-2-v1, we support Alt.2-1 since the subsequent discussions may be required in the limited TU if the mTRP is supported. |
|  |  |
|  |  |

### [High] Filtering of measurement results for evaluation and reporting

##### [Summary of contributions]

Necessity of gNB configured filtering for event evaluation and reporting

* **Yes(11): Nokia, CATT, DOCOMO, KDDI, Ericsson, LGE, Lekha, NEC, Fujitsu, IDC, Meta**
  + First order IIR filtering can be considered
  + Simulation results are provided by Nokia and Ericsson
  + Observation by Nokia (Simulation results are provided)
    - The benefits of additional L1 filtering are not clearly evident or in other words finding the optimal parameters for coefficients and TTT may not be straightforward. Nevertheless, it could be beneficial to leave the decision regarding additional L1 filtering for event-triggered LTM to the network.
    - Support network configurable L1 filtering for event-triggered L1 measurement reporting for LTM.
  + Observation by Ericsson (Simulation results are provided)
    - Large variance in L1-RSRP cannot be handled well by TTT mechanisms: If TTT is too long then temporary dips will reset the timer and delay the event. If TTT is too short then it leads to frequent ping-pong handovers.
    - A network configurable filter can reduce the variance of RSRP, making the trend clear such that TTT and event thresholds and offsets can be properly configured
    - A network configurable filter can ensure consistent variance of the RSRP measurements used for event evaluation
    - Different network deployments and network configurations require different filter settings for optimal performance
    - With NW-configurable filtering, the number of ping-pong handovers is reduced.
    - A first-order IIR filter only requires the UE to store one state-variable corresponding to the filtered RSRP.
    - A first-order IIR filter is configured with a single filter coefficient.
    - Introduce a network configurable filter in the MAC layer.
    - The network configurable filter is a first order IIR filter.
    - LTM event conditions should be evaluated on RSRP measurements that are filtered with the network configurable filter.
* **No(7): ZTE, Huawei, Apple, Lenovo, MediaTek, Qualcomm, vivo**
  + TTT (time duration is network configurable) can solve the issue
  + additional delay is introduced by the filtering
  + Can be left to UE implementation, which gives more flexibility to a UE to optimize the filtering algorithm based on radio channel property (e.g., UE speed) and hardware processing capability

##### [FL observation]

FL view is summarized as follows:

* It is proposed that the filtering does not always require to be defined in RAN1. Thus, “L1” is deleted here.
* The arguments here have not changed from previous meetings (but slightly more companies are positive to introduce gNB configured filtering)
  + There is a tendency where UE vendors don’t want to specify anything related to filtering while network side want more controllability.
* If filtering is introduced, 1st order IIR filtering can be introduced in MAC layer, i.e. PHY can just forward the measurement data to the upper layer
* According to RAN2 agreement, periodic report is still available for event triggered reporting. If so, filtering operation may be possible at the network side and hence filtering would be more important for event evaluation.
* Some companies think TTT would provide the same effect as filtering, while some companies don’t (no change from previous meeting)

FL thinks it would be safer to introduce the gNB configured filtering in order to achieve stable LTM behavior while this requires more complicated implementation at UE side. Hence, the decision is not so easy. Also FL thinks it would be good idea to keep this issue open for long time and it’s time to reply to RAN2. FL would like to suggest two approaches in FL proposal 3-5 and conclude it in this meeting.

##### [FL Proposal 3-5-v1]

Companies are asked to provide their views on the following approaches for the necessity of filtering

* Approach 1: Respect the majority companies, and give positive feedback to RAN2 to introduce gNB configured filtering
  + RAN1 sees the necessity to introduce gNB configured filtering at least for event evaluation based on SSB and CSI-RS.
  + From RAN1 perspective, the L1 measurement results are sent to upper layer, and first order IIR, similar to L3 filtering, is applied at MAC layer. The final decision is up to RAN2.
  + Send an LS to RAN2 to inform this conclusion.
* Approach 2: Just inform the RAN1 situation
  + RAN1 has no common understanding on whether UE specific filtering is enough or gNB configured filtering is needed for event evaluation and reporting based on SSB and CSI-RS.
    - If gNB configured filtering is introduced, it is not necessarily defined in RAN1 specification.
  + Send an LS to RAN2 to inform this conclusion.

##### [Comments to 3-5-v1]

|  |  |
| --- | --- |
| Company | Comment |
| Fujitsu | We support Approach 1. Firstly, we believe that most of companies have common understanding that the filtering is needed as TTT itself cannot cope with higher fluctuation of L1-RSRP. The controversial point is which filtering method is introduced, NW configurable or UE implementation filter. For the event triggered reporting, the threshold for the event plays the most important role to decide the cell switch. However, the filtering by UE implementation provides various filtered results even the input of the filter is ideally same due to depending on the implementation method. This makes difficult for gNB to set the appropriate threshold for the event. |
|  |  |
|  |  |

### [Low] CSI reference resource and processing Units for event triggered reporting

##### [Summary of contributions]

It is pointed out by Nokia that the legacy definition of CSI reference resource and processing unit may not apply since MAC CE (i.e. reporting slot is unknown from L1 perspective) is used for L1 RSRP reporting for LTM event triggered reporting. Hence, it is proposed to study the following aspects

* Whether/how to define CSI reference resource.
* CPU usage, including rules for the CPU occupancy timeline and the number of CPUs.

##### [FL observation]

Since this is the first meeting to discuss this issue, the companies view is not clear. Hence, FL would like to suggest gathering the companies view aiming at the consensus at RAN1#120bis meeting.

##### [FL proposal 3-6-v1]

Companies are encouraged to provide their view on the following aspects for MAC CE based event-triggered L1 measurement reporting, aiming at the further progress in RAN1#120bis, if necessary.

* Whether/how to define CSI reference resource.
* CPU usage, including rules for the CPU occupancy timeline and the number of CPUs.

*FL note: no online/offline discussion is planned at RAN1#120.*

##### [Comments to 3-6-v1]

|  |  |
| --- | --- |
| Company | Comment |
|  |  |
|  |  |
|  |  |

### [Closed] Other issues

##### [Summary of contributions]

Proposals on configuration aspect are provided by Qualcomm

* For CSI-RS-based LTM L1 measurement, both event-triggered and gNB-scheduled reporting should use the Rel-18 LTM CSI Resource Setting as the baseline.

This aspect can be discuss in RAN1 after receiving the explicit request from RAN2.

##### [Conclusion]

The discussion of this section is closed without any FL proposal.

## Beam Management based on CSI-RS

### [No issue] Candidate TCI states activation and indication based on CSI-RS

##### [Agreements in previous meetings]

Agreement

* CSI-RS for BM as the referenceSignal with QCL-TypeD is supported for an LTM TCI state, where TRS is configured as referenceSignal with QCL-TypeA

##### [Conclusion]

No new issues are identified in this meeting.

### [Closed] UE Rx beam management

##### [Agreements in previous meetings]

Not agreements yet

##### [Summary of the contributions]

The necessity of Rx beam refinement, i.e. CSI-RS with *repetition*=*on* is discussed:

* Necessary: Nokia, CATT, vivo
  + Allowing the UE to conduct CSI-RS measurements from different LTM candidate and serving cells with different Rx beamwidths/gains could result in suboptimal cell-switch decisions by the network
* Not necessary, i.e. *repetition=off* : Huawei, Ericsson, MediaTek, DOCOMO
  + Rx beam refinement for multiple candidate cells may cause large measurement overhead and a waste of RS resource.
  + The overhead on the NW side is large, since multiple CSI-RS resources must be transmitted in the same beam. Therefore, P3 is more suitable with aperiodic CSI-RS, where only a few Tx beams are probed:

##### [FL observation]

In the previous meeting, FL asked a question on the necessity of additional Rx beam refinement using candidate cell CSI-RS. However, the result was that majority of the companies see no strong necessity, and it seems that the situation hasn’t been changed.

Given the situation, FL sees no strong necessity to have any FL-led discussion in this meeting. Proponents are encouraged to have more offline discussion toward RAN1#120bis meeting.

##### [Conclusion]

The discussion of this section is closed without any FL proposal.

### [Closed] Other issues

##### [Summary of proposal]

* Spreadtrum: Only support unified TCI framework for beam indication mechanism in Rel-19 LTM.
  + FL thinks this is a common understanding and no discussion is necessary

##### [Conclusion]

The discussion of this section is closed without any FL proposal.

## CSI acquisition for candidate cell(s)

### [High] CSI acquisition framework i.e. timing of measurement and reporting

##### [Agreements in the previous meetings]

**Agreement (RAN1#118bis)**

The following alternatives are further studied:

* Alt-1: CSI-RS measurement and CSI reporting operations are performed before reception of LTM Cell Switch Command (CSC) MAC CE.
  + The report is sent to the serving cell and transferred to the candidate/target cell(s)
* Alt-2: CSI-RS measurement can start before reception of LTM CSC MAC CE and CSI reporting operation is performed after reception of LTM CSC MAC CE.
  + The report is sent directly to target cell
* Alt-3: CSI-RS measurement and CSI reporting operations are performed after reception of LTM CSC MAC CE.
  + The report is sent directly to target cell

Companies are requested to provide the details of exact report timing and triggering mechanism in the next meeting

Working Assumption (RAN1#119)

As baseline, CSI-RS measurement and CSI reporting operations are performed after reception of LTM CSC MAC CE.

* The report is sent directly to target cell
* Introduce UE capability for CSI-RS measurement can start before reception of LTM CSC MAC CE
  + Other than UE capability, strive for no additional spec impact compared to the baseline (only one triggering mechanism will be specified)

##### [Summary of contributions]

**Issue 1: Confirming working assumption**

* 17 companies are OK to confirm the working assumption (even though some of them provide clarification proposals)
  + Huawei, Spreadtrum, ZTE, LGE, CMCC, vivo, Nokia, Fujitsu, IDC, Sony, Lenovo, Xiaomi, Apple, KDDI, DOCOMO, MediaTek. Google
* 3 companies showed their concern on confirming the working assumption
  + CATT: it is not easy to achieve the same triggering mechanism before and after CSC
  + Lekha, NEC: CSI acquisition (reporting) before CSC

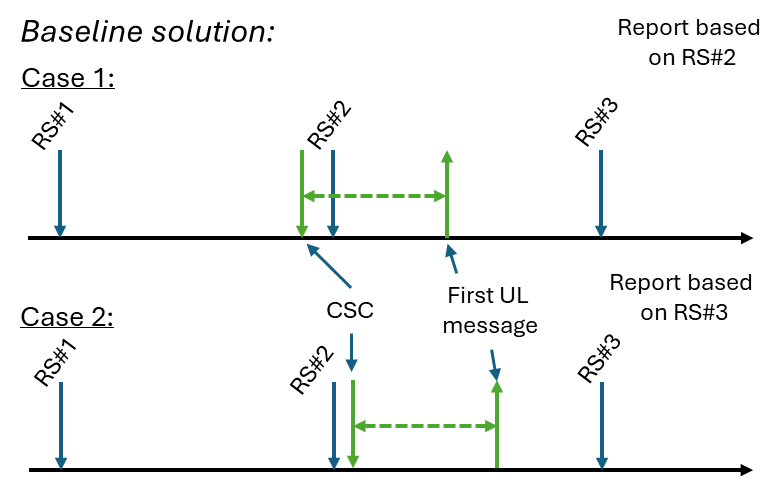
**Issue 2: details of triggering mechanism**

We have a lot of options for CSI acquisition triggering proposed in this meeting. It is noted that sub-options are not captured to avoid the divergent discussion in RAN1#120

* Option 1: L1/L2 signaling before CSC – *this option is useful to unify the triggering mechanism for measurement before and after CSC*
  + Option 1-1: DCI transmitted from the source cell, i.e. CSI request field is extended to support candidate/target cell CSI acquisition
  + Option 1-2: A new mechanism using DCI format
  + Option 1-3: PDCCH order for candidate cell
  + Option 1-4: Candidate Cell TCI States Activation/Deactivation MAC CE
* Option 2: L1/L2 signaling when CSC is transmitted – *this option is simple*
  + Option 2-1: DCI scheduling the PUSCH carrying CSC MAC CE
  + Option 2-2: CSC MAC CE
* Option 3: L1/L2 signaling after CSC – *this option is useful to avoid the timeline issue (i.e. both triggering and reporting is performed by the target cell)*
  + Option 3-1: DCI transmitted from the target cell, i.e. CSI request field
  + Option 3-2: MAC CE transmitted from the target cell
  + Option 3-3: RAR UL grant for RACH-based LTM

**Issue 3: reporting mechanism**

First, we should determine which container to use. After that, the detailed design can be discussed.

* Option X: UCI
  + In this case, PUSCH may used and the existing mechanism for multiplexing can be reused
  + According to the contributions, mainly 3 cases are discussed, i.e. RACH-less, RACH-based with CFRA and RACH-based with CBRA, e.g.
    - Use first PUSCH transmission, either CG or DG
    - UL channel scheduled by LTM CSC MAC CE.
    - UE send “CSI is ready” information by Msg 3 or first PUSCH transmission, then CSI is reported
    - PUSCH scheduled by RAR UL grant
    - PUSCH of MsgA if 2-step CFRA
* Option Y: MAC CE
  + In this case, the UE reports the early CSI to target over MAC CE as soon as the CSI has been calculated
  + As a background, the timing issue caused by “trigger by source cell and UCI transmitted to target cell” is explained by Ericsson’s tdoc
  + 
  + The timing between the CSI-RS transmission and the LTM CSC is unknown at the target. The target only knows when it receives the first UL message, and the time between the LTM CSC and the first UL message is unknown. In case 1, the UE has most likely computed valid CSI already when transmitting the first UL message. In case 2, the UE cannot compute valid CSI until after the reception of RS#3

**Issue 4: UE complexity reduction for CSI measurement before cell switch command (CSC)**

It is pointed out that it is not so easy to perform the measurement for all candidate cells. There are some proposals to limit the number of candidate cells to measure before CSC:

* Option A: CSI measurement starts upon transmission of L1 measurement report
* Option B: CSI measurement starts upon reception of MAC CE activating candidate cell TCI state(s)
* Option C: CSI measurement is performed only for the candidate cell(s) associated with/indicated by the PDCCH order
* Option D: The cells/CSI-RSs for CSI measurement are indicated (or enabled/disabled) by MAC CE and/or DCI
* Option E: The cells/CSI-RSs for CSI measurement are explicitly configured by RRC
* Option F: CSI measurement is performed only for intra-frequency candidate cells

FL would like to note that option A-F are not necessary if the trigger of CSI acquisition is transmitted before CSC.

##### [FL observation]

Considering the tons of options and combination to be considered here, FL suggestion is to focus on the triggering mechanism (issue 2) and high level principle of reporting (issue 3). Then, the necessity of amending the WA can be decided.

##### [FL proposal 5-1-1-v1]

For the triggering mechanism of CSI acquisition, the following mechanism are discussed and down-selected during unofficial/official offline.

* Option 1: L1/L2 signaling before CSC – *this option is useful to unify the triggering mechanism for measurement before and after CSC*
  + Option 1-1: DCI transmitted from the source cell, i.e. CSI request field is extended to support candidate/target cell CSI acquisition
  + Option 1-2: A new mechanism using DCI format
  + Option 1-3: PDCCH order for candidate cell
  + Option 1-4: Candidate Cell TCI States Activation/Deactivation MAC CE
* Option 2: L1/L2 signaling when CSC is transmitted – *this option is simple but additional issue may arise, such as timeline issue and/or UE complexity to measure a lot of candidate cells before CSC*
  + Option 2-1: DCI scheduling the PUSCH carrying CSC MAC CE
  + Option 2-2: CSC MAC CE
* Option 3: L1/L2 signaling after CSC – *this option is useful to solve the timeline issue (i.e. both triggering and reporting is performed by the target cell)* 
  + Option 3-1: DCI transmitted from the target cell, i.e. CSI request field
  + Option 3-2: MAC CE transmitted from the target cell
  + Option 3-3: RAR UL grant for RACH-based LTM

##### [FL proposal 5-1-2-v1]

For the reporting mechanism of CSI acquisition, the following mechanism are discussed unofficial/official offline for the better understanding.

* Option X: CSI is reported by UCI after CSC
  + In this case, PUSCH is used and the existing mechanism for multiplexing can be reused
* Option Y: CSI is reported by MAC CE after CSC
  + In this case, the UE reports the early CSI to target over MAC CE as soon as the CSI has been calculated

##### [Comments to 5-1-1-v1 and 5-1-2-v1]

|  |  |
| --- | --- |
| Company | Comment |
| Fujitsu | For FL proposal 5-1-1-v1, we support Option1-2. In previous meeting as shown in the working assumption, we discussed about one triggering mechanism for both UEs with/without capability. We think that the triggering indication with new DCI or subsequent signalling can be received by both UEs before the reception of CSC. For UE with capability, the UE can start the CSI measurement immediately when the UE receives the triggering indication. For UE without capability, however, the UE can start the CSI measurement after (or as soon as) receiving the CSC when the UE receives the triggering indication. This method is beneficial that the CSI acquisition can be activated/deactivated for both UEs.  For FL proposal 5-1-2-v1, we support OptionX. The CSI is processed and used in PHY layer. If the MAC CE is used as the container of CSI acquisition, the delay will increase since the CSI should firstly transfer to MAC layer, and go back to PHY layer. |
|  |  |
|  |  |

### [Mid] Time domain property of CSI-RS resource

##### [Summary of contributions]

* Periodic CSI-RS resource
  + Support(13): Huawei, CATT, ZTE, CMCC, vivo (measurement before CSC), Nokia, Fujitsu, Apple, Samsung, Ericsson (for candidate cells, i.e. before CSC), Qualcomm, DOCOMO, MediaTek
  + Not support/Concern(0)
* Semi-persistent resource
  + Support(10): Huawei, CATT, ZTE, CMCC, Nokia, Apple, Samsung, ETRI, Qualcomm, DOCOMO
    - For SP CSI-RS activation/deactivation for candidate cell, the existing MAC CE for semi-persistent CSI-RS Resource Set Activation/Deactivation can be extended to candidate cell for early CSI acquisition.
  + Not support/Concern(0)
* Aperiodic CSI-RS resource
  + Support (5): Spreadtrum(associated with aperiodic report), ZTE (for intra-DU), vivo(after CSC), Samsung, ETRI
  + Not support/Concern(1): Apple
    - the slot offset between the triggering command and the triggered CSI-RS varies over time and cannot be provided by RRC signal
  + TBD: Huawei (come back after CSI-resource for BM), ZTE (for Inter CU/DU), Nokia

##### [FL observation]

Even though the discussion on CSI acquisition framework has not been finished, large number of companies think periodic CSI-RS can be supported. FL suggestion is to agree on this for our progress. Semi-persistent and aperiodic and be discussed later.

##### [FL proposal 5-2-v1]

At least periodic CSI-RS resource is supported for CSI acquisition.

##### [Comments to 5-2-v1]

|  |  |
| --- | --- |
| Company | Comment |
| Fujitsu | We agree to support ‘at least’ periodic CSI-RS resource. Similar with gNB scheduled reporting and event triggered reporting cases, RAN1 should further study the on-demand CSI-RS such as SP CSI-RS to achieve network energy saving and to avoid redundant interference. |
|  |  |
|  |  |

### [Paused] Time domain property of CSI-RS reporting

##### [Summary of contributions]

##### [FL observation]

The discussion of time domain property of CSI-RS resource highly depends on the outcome of CSI acquisition framework, especially the container (UCI or MAC CE). Thus, the discussion of this section is paused.

### [Closed] 2nd level details for CSI acquisition

##### [Summary of contributions]

The following issues are identified as the 2nd level discussion for CSI acquisition

* Restrictions on the CSI configurations
  + Codebook
    - Type I: Spreadtrum, CATT, ZTE, Huawei, vivo, Nokia, OPPO, Ericsson, DOCOMO, Google
    - Rel-19 eType I: ZTE
  + Number of ports
    - Up to 32: vivo
    - Up to 192: Ericsson
  + Report quantity
    - cri-RI-PMI-CQI: CATT, ZTE, Huawei, LGE, Nokia, OPPO, Lenovo, Ericsson, DOCOMO, Google
    - cri-RI-PMI-CQI if SRS transmission is supported: ZTE
    - CQI for Rank1 only: MediaTek
  + Bandwidth
    - Wideband CQI/PMI: Huawei, CMCC, vivo, OPPO, Lenovo
    - Subband CQI/PMI: CMCC
* CSI reference resource
* CPU occupancy timeline – which might be RAN4 expertise
* CPU usage
* RRC configuration - how to achieve the unified the configuration for L1 measurement

##### [FL observation]

Even though some proposals look agreeable considering the number of supporting companies, FL sees no time to discuss the details in this meeting. FL suggestion is focus on the high priority issues in this meeting, and companies are encouraged to provide their views on the issues above in the next RAN1 meeting.

##### [FL proposal]

The discussion of this section is closed without any FL proposal.

## Conditional intra-CU LTM

### [Closed] RAN1 spec impact of Conditional intra-CU LTM

##### [Agreements in the previous meetings]

None

##### [Summary of contributions]

* CATT
  + For RACH-less conditional LTM, if DG-based approach is supported, further study how to determine the TCI state, which is used to scheduling PUSCH on which RRCReconfigurationComplete message is transmitted to the target cell.
* Vivo
  + No additional RAN1 specification impact will be introduced by PDCCH-ordered early RACH and early Candidate TCI state activation/deactivation for CLTM.
* Nokia
  + RAN1 should at least discuss the issue of the target TCI state to be used during cell switch execution, specifically for RACH-less CLTM.
  + For RACH-less cell switch, unlike LTM, where the cell switch notification from the source cell to the target cell includes information about the TCI state(s) used in the cell switch command, in CLTM, the target cell may not have prior knowledge of the TCI state used by the UE for the cell switch execution.
  + Early synchronization procedures, such as PDCCH-ordered RACH-based early TA acquisition or MAC CE-based TCI state activation/deactivation, could help the target cell identify potential beams for the incoming UE.
  + A candidate TCI state associated with the candidate RS that satisfies the CLTM cell switch condition should be used for CG-based RACH-less CLTM if at least one of the conditions is met:
    - PDCCH ordered RACH transmission associated with the candidate RS has been performed
    - Candidate TCI state activation associated with the candidate TCI state has been performed (or when the determined candidate TCI state is in a list of active TCI states)
    - Otherwise, RACH-based CLTM should be the default procedure.
* NEC
  + For conditional LTM, support that UE should determine the TCI state for the target cell.
* ETRI
  + Develop an efficient TA signalling mechanism that allows early TA delivery while minimizing UE overhead and signalling complexity in C-LTM.
  + Evaluate whether the new MAC CE for TA transmission for target cell can be optimized to reduce its role overlap with the CSC MAC CE while maintaining synchronization efficiency in C-LTM.
  + In C-LTM, early CSI acquisition is needed as cell switching is based on execution conditions rather than an explicit CSC MAC CE, requiring CSI measurement before execution.
  + This impacts RAN1, necessitating a new mechanism to trigger early CSI measurement based on execution conditions before mobility execution.
  + Establish a mechanism for UE to determine optimal switching timing in L1-based C-LTM, considering synchronization with upper-layer mobility preparation.
* Ericsson
  + TS 38.213 Section 21 need to be updated to describe conditional LTM, including the following aspects:
    - Configuration and evaluation of CLTM execution conditions in the UE,
    - TCI state to be applied upon CLTM execution,
    - The timeline for CLTM execution,
    - CG PUSCH transmission in the target cell.
* DOCOMO
  + For conditional intra-CU LTM, RAN1 should wait for determination of whole procedure design in RAN2.

##### [FL observation]

FL agrees the assessment by Ericsson, i.e. - TS 38.213 Section 21 need to be updated to describe conditional LTM. On the other hand, the necessity of the RAN1 discussion is not clear yet even though the following aspects are the interest by some companies:

* TCI state applied after cell switch and related TA acquisition procedure

Moreover, it is not clear if RAN2 will proceed the discussion, or they expect RAN1 to discuss these issues. Hence, FL suggestion is to wait for RAN2 to define the whole procedure for conditional intra-CU LTM.

##### [Conclusion]

The section is closed without any FL proposal. Companies are encouraged to further assess the necessary discussion in RAN1 for conditional intra-CU LTM considering the RAN2 discussion and the input from companies in this RAN1 meeting.