**3GPP TSG RAN WG1 Meeting #120 R1-2500423**

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

**Source: Moderator (Fujitsu)**

**Title: Final FL summary 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]

[[FL proposal 1-3-1-v2]](#_[FL_proposal_1-3-1-v2])SP CSI-RS for gNB scheduled reporting

[[FL proposal 1-3-2-v2]](#_[FL_proposal_1-3-2-v2])SP CSI-RS for event triggered reporting

[[FL proposal 1-3-3-v2]](#_[FL_proposal_1-3-3-v2])AP CSI-RS for gNB scheduled reporting

[[FL proposal 3-4-1-v2]](#_[FL_proposal_3-4-1-v2]) RS type identification for event LTM2

[[FL proposal 3-4-2-v2]](#_[FL_proposal_3-4-2-v2]) Support of mTRP for serving cell

[[FL proposal 1-6-2-v2]](#_[FL_proposal_1-6-2-v2])the constraint of CSI-RS configurations

[[FL proposal 1-6-1-v2]](#_[FL_proposal_1-6-1-v2])CSI-RS resource set

##### [Proposals for Tuesday offline]

[[FL proposal 5-1-v2]](#_[FL_proposal_5-1-v2]) 25-min CSI-acquisition framework

[[FL Proposal 3-5-v2]](#_[FL_Proposal_3-5-v2]) 5-min filtering for event evaluation and reporting

##### [Topics for Wednesday off-Offline]

After lunch break (14:45-15:30) @ near Younsun room

[[FL proposal 3-4-1-v2]](#_[FL_proposal_3-4-1-v2]) RS type identification for event LTM2

[[FL proposal 3-4-2-v2]](#_[FL_proposal_3-4-2-v2]) Support of mTRP for serving cell

[[FL proposal 5-1-v2]](#_[FL_proposal_5-1-v2]) CSI-acquisition framework if necessary

##### [Proposals Thursday Offline 8:30-9:00]

[[FL Proposal 3-5-v2]](#_[FL_Proposal_3-5-v2]) 5-min: filtering for event evaluation and reporting

[[FL proposal 3-4-2-v3]](#_[FL_proposal_3-4-2-v3]) 2-min: Support of mTRP for serving cell

[[FL proposal 5-1-v4]](#_[FL_proposal_5-1-v4]) 20-min: CSI-acquisition framework

[[FL proposal 5-1-3-v1]](#_[FL_proposal_5-1-3-v1]) If time permits: UL container for CSI-acquisition framework

##### [Proposals for Thursday Online 12:15-13:00]

Draft LS on SP-CSI-RS activation/deactivation in R1-2501499

[[FL Proposal 3-5-v2]](#_[FL_Proposal_3-5-v2]) filtering for event evaluation and reporting

Draft LS on filtering in R1-2501576

[[FL proposal 5-1-v4]](#_[FL_proposal_5-1-v4]) CSI-acquisition framework

[[FL proposal 3-4-2-v3]](#_[FL_proposal_3-4-2-v3])Support of mTRP for serving cell

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

[[FL proposal 3-4-1-v3]](#_[FL_proposal_3-4-1-v3]) RS type identification for event LTM2 – comeback at the next meeting

##### [Proposals for Friday Online 14:30-15:00]

No proposals

# Contact people

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

|  |  |  |
| --- | --- | --- |
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# 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

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| --- | --- | --- |
| [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 |
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| [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.

### [Closed] 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. |
| Spreadtrum | FL proposal 1-3-1-v1: Support to confirm the WA.FL proposal 1-3-2-v1: Option 1 is our first preference. We are open to discuss Option 2 if the spec impact is relatively small, e.g. the activation/deactivation mechanism of LTM events and evaluation needs to be considered, otherwise the gNB does not know when the SP-CSI-RS should be activated.FL proposal 1-3-3-v1: Support Option 1. Considering the more frequent coordination between serving cell and candidate cells and complex spec design, e.g. triggering signaling design and relaxation for measurement latency, there is no clear benefit to introduce AP-CSI-RS for candidate cells. As for event triggered reporting, AP-CSI-RS is not conducive to continuous monitoring of the LTM event. |
| Ericsson | 1-3-1-v1: Support. The activation/deactivation mechanisms need to be discussed.1-3-2-v1: Do not support, the use case is unclear.1-3-3-v1: Do not support: there is a significant amount of signalling needed between the source, the LTM Candidate and UE that comes with delays that that can lead to that the UE to misses the actual transmission. As we don’t see any significant benefits, we suggest that aperiodic CSI-RS should not be supported, also to limit the work in RAN1 and other working groups. |
| Nokia | FL proposal 1-3-1-v1: SupportFL proposal 1-3-2-v1: Support Option 2, as mentioned by Fujitsu, the advantages of using SP CSI-RSs should be available for both types of reporting, gNB-scheduled and event-triggered. Event-triggered reporting only controls the reporting mechanism; the selection of RSs to be activated for measurement should remain the same for both types of reporting. FL proposal 1-3-3-v1]: Support Option 1 – same view as Ericsson.  |
| Qualcomm | **Proposal 1-3-1-v1**: We support confirming the WA.**Proposal 1-3-2-v1**: It is suggested to postpone the discussion, as a similar discussion is pending in the UE-initiated beam reporting AI. However, if an immediate decision is required in this meeting, Option-2 is slightly preferred.**Proposal 1-3-3-v1**: We are generally fine with Option-2, subject to RAN3’s assessment of its feasibility.  |
| CMCC | **Proposal 1-3-1-v1: Support.****FL proposal 1-3-2-v1: Support Option-1.** Semi-persistent CSI-RS is activated by NW, which debates with the motivation of UE event triggered reporting.**FL proposal 1-3-3-v1: Support Option-1.** The frequent coordination with candidate cells is unacceptable. |
| NTT DOCOMO | 1-3-1-v1: We support confirming WA.1-3-2-v1: We are fine to discuss, and slightly prefer Option-2.1-3-3-v1: We are fine with Option-2 if RAN3’s assessment is feasible. |
| InterDigital | 1-3-1-v1: Support.1-3-2-v1: Prefer Option 1.1-3-3-v1: Prefer Option 1. |
| ZTE | **Proposal 1-3-1-v1**: we support confirming the WA. But for mechanism to activate/deactivate SP CSI-RS resource set for candidate cell, we think that RAN1 should first discuss and clarify how to activate/deactivate SP CSI-RS resource set and then leave specific MAC CE design to RAN2. At least from our understanding, RAN1 needs to discuss one of the following potential alternatives for SP CSI-RS resource set activation/deactivation:* Alt-1: One single MAC CE is used to activate/deactivate SP CSI-RS resource set for one candidate cell.
* Alt-2: One single MAC CE is used to activate/deactivate SP CSI-RS resource set(s) across all candidate cells.
* Alt-3: One single MAC CE is used to activate/deactivate SP CSI-RS resource set(s) for candidate cell(s) and serving cell.

**Proposal 1-3-2-v1**: As we know, SP CSI-RS for event evaluation has not been supported for Rel-19 MIMO UEIBM so far. We think the potential reason behind this is that it may not only cause the entire event evaluation procedure complicated and but also significantly reduce inherent advantages of event-triggered reporting approach. In addition, following the principle of unifying event-triggered/initiated reporting design in Rel-19 MIMO and Rel-19 LTM as much as possible, we don’t tend to support SP CSI-RS for event-triggered reporting for Rel-19 LTM at this stage.**Proposal 1-3-3-v1:** If we don’t want to involve other work groups such as RAN3, we can limit the usage of AP CSI-RS as intra-DU, corresponding to Alt-2. But considering the limited remaining time for the WID, we tend to spend more time on high priority issues such as detailed design of early CSI acquisition, rather than such optimization issues. |
| Huawei, HiSilicon | **FL proposal 1-3-1-v1:** Support**FL proposal 1-3-2-v1:** Support option 2. The benefit of supporting SP CSI-RS for gNB scheduled report can be extended to event triggered report. From standard effort perspective, we do not see big difference to support SP CSI-RS to event triggered report. **FL proposal 1-3-3-v1:** Our first preference is option 1 but can live with option 2. The benefit of overhead reduction is quite important for CSI-RS based measurement considering the increased number of narrow beams to be measured. The signaling/procedure developed for SP-CSI-RS can be the start point to support AP-CSI-RS |
| Google | **FL proposal 1-3-1-v1**: Support **FL proposal 1-3-2-v1**: We can go with the majority. But we should make it clear to say this proposal is “*for candidate cell L1-RSRP measurement*”. **FL proposal 1-3-3-v1**: Option 2, and we can ask other WG for inter-DU case.  |
| ITRI | **FL proposal 1-3-1-v1:** Support.**FL proposal 1-3-2-v1:** Prefer to clarify the use case first..**FL proposal 1-3-3-v1:** Prefer Option 1. |
| CATT | 1-3-1-v1: Support. 1-3-2-v1: Support. We prefer Option 2 to support SP CSI-RS for event triggered reporting1-3-3-v1: We support Option 2. AP CSI-RS resource configuration enhances operational flexibility and significantly reduces overhead. |
| Samsung | **FL proposal 1-3-2-v1:** SP CSI-RS is actually a more complicated procedure than AP CSI-RS involving RS activation and a different timeline assumption. For event-triggered LTM, we do not see the necessity of supporting SP/AP CSI-RS for event evaluation – periodic CSI-RS would suffice. **FL proposal 1-3-3-v1:** Support Option-1, we do not support AP CSI-RS for event evaluation for LTM. |
| Lenovo | **FL proposal 1-3-1-v1:** Support.**FL proposal 1-3-2-v1:** Support Option 1. Firstly, SP CSI-RS based UEI beam report was not accepted in MIMO. Secondly, SP CSI-RS based event based beam report may cause big spec efforts. For example, how to ensure all the SP CSI-RS resources for candidate cell measurement are simultaneously activated and deactivated. Another issue is how to handle the case that part of the CSI-RS for some candidate cells are deactivated.**FL proposal 1-3-3-v1:** Support Option 2. This option is helpful for gNB to trigger a quick beam report for a certain candidate cell or a set of candidate cells. |
| vivo | **FL proposal 1-3-1-v1:**Support this proposal. Besides the legacy activation and deactivation mechanism for SP CSI-RS resources, whether to deactivate active SP CSI-RS resources on candidate cells after the reception of LTM CSC MAC CE should also be discussed.**FL proposal 1-3-2-v1:**Fine with this proposal and prefer Option-1**FL proposal 1-3-3-v1:**Fine with this proposal and prefer Option-1. |
| MediaTek | Proposal 1-3-1-v1: SupportProposal 1-3-2-v1: Option-1. We think that SP/A CSI-RS is not feasible for event-triggered reporting.Proposal 1-3-3-v1: Option-1. We don’t think A-CSI-RS is necessary. |
| TCL | **FL proposal 1-3-1-v2:** Support.**FL proposal 1-3-2-v2:** We believe it should be unified with Rel-19 MIMO UEIBM. Therefore, we prefer to delay the discussion on this topic and wait for the conclusion of Rel-19 MIMO UEIBM. **FL proposal 1-3-3-v2:** Support Option 1. The benefits of supporting AP CSI-RS are unclear and may lead to frequency signal interaction, which we believe is unnecessary. |
| LGE | **FL proposal 1-3-1-v1:** Support.**FL proposal 1-3-2-v1:** Support Option 2. We agree with the benefits of SP CSI-RS. For the case of deactivated SP CSI-RS, we agree with the UE is not required to measure the SP CSI-RS.**FL proposal 1-3-3-v1:** Support Option 1 because of signalling overhead. As Fujitsu explained, to measure AP CSI-RS, serving cell should trigger CSI-RS to UE in each measurement and it will cause large signalling overhead to UE. |

##### [FL proposal 1-3-1-v2]

* 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.*

* At least 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
	+ Alt-1: A single MAC CE can activate/deactivate SP CSI-RS resource set for one candidate cell.
	+ Alt-2: A single MAC CE can activate/deactivate SP CSI-RS resource set(s) across multiple candidate cells.
	+ Alt-3: A single MAC CE can activate/deactivate SP CSI-RS resource set(s) for candidate cell(s) and serving cell.
* Send an LS to RAN2 to inform this agreement

##### [FL proposal 1-3-2-v2]

Discuss and down-select the following options

* Option 1: SP CSI-RS is not supported for event triggered reporting
	+ Supported by (9) Spreadtrum, Ericsson, CMCC, IDC, ZTE, Samsung, Lenovo, vivo, MediaTek
* Option 2: SP CSI-RS is supported for event triggered reporting
	+ Supported by (6) Fujitsu, Nokia, Qualcomm, DOCOMO, Huawei, CATT,
	+ 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-v2]

Discuss and down-select the following options

* Option 1: Aperiodic CSI-RS resource is not supported for gNB scheduled reporting or event triggered reporting
	+ Supported (10) Fujitsu Spreadtrum, Ericsson, Nokia, CMCC, IDC, ITRI, Samsung, vivo, MediaTek
* Option 2: Aperiodic CSI-RS resource is supported at least for gNB scheduled reporting in intra-DU scenario
	+ Supported (7) Qualcomm, DOCOMO, ZTE, Huawei, Google, CATT, Lenovo,

##### [Conclusion]

The following agreement and conclusions were made during Monday online session

Agreement

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 which will be specified in RAN2

Send an LS to RAN2 to inform this agreement. Final LS in R1-250XXXX.

**Conclusion**

There is no RAN1 consensus to support SP CSI-RS for event triggered reporting

**Conclusion**

There is no consensus on the support of aperiodic CSI-RS resource for gNB scheduled reporting or event triggered reporting

With this, the discussion of this section is closed

### [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.

### [Closed] 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.  |
| Spreadtrum | Agree with the FL’s conclusion. |
| Ericsson | Support. No additional signalling is needed, the UE uses the QCL configuration in the NZP-CSI-RS-Resource in ltm-NZP-CSI-RS-ResourceToAddModList-r18 |
| Nokia | Fine with the conclusion.  |
| Qualcomm | Support the proposed conclusion. |
| CMCC | Support. Different from L3 mobility, which is RRC explicitly configured *associatedSSB* to obtain timing reference for CSI-RS. In LTM, the QCLed SSB can be reused as timing reference. |
| NTT DOCOMO | We are fine with the conclusion. |
| ZTE | We are fine with the conclusion. |
| Huawei, HiSilicon | Fine with the conclusion |
| Google | OK with this conclusion  |
| ITRI | Fine with the conclusion |
| CATT | We share the similar view with FL and some other companies that QCLed SSB hould serve as the timing reference of candidate cell CSI-RS measurement. However, it needs to be clarified on whether existing legacy procedure and function already adequately support for LTM scenarios. |
| Lenovo | Fine with the conclusion |
| vivo | Fine with this conclusion, there is RAN4 impact.  |
| TCL | We are fine with the conclusion. |
| LGE | Fine with the conclusion |

##### [Conclusion]

FL proposal 1-5-v1 is skipped due to the lack of time in this meeting. FL plan is to come-back at RAN1#120bis meeting.

With this, the discussion of this section is closed.

### [Closed] 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. |
| Spreadtrum | Support Alt.A. The candidate cell corresponding to CSI-RS resource can be derived based on the correspondence between root SSB and the candidate cell, where the root SSB is for the CSI-RS resource or for the QCL source RS of the CSI-RS resource.As for ‘repetition’, we think the repetition=off is always configured or specified. |
| Ericsson | Support Alt. A. CRI is not well defined for Alt. BFor Alt.1/Alt2: repetition: Repetition need to be set on resource set level since it is a parameter that characterizes the relation between different resources, not a characteristic of a single CSI-RS resource. For Alt1/Alt2: We don’t think that restriction on bandwidth, periodicity or frequency domain density is needed since RSRP is an average power across resource elements. Higher bandwidth or density or periodicity may improve the RSRP measurement accuracy, but not the expected RSRP value in general. Note that the transmit power may be different for different candidates (different gNBs), so the comparison may not be “fair” in any case. |
| Nokia | We prefer Alt.B, as some parameters like “repetition” should be set at resource set level.For Alt.1/Alt.2 – Support no additional restriction– that may mean Alt.2 in principle. |
| Qualcomm | **Proposal 1-6-v1**: We support Alt.B. to reuse existing configuration IEs as much as possible.We also support Alt.1 at least for intra-frequency scenarios. Details on which parameters, such as bandwidth, periodicity, etc., to be aligned should be further discussed. |
| CMCC | Support Alt.A. The bandwidth, periodicity, frequency domain density may be different for different candidate cells, this can be left to gNB configuration. |
| NTT DOCOMO | Our first preference is Alt.B to reuse existing configuration. |
| ZTE | We support Alt-A to keep the same configuration framework as Rel-18 LTM.As for whether to limit some parameters to be the same for all CSI-RS resources within one resource set, it will be up to the implementation. |
| Huawei, HiSilicon | **FL proposal 1-6-v1:** We support Alt B, which inherit the characteristic of CSI RS resource set for serving cell as much as possible. As for the CRI, it can be indexed as whole by cascading all resource set associated with the same report config.We support Alt 2. It is quite difficult to align these parameters across different cells, which may be in different FR with different numerologies. It is also the major motivation to support Alt B.  |
| CATT | Support Alt. A, which provides a cleaner LTM report configuration structure than Alt. B. For Alt.1: Requiring identical settings for these parameters for all CSI-RS resources may impose unnecessary constraints.For Alt2: Support. We assert that the alignment of the CSI-RS configuration within an NZP CSI-RS resource set is unnecessary. |
| Samsung | **Proposal 1-6-v1**: we support Alt-A, which reuses the same design as associating SSBs with different candidate cells, or PCIs for inter-cell multi-TRP/ICBM. |
| Lenovo | **Proposal 1-6-v1:** We support Alt.A. All the design for SSB based beam measurement and beam report can be fully reused for CSI-RS based measurement and report.We prefer Alt.1. The first question for Alt.2 is how can the UE compare different CSI-RS with different periodicity and different bandwidth. The second question is that will Alt.2 support the case that CSI-RS other than for beam management for the LTM beam management? |
| vivo | Support Alt.A to reuse the configuration framework in Rel-18 LTM and prefer Alt.1 to ensure fair comparison.  |
| MediaTek | Proposal 1-6-v1: Alt A. Similar to R18 LTM SSB resource configuration. On Alt-1 vs. Alt-2, the answer may depend on intra or inter-frequency cases. |
| TCL | **FL proposal 1-6-1-v2**: We support Alt-A to keep the same configuration framework as Rel-18 LTM.**FL proposal 1-6-2-v2**:We prefer Alt.1 as we believe that using the same configuration of CSI-RS ensures fairness among different candidate cells. |
| LGE | We prefer Alt.A. It is natural to follow SSB design in CSI-RS too. In SSB, the resource of SSB is provided by LTM-CSI-SSB-ResourceSet in LTM-CSI-ResourceConfig. In LTM-CSI-SSB-ResourceSet, a ltm-CandidateIdList is configured for each SSB resources. Same structure could be adopted to CSI-RS.We support Alt 1. In legacy serving cell CSI-RS measurement operation, some parameters configured in CSI-RS resource are same within CSI-RS resource set. We can discuss which parameters should be included. |

##### [FL proposal 1-6-1-v2]

* 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.
		- Support: (10) Fujitsu, Spreadtrum, Ericsson, CMCC, ZTE, CATT, Samsung, Lenovo, vivo, MediaTek
	+ Alt.B: multiple resource sets*, where each resource set is associated with a candidate cell,* containing CSI-RS resources.
		- Support: (3) Nokia, Qualcomm, Huawei
	+ FFS: how to associate between the measurement CSI-RS resources and candidate cells
		- explicit or implicit signaling of candidate cells

##### [FL proposal 1-6-2-v2]

* Alt.1: The following parameters shall be the same for all CSI-RS resources associated with the same resource set
	+ Support: Nokia, Qulacomm, Lenovo, vivo, MediaTek(depends inter-freq or intra-freq)
	+ 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
	+ Support: Fujitsu, Ericsson, CMCC, DOCOMO, ZTE, Huawei, CATT

##### [Conclusion]

The following agreements were made during Monday online discussion.

Agreement

Alt.2: The parameters defined in legacy *NZP-CSI-RS-resource* can be different for CSI-RS resources associated with the resource set

Agreement

An LTM report configuration for L1-RSRP is associated 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.
	+ FFS: how to associate between the measurement CSI-RS resources and candidate cells
		- explicit or implicit signaling of candidate cells

With this, the discussion of this section is closed.

### [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

### [Closed] 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.

$$CRI=\sum\_{s=0}^{m-1}K\_{s}+k-1$$

* 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.

##### [Conclusion]

With the agreement in section 5.1.6, the discussion of section is unnecessary because the CRI definition is clear now. The discussion of this section is closed.

### [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

### [Closed] 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. |
| Spreadtrum | The maximum number of beam measurement results that can be reported can reuse the Rel-18 configuration or up to RAN2.  |
| Ericsson | Support Alt 1. It is too restrictive to just have 1 for LTM2 as the network can benefit from at least some measurements from candidate cells. |
| Nokia | Support up to 16 measurements for LTM 3/4/5. However, for LTM2, we don’t expect the UE to report candidate RSs, so further discussion is needed to determine what should be allowed to be reported from the current serving cell. |
| Qualcomm | **Proposal 3-3-v1**: We support Alt-1 as baseline for all events, which follows the same design as Rel-18 LTM L1 reporting.  |
| CMCC | Support 16 as the maximum number of the total beam measurement results for LTM 3/4/5. For LTM2, only the RSRP of current beam is reported.  |
| NTT DOCOMO | We think that RAN1 needs to decide only the maximum number. The details should be up to RAN2. |
| ZTE | We need to wait an LS sent from RAN2. |
| Huawei, HiSilicon | It is up to RAN2 as MAC CE is used. |
| CATT | Share the similar view with Fujitsu. |
| Samsung | It can be up to RAN2 as they are responsible for designing detailed contents of the container |
| vivo | Prefer Alt 2. |
| TCL | It is up to RAN2, as it is reported via MAC CE. |
| LGE | If RAN2 send LS, we can discuss it. If we discuss before receiving LS might cause confusion if RAN2 agreed differently with RAN1. |

##### [Conclusion]

Not many views are provided on the maximum number of beam measurement results that can be reported in event-triggered measurement report because RAN2 LS has not been provided to RAN1 yet. FL suggests discussing this issue in the next meeting taking into account the conclusion in RAN2.

### [Closed] 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 |
| Fujitsu | 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. |
| Spreadtrum | FL proposal 3-4-1-v1, we can wait for MIMO conclusion on whether Event-1 supports configuring new beam RS.FL proposal 3-4-2-v1, we support Alt.2-1. It is not necessary to configure mTRP and LTM event triggered reporting simultaneously. |
| Ericsson | 3-4-1-v1: Open to discuss, our preference is Alt1-2 so that we reuse the agreed implicit mechanism to decide between CSI-RS and SSB resource on the serving cell. A potential contradiction is avoided from e.g. explicitly indicating the resource type CSI-RS and at the same time configure a LTM Candidate resource set with SSBs. |
| Nokia | FL proposal 3-4-1-v1: Open to discuss with our preference to Alt 1-1.FL proposal 3-4-2-v1: We believe it is not a good idea to impose any constraints on the serving cell to support LTM. Therefore, we support Alt 2-2 and suggest clarifying the FFS. From our understanding, clarifying FFS should not lead to prolonged discussions or any significant specification impact. |
| Qualcomm | **Proposal 3-4-1-v1**: We support Alt 1-2 to keep a consistent design for all events.**Proposal 3-4-2-v1**: We prefer Alt 2-1. The mobility enhancement WID does not clearly indicate whether mTRP scenarios are within scope, while the UE-initiated beam reporting WID explicitly restricts the scope to sTRP scenarios. For design commonality and managing workload, it is suggested to limit the scope to sTRP scenarios. |
| CMCC | **FL proposal 3-4-1-v1:** Support Alt 1-1. The RS from candidate cell is not e valuated, it is not needed to configure it at all.**FL proposal 3-4-1-v1:** Support Alt 2-2. To consider the left Tus, mTRP scenarios may be precluded in Rel-19. |
| NTT DOCOMO | 3-4-1-v1: We support Alt 1-2 for unified design.3-4-2-v1: We share same view with Nokia. It would be beneficial to support LTM without such a restriction on the serving cell. |
| ZTE | **Proposal 3-4-1-v1:** support Alt 1-2 to keep the same rule to all LTM events.**Proposal 3-4-2-v1:** As we know, in Rel-18 LTM, all discussion only focus on single TRP scenario. In Rel-19 LTM, such principle should continue to be followed. So we don’t think that the discussion related to MTRP is necessary. |
| Huawei, HiSilicon | **Proposal 3-4-1-v1:** Support Alt 1-1. As no need to compare with candidate cell, configuring a fake candidate cell RS is misleading. We do not see why same rule for LTM3,5 should be reused considering totally different use cases. We can also wait for MIMO conclusion if they can resolved it early.**Proposal 3-4-2-v1:** The previous discussion on mTRP is for candiate cell. however, forcing UE configured LTM only working in sTRP mode is quite restricting. We support Alt 2-2.  |
| Google | **Proposal 3-4-1-v1**: Alt 1-1. There is no relation between candidate RS quality and event triggering condition of LTM2. It is unclear why UE needs to measure candidate RS. It is then awkward to configure candidate RS in this case. **Proposal 3-4-2-v1**: Tend to support Alt 2-1 and agree with QC’s view  |
| ITRI | **Proposal 3-4-1-v1: W**e prefer Alt 1-1.**Proposal 3-4-2-v1**: Support Alt 2-2 and share the same view with Nokia. |
| CATT | **Proposal 3-4-1-v1: W**e prefer Alt 1-2.**Proposal 3-4-2-v1**: We are fine with either option. However, should the decision on whether to support of multi-TRP scenario be made by RAN2, instead of RAN1?. |
| Samsung | **Proposal 3-4-1-v1**: support Alt 1-2; we do not think Alt 1-1 is viable given the dynamic nature of event-triggered reporting for evaluating dynamic channel change of current serving cell beam.**Proposal 3-4-2-v1**: support Alt 2-1; the focus should be sTRP. Regardless of whether mTRP is assumed for serving or candidate cell(s), we do not think we need to consider this application scenario given the limited TU – it would mean that we need to check every possible mTRP schemes that are supported in legacy releases.  |
| Lenovo | **Proposal 3-4-1-v1: P**refer Alt 1-1.**Proposal 3-4-2-v1**: Support Alt 2-2. |
| Vivo | **FL proposal 3-4-1-v1:** According to RAN2#128 meeting, RS type (SSB or CSI-RS) used for LTM event evaluation was agreed but it is not clear abouth the application scenarios.

|  |
| --- |
| * Network can configure which RS type (SSB or CSI-RS) is used for LTM event evaluation.
 |

Therefore, we think clarification on the above agreement should be provided from RAN2 first and then justify whether the discussion is needed or not. **FL proposal 3-4-2-v1:** Support Alt 2-2 and we share similar view with Nokia that no significant specification impacts is required for the FFS. |
| MediaTek | Proposal 3-4-1-v1: Same view as Vivo. I don’t think we need this proposal. In last RAN2 meeting, they agreed to support “rs-type” configuration in event definition. Serving cell RS type can simply follow event configuration. *RAN2 agreement: Network can configure which RS type (SSB or CSI-RS) is used for LTM event evaluation.*Proposal 3-4-2-v1: We don’t support mTRP. Same view as QC. |
| TCL | **Proposal 3-4-1-v2:** We prefer Alt 1-1.**Proposal 3-4-2-v1**: We prefer Alt 2-1. |
| Xiaomi | **Proposal 3-4-2-v1**: prefer Alt 2-1, not extend to mTRP. |
| KDDI | **Proposal 3-4-2-v1**: We prefer Alt 2-2. We support mTRP. Same view as Nokia. |

##### [FL proposal 3-4-1-v2]

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

* Alt 1-1: RS type is RRC configured
	+ Support: (9) Fujitsu, Nokia, CMCC, Huawei, Google, ITRI, Lenovo, vivo (RAN2 will have this parameter), MediaTek (same as vivo)
* Alt 1-2: At least one candidate RS shall be configured
	+ Support: (6) Ericsson, Qualcomm, DOCOMO, ZTE, CATT, Samsung

##### [FL proposal 3-4-2-v2]

* Alt.2-1: It is not expected that LTM event triggered reporting and mTRP operation at serving cells are simultaneously configured.
	+ Support: (8) Fujitsu, Supreadtrum, Qualcomm, CMCC, ZTE, Google, Samsung, MediaTek
* 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
	+ Support: (6) Nokia, DOCOMO, Huawei, ITRI, Lenovo, vivo

##### [FL proposal 3-4-1-v3]

Conclusion (not captured in chair’s note in this meeting)

* Companies are encouraged to check with their RAN2 colleagues if there are any issues for RS type determination for event LTM2
* Come back in RAN1#120bis if necessary

##### [FL proposal 3-4-2-v3]

* If RAN2 agrees the coexistence of LTM event triggered reporting and mTRP operation at serving cells,
	+ When more than one TCI states are indicated in a serving cell,
		- Alt.1: the indicated TCI state for the serving cell which has the highest RSRP value is chosen for evaluation of event LTM2, LTM3 and LTM5.
		- Alt 2: It is up to UE implementation to choose which indicated TCI state for the serving cell to use
		- *FL note: down-select now!*
* Send an LS to RAN2 to ask their feedback

##### [Conclusion]

The following agreement and conclusion were made during Thursday online discussion.

**Conclusion**

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

**For future meetings:**

Companies are encouraged to check with their RAN2 colleagues if there are any issues for RS type determination for event LTM2. Come back in RAN1#120bis if necessary.

The discussion of this section is closed

### [Closed] 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.  |
| Spreadtrum | We support Approach 2 and leave it to UE implementation. |
| Ericsson | Support Approach 1. We have learned from long experience that the NW need to have the possibility configure a filter (in addition to the UE implementation filter). The TTT and event offset/thresholds are configured on cell-level, not UE-specific, hence there need to be consistent RSRP variance across the UE population.The possibility to apply filtering at the gNB side, as suggested by some companies, does not exist for Conditional LTM which will use the same events.Such filtering would be up to UE capability. |
| Nokia | We prefer Approach 1. |
| Qualcomm | **Proposal 3-5-v1**: We are fine with Approach 1. However, we can just inform RAN2 about our observation that network-specified filtering can be beneficial in certain situations, without indicating whether it is necessary or not. The assessment and decision should rest with RAN2. |
| NTT DOCOMO | Support Approach 1. |
| InterDigital | Support Approach 1. There is very little upside in UE trying to optimize things on its own and lots of potential downside (feature working worse than legacy). |
| ZTE | We tend to reach a conclusion in RAN1, e.g., From RAN1 perspective, there is no consensus on introducing L1 filtering operation for event-triggered reporting. And send an LS to RAN2 for informing RAN1 conclusion. |
| Huawei, HiSilicon | We do not see the necessity to define filtering. It can be implemented by UE or NW or both. In addition, LTM can be performed with L3 measured in R18. If NW think the L1 measurement is not stable, L3 measurement result be directly used. for L3 measurement, event triggered report is already supported. Defining L1 filtering is redundant.  |
| NEC | Support Approach 1. |
| Google | We think Approach 2 best reflects current RAN1 situaiton.  |
| ITRI | We prefer Approach 1 |
| CATT | Support Approach 1. Introducing gNB configured filtering will ensure the consistent L1 event triggering behaviour across UEs, which is crucial for stable LTM performance. |
| Samsung | If such filtering is indeed needed, it should be optional for UE. |
| Lenovo | We also think Approach 2 reflects current RAN1 situation better.  |
| vivo | We support Approach 2 and leave it to UE implementation. |
| TCL | We prefer Approach 2. |
| LGE | We support Approach 1 |
| Xiaomi | Prefer Approach 2 and leave it to UE implementation. |
| Verizon | Support Approach 1 |
| KDDI | Support Approach 1 |

#####

##### [FL Proposal 3-5-v2]

* There is no consensus in RAN1 to support specified filtering of L1-RSRP for LTM.
	+ Send an LS to RAN2 to inform that L1 filtering is up to UE implementation.

##### [Conclusion]

The following conclusion was made during Thursday online discussion

**Conclusion**

There is no consensus in RAN1 to support specified filtering of L1-RSRP for LTM.

Send an LS to RAN2 to inform that L1 filtering is up to UE implementation. Final LS in R1-2501577.

With this, the discussion of this section is closed.

### [Closed] 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 |
| Spreadtrum | We are open to discuss the CSI processing criteria and CSI computation time.For the event triggered reporting, the serving cell RS and/or candidate cell RS need to be measure at UE to determine whether the event condition is met, where the CPU needs also to be occupied. If the CSI processing criteria is not defined (such as the number of CPUs occupied, the number of OFDM symbols required for CPU occupation), the gNB cannot accurately determine the CPU occupation at UE and cannot accurately schedule the UE to perform CSI processing. OCPU=1 can be used for event detecting. Similar to a gNB controlled aperiodic CSI report, a command configuring/triggering LTM event evaluation can be determined as the starting point for CPU occupation and until the last symbol of the PUSCH carrying the report. |
| Nokia | The CSI Processing Unit (CPU) is a RAN1 aspect from a specification standpoint, and it is important to clarify it, at least for all L1 measurements that the UE performs and reports, as also mentioned by Spreadtrum. We have already defined it periodic, semi-persistent, and aperiodic reporting, and we see no reason not to clarify CPU occupancy and the timeline for event-triggered reporting of L1 measurements. We should also discuss whether we need to consider CSI reference resource to define CPU timeline or to clarify which measurement RSs were used for a reporting instance as it’s important that both NW and UE have common understanding on these important aspects.  |
| vivo | We think it is unnecessary to discuss this issue. The procedure of LTM event-triggered reporting is similar to BFR. Only measurement is performed in the physical layer but evaluation and reporting are performed in the MAC layer. No CPU-related issues are specified within BFR procedure in the current specification. Therefore, it is not needed for LTM event-triggered reporting neither.  |
| TCL | We are open to discuss the CSI processing criteria and CSI computation time. |

##### [Conclusion]

Not many views are provided for [FL proposal 3-6-v1] this time. Companies are encouraged to further assess this issue until the next meeting.

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

### [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)

### [Closed] 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.  |
| Spreadtrum | FL proposal 5-1-1-v1, we support Option 2-2 and it is the most direct way for early CSI acquisition and interruption time reduction. A field can be introduced in LTM CSC MAC CE to trigger the CSI reporting, where a pre-configured CSI report configuration can be indicated.FL proposal 5-1-2-v1, we slight prefer Option Y. Similar to RAN2 conclusion on event triggered LTM reporting, MAC CE can be used as the CSI report container as soon as the CSI has been calculated. |
| Ericsson | **5-1-1-v1:** This is unclear: assuming that we only support periodic CSI-RS, the UE is supposed to acquire CSI directly after configuration, so that it can report according to further indications from the NW. There may be some differences for early CSI acquisition, but that can be discussed after the reporting mechanism has been resolved. **5-1-2-v1:** Support Option Y, it is the simplest way to avoid problems with the timeline, and the uncertainty when the CSI is available in the UE. Note that UCI can only be sent if the NW knows that the UE has included it in the PUSCH.  |
| Nokia | **FL Proposal 5-1-1-v1**: As mentioned by Ericsson, an additional option should be included where the UE is required to acquire CSI directly based on the configuration. This could be the simplest option, working for both scenarios: when the UE starts the measurement before receiving the CSC or after receiving the CSC. We can then discuss whether we need to address Issue 4, which involves reducing the measurements configured in the HO configuration. Option 2 may not be suitable for all Ues, especially those that support measurements before receiving the CSC.**FL Proposal 5-1-2-v1**: Support Option X using UCI. Using MAC-CE and not adhering to the CSI processing/computation timeline would be a significant divergence from the legacy framework, which we do not support. |
| Qualcomm | **Proposal 5-1-1-v1**: We support the proposal, particularly Option 1-4. However, we believe that the main bullet needs clarification. Our understanding is that the crucial point is restricting/indicating “when” to start the measurement of “which” CSI-RS resources in order to reduce overhead. The current wording “CSI acquisition triggering” is rather ambiguous.**Proposal 5-1-2-v1**: We support Option Y as it simplifies multiplexing in the PUSCH for the first UL Tx or Msg3. As Ericsson commented, the CSI report may not always be available due to timing and availability of CSI-RS resources. Therefore, if a UCI-based report is to be multiplexed in the PUSCH, it can lead to misalignment between the network and UE. |
| CMCC | **FL proposal 5-1-1-v1: Support Option 2-2.** For CSI acquisition, the CSI-RS resources for all candidate cell(s) are pre-configured by RRC from serving cell. The CSI-RS resources for all candidate cell(s) are associated with the CSI report configuration. When CSC MAC CE is received by UE, based on the target cell configuration ID information in the MAC CE, the CSI-RS resources of that target cell are activated for CSI report. CSC MAC CE can be reused without introduce additional bits to trigger the CSI report. It is the most simplest and straightforward way.**FL proposal 5-1-2-v1: Support Option X.** Support UCI to carry CSI report as legacy. The case 2 proposed by Ericsson could be avoided by adequate CSC MAC CE transmission time, which could be left to NW implementation. |
| NTT DOCOMO | **5-1-1-v1:** We support Option-1-2. For Opton-2 and Option-3, the benefit to introduce UE capability of measurement before CSC would be unclear. Regarding the main bullet, we share the same view with QC. Triggering mechanism should be focused on the measurement.**5-1-2-v1:** We prefer Option-X. |
| InterDigital | **FL Proposal 5-1-1-v1**: There should also be an option “no additional signaling”. The UE that can acquire CSI before cell switch can start measurement after reporting a candidate cell better than serving cell, if it has been given CSI configuration corresponding to the candidate cell. Then, if the CSC MAC CE indicates a target cell that it has already measured, it can provide the CSI.**FL proposal 5-1-2-v1**: It is not desirable to delay transmission of cell switch MAC CE to get CSI. Option Y seems preferable from that perspective. Option X can also be fine if there is a way for the UE to indicate availability of CSI. |
| ZTE | **Proposal 5-1-1-v1:** we are a bit confused about what this proposal is attempting to discuss. From our perspective, we need to first discuss and determine whether proposal 5-2-v1 can be supported, such as supporting periodic CSI-RS. If so, we can further discuss when CSI-RS measurement can be performed and whether additional restriction needs to be introduced for two cases: one is CSI-RS measurement can be started before reception of LTM CSC MAC CE, the other is CSI-RS measurement is done after reception of LTM CSC MAC CE. The benefit of doing this is that it can make the discussion of CSI-RS measurement part simpler and easier. **Proposal 5-1-2-v1**: we prefer Option-X since it is in line with the rule of legacy CSI reporting. As for timing requirement of CSI reporting, we think that the cell switch time is enough to complete CSI calculation and preparation of UL transmission. So we don’t think that it is necessary to use MAC CE to carry CSI reporting during LTM cell switching.In addition, from our perspective, although CSI reporting design involves which container to use for carrying CSI reporting, e.g., UCI or MAC CE, we think that it does not directly affect our discussion on the time domain behavior of CSI reporting, mechanism to trigger CSI reporting, UL channel to carry CSI reporting, etc. Instead, we think we should first discuss the time domain behavior of CSI reporting, mechanism to trigger CSI reporting and possible UL resource to carry CSI reporting, and then discuss which container will be used for CSI reporting transmission. This can not only simplify the discussion of this part, but also push it forward. |
| Huawei, HiSilicon | **FL proposal 5-1-1-v1**: we are not sure what does the “triggering mechanism” mean. Does it the trigger the measurement or report. For triggering of CSI measurement, UE should start to measure once the P-CSI-RS is configured or SP-CSI-RS is activated as legacy if UE is capable of measurement before CSC. otherwise, UE should measure the CSI-RS after the CSC is validated, e.g. 3ms after the ACK is feedback. As for triggering of report, we think UE should piggyback the CSI report together with first UL or msg3/msg5. No additional triggering signaling is required.**FL proposal 5-1-2-v1**: Support option X. The CSI acquisition is RAN1 objective and there are sufficient CSI feedback mechanism defined in RAN1 based on UCI we can refer to, instead of introducing new CSI feedback based on MAC CE. The UCI multiplexing rule define in TS38.212 can be reused as long as the PUSCH is clear, e.g. first UL, msg3/msg5 and etc.. |
| NEC | **FL Proposal 5-1-1-v1**: Support at least Option 2. To our understanding, if the “triggering mechanism” means “triggering CSI measurement and reporting mechanism”, to support UE with capability, i.e., CSI measurement before receiving CSC MAC CE, Option 1 may be considered. However, according to the agreement in the last meeting, CSI reporting is not supported before receiving CSC MAC CE. Therefore, regardless of whether Option 1 is adopted or not, CSI reporting requires CSC MAC CE to trigger, in other words, CSI reporting needs to be triggered based on Option 2. For UE without capability, we think Option 2 should be a natural method.**FL Proposal 5-1-2-v1**: Support Option X. We think that legacy CSI measurement and reporting framework should be considered. And additional latency of CSI acquisition may be caused based on Option Y. |
| Google | First, just to clarify, our position on confirming the WA is to confirm with revision. We think original wordings are too strong on having a unified solution. **FL proposal 5-1-1-v1**: We support Option 1 and Option 2. In our views, for CSI measurement **before** CSC, Option 1 is the only way; for CSI measurement **after** CSC, Option 1 and 2 can both applicable. Actually, we think Option 2 is more appropriate for CSI measurement **after** CSC to avoid reference timing issue for the CSI triggering delay. **FL proposal 5-1-2-v1**: Option X. We have very limited time for this WI. It would be difficult to introduce new medium for conveying L1 signaling.  |
| ITRI | **FL proposal 5-1-1-v1:** We support option 1, and the detail can be further discussed.**FL proposal 5-1-2-v1:** We support Option X, legacy framework for CSI measurement and reporting is preferable. |
| CATT | **For proposal 5-1-1-v1:** The proposal not clear to us. Is it used for measurement triggering, reporting triggering or both? If it is used for measurement triggering, we support Option 1-4. **For proposal 5-1-2-v1:** Support Option X. We prefer to use the same framework as legacy CSI reporting. Otherwise, some RAN1 related issues, e.g. CSI reference resource has to be redefined.  |
| Samsung | **FL proposal 5-1-1-v1**: we think at least Option 2-2 needs to be supported for measurement/reporting. The UE can start measuring CSI-RS after a certain time period upon reception of the CSC, and such UE behavior needs to be specified – implicitly known or via an explicit field in CSC MAC CE. **FL proposal 5-1-2-v1**: we can only support Option X. We do not understand why reporting CSI via UCI would result in timeline mismatch. Reporting CSI via MAC CE has zero benefit(s) in terms of latency and overhead reductions, which also departs from legacy CSI framework and we would not support. |
| Lenovo | **FL proposal 5-1-1-v1**: Actually, we support Option 1-4 and Option 2-2 to reuse the existing signaling. For option 1-2, does it mean a new DCI format will be introduced? For option 1-1 and 1-3, the corresponding UE behaviors are not clear.**FL proposal 5-1-2-v1**: We support Option X. |
| vivo | **FL proposal 5-1-1-v1**:We share the similar view as Huawei that it should clarified whether the trigger mechanism is used for measurement or reporting first. For the measurement trigger mechanism, the next step is to discuss whether to require a unified measurement trigger mechanism for UEs with different UE capabilities. If so, only Option-1 is feasible. Otherwise, all options can be considered. However, for the report trigger mechanism, LTM CSC MAC CE should be the baseline as reporting is performed after the reception of LTM CSC MAC CE. Besides, the measurement resources that the reported measurement results are derived from should be indicated in the LTM CSC MAC CE.**FL proposal 5-1-2-v1**: Prefer Option X and CSI measurement results are carried by UCI in the current specification. Corresponding transmission mechanism on PUSCH and overlap handling rules are complete. From the perspective of spec impact, UCI-based reporting is preferred.  |
| vivo | FL proposal 5-1-1-v1:We share the similar view as Huawei that it should clarified whether the trigger mechanism is used for measurement or reporting first. For the measurement trigger mechanism, the next step is to discuss whether to require a unified measurement trigger mechanism for UEs with different UE capabilities. If so, only Option-1 is feasible. Otherwise, all options can be considered. However, for the report trigger mechanism, LTM CSC MAC CE should be the baseline as reporting is performed after the reception of LTM CSC MAC CE. Besides, the measurement resources that the reported measurement results are derived from should be indicated in the LTM CSC MAC CE.FL proposal 5-1-2-v1: Prefer Option X and CSI measurement results are carried by UCI in the current specification. Corresponding transmission mechanism on PUSCH and overlap handling rules are complete. From the perspective of spec impact, UCI-based reporting is preferred.  |
| TCL | **FL proposal 5-1-1-v1:** We support option 2, and the detail can be further discussed.**FL proposal 5-1-2-v1:** We support Option X, legacy framework for CSI measurement and reporting is preferable. |
| LGE | **FL proposal 5-1-1-v1:** We support Option 3-1. Other all options have ambiguity on operation. For example, in Option 2-2, CSC MAC CE is usable and simple for measure after CSC MAC CE. But it is not applicable for measure before CSC MAC CE. Except additional triggering mechanism, it doesn’t work well in measure before CSC MAC CE. However, Option 3-1, which is legacy behavior, because it indicates concretely how measurement operate, it works well in both measure before/after CSC MAC CE.**FL proposal 5-1-2-v1:** We support Option X. Based on defining measurement trigger in proposal 5-1-1, UE is indicated to measure CSI-RS. All of required operation is already defined in UCI. In addition, if exact report container is predefined, UE need to measure CSI-RS from measurement triggering to predefined UCI container. It means new UE requirement is defined. |
| Xiaomi | FL proposal 5-1-1-v1In our understanding, there is only triggering for report in legacy system. UE needs to perform measurement before reporting, but when to start the measurement depends on the availability of the resource and the UE implementation. So regarding the triggering for report, we prefer Option 2 and Option 3. FL proposal 5-1-2-v1We prefer Option X to use UCI for CSI report as legacy system. |
| Qualcomm | **Proposal 5-1-v2/v3**: In the CSI acquisition framework diagram, a related issue with “Open Issue 5” is whether the UE is obligated to measure the CSI-RS before completing the LTM handover. Some companies, such as Qualcomm and Ericsson, have noted that when periodic CSI-RS is used, the timing between the CSI-RS transmission and the LTM CSC may be uncertain. In this situation, if the UE should always measure the CSI-RS, it would further delay the LTM procedure. Therefore, one possible option is that the UE may choose to complete the LTM first without measuring the CSI-RS and indicate the target cell that valid CSI for reporting is not available. To capture this point, we may soften the wording as “After the reception of cell switch command, the UE may measure~~s~~ the indicated CSI-RS resource”.For Open Issue 6, our preference is MAC CE. Given that a valid CSI report may not always be available, as discussed above, if the report is on UCI, there could be misalignment between the UE and network regarding the presence of the UCI, necessitating blind decoding. Additionally, when CG-PUSCH in the target cell is used for the first UL transmission, it is likely that the same CG-PUSCH resources are shared cell-wise for multiple LTM UEs. Since legacy UEs without early CSI acquisition will not transmit the UCI multiplexed with the first UL transmissions, while the new UEs may transmit UCI for CSI reporting, it also requires blind decoding at the network. With MAC CE-based reporting, multiplexing with the first UL transmission is straightforward and no blind decoding is needed. |
| InterDigital | **FL proposal 5-1-v3:** Regarding this part: “[or DCI scheduling cell switch command]” this seems to imply the UE has to (re-)interpret the contents of the DCI after successfully decoding the corresponding PDSCH and finding it contains CSC MAC CE?For Open Issue 3, one option is that the network configures criteria (event) to start measuring a CSI-RS.For Open Issues 5 and 6, agree with Qualcomm’s points above. |

##### [FL proposal 5-1-v2]

The following figure is the outcome of off-offline discussion with a small group. This can be the starting point of official offline discussion on Tuesday.



After the Tuesday offline discussion, the diagram is updated as follows. FL proposals will be made based on it.



##### [FL proposal 5-1-v3]

For target cell CSI acquisition,

* A UE is provided with RRC configurations for periodic CSI-RS resource and CSI report for each candidate cell
	+ FFS: Semi-persistent CSI-RS resource
* After the RRC configuration, the UE starts measuring CSI for the subset of configured CSI-RS resource(s), which is subject to UE capability
* The information included in cell switch command [or DCI scheduling cell switch command] explicitly or implicitly indicates at least the following:
	+ Which CSI-RS configuration among the configured CSI-RS resources is used for CSI measurement after the reception of cell switch command
	+ Which report configuration among the configured CSI report configurations is used for reporting
	+ Whether or not the reporting is performed
* After the reception of cell switch command, the UE measures the indicated CSI-RS resource
* At least aperiodic reporting is used to convey the latest measured CSI of the indicated CSI-RS resource, and the report is sent to the target cell
	+ FFS: semi-persistent and/or periodic CSI reporting

Note: with this proposal, the working assumption made in RAN1#119 doesn’t need to be confirmed.

##### [FL proposal 5-1-v4]

For target cell CSI acquisition,

* A UE is provided with RRC configurations for periodic CSI-RS resource(s) and CSI report(s) for one or more candidate cell
	+ For a candidate cell,
		- down-select from the following alternatives:
			* Alt 1 A single CSI report configuration is configured
			* Alt 2 Multiple CSI report configurations are configured
		- down-select from the following alternatives:
			* Alt X: A single CSI-RS resource for CMR is associated with a CSI report configuration
			* Alt Y: Multiple CSI-RS resources for CMR are associated with a CSI report configuration
	+ FFS: Semi-persistent CSI-RS resource
* After the RRC configuration and before the reception of CSC, the UE may measure CSI based on the configured CSI-RS resource(s), which is subject to UE capability
	+ FFS: whether or how to select a subset of CSI-RS resources to measure (note: this does not mean triggering mechanism for measurement but suggestion to the UE)
* The information included in cell switch command:
	+ Implicitly indicate at least the following:
		- which CSI report configuration among the configured CSI report configurations is used for reporting
	+ FFS: whether explicitly indicate at least the following:
		- Whether or not the reporting is performed
* After the reception of cell switch command, the UE may measure (depending on the timeline) the CSI-RS resource(s) associated with implicitly indicated CSI report configuration at least until the triggered reporting is performed
	+ FFS: how/whether to select CSI-RS resource(s) among the associated CSI-RS resources for measurement, if alt Y is adopted
* At least aperiodic reporting is used to convey the latest available measured CSI, and the report is sent to the target cell
	+ Option 1: to use UCI
	+ Option 2: to use MAC CE

Note: with this proposal, the working assumption made in RAN1#119 doesn’t need to be confirmed.

##### [FL proposal 5-1-3-v1]

* For UL container for LTM CSI report to target cell, down select one from the following two options:
	+ Option 1: Using UCI for LTM CSI report.
		- LTM CSI report is transmitted using a first PUSCH after receiving cell switch command MAC CE.
			* if CBRA procedure is not performed after CSC MAC-CE, the first PUSCH is first CG-PUSCH or DG-PUSCH.
				+ FFS: the first PUSCH if CBRA procedure is performed after CSC MAC-CE
		- If the UE does not perform CSI measurement before CSC, the CQI index ‘0’ (out of range) is used for LTM CSI report, if the gap between the last symbol of the earliest NZP-CSI-RS resource after CSC MAC-CE and starting symbol of the first PUSCH is smaller than ’N’ symbols.
			* FFS: the value of ’N’.
		- After the first PUSCH, the UE can be triggered to report aperiodic CSI based on a LTM-CSI-ReportConfig.
	+ Option 2: Using a MAC CE for LTM CSI report.

##### [Conclusion]

The following agreement was made during the online session on Thursday.

**Agreement**

For target cell CSI acquisition,

1. A UE is provided with RRC configurations for periodic CSI-RS resource(s) and CSI report(s) for one or more candidate cell
	* For a candidate cell,
		+ down-select from the following alternatives:
			- Alt 1: A single CSI report configuration is configured
			- Alt 2: Multiple CSI report configurations can be configured
		+ down-select from the following alternatives:
			- Alt X: A single CSI-RS resource for CMR is associated with a CSI report configuration
			- Alt Y: Multiple CSI-RS resources for CMR can be associated with a CSI report configuration
	* FFS: Semi-persistent CSI-RS resource
2. After the RRC configuration and before the reception of CSC, the UE may measure CSI based on the configured CSI-RS resource(s), which is subject to UE capability
	* FFS: whether or how to select a subset of CSI-RS resources to measure
	* FFS: when the UE may start measuring the configured CSI-RS resources
3. UE determines the CSI report configuration based on the CSC
4. After the reception of cell switch command, the UE may measure (depending on the timeline) CSI-RS resource(s) associated with determined CSI report configuration
5. The latest available measured CSI on target cell resource(s) is conveyed at least by a single report, and the report is sent to the target cell
	* Option 1: to use UCI
	* Option 2: to use MAC CE

Note: with this agreement, the working assumption made in RAN1#119 is automatically confirmed.

FL proposal 5-1-3-v1 was not discussed in RAN1#120 due to the lack of time.

Companies are encouraged to further assess the open issues on CSI-acquisition discussed in this meeting, i.e.

* Open issue 1:
	+ Configuration details e.g. Type of Codebook
* Open issue 2:
	+ Support of SP-CSI-RS resource
* Open issue 3:
	+ FFS: whether or how to select a subset of CSI-RS resources to measure (note: this does not mean triggering mechanism for measurement but suggestion to the UE)
* Open issue 4:
	+ Details of the indication by CSC
		- E.g. Whether report or not can be indicated
* Open issue 5:
	+ Details of timeline
* Open issue 6:
	+ Container of single reporting, see FL proposal 5-1-3-v1
* Open issue 7
	+ Number of CPUs and CPU occupancy timeline, CSI-reference resources, Definition of Active CSI-RS

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

### [Closed] 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. |
| Spreadtrum | If periodic CSI-RS is supported, the first transmission occasion should be clarified for the CSI-RS measurement and CSI reporting operations after reception of LTM CSC MAC CE, e.g. after the LTM CSC MAC CE or the HARQ-ACK of the LTM CSC MAC CE or the beam application time of the indicated TCI state for target cell. |
| Ericsson | Support |
| Nokia | Support the FL proposal. |
| Qualcomm | **Proposal 5-2-v1**: We support the proposal. |
| CMCC | Support |
| NTT DOCOMO | We are fine with the FL proposal. Based on the previous agreement for L1-RSRP report, one editorial suggestion is following.

|  |
| --- |
| [FL proposal 5-2-v1]At least periodic CSI-RS resource is supported for CSI acquisition for candidate cell. |

 |
| ZTE | We support the original FL proposal. Regarding the proposal raised by DOCOMO, we think that the original wording is applicable to Case-1: “CSI-RS measurement before reception of LTM CSC MAC CE” and Case-2: “CSI-RS measurement after reception of LTM CSC MAC CE”. If we add “for candidate cell” into the original proposal, it may create a misunderstanding that this proposal is only applicable to Case-1 since CSI-RS measurement is performed for target cell rather than candidate cell for Case-2. |
| NEC | Support. And we think that SP/AP CSI-RS can also be considered. For instance, a triggered AP CSI-RS for CSI acquisition for target cell can be transmitted after cell switch. |
| Google | **FL proposal 5-2-v1**: Support. We think, given the number of support P and SP, we can also agree semi-persistent CSI-RS resource for this time being.  |
| ITRI | Support |
| CATT | Not Support.As discussed in our Contribution, we have raised concerns regarding the significant overhead implications associated with periodic CSI-RS for CSI reporting. To maintain efficient CSI-RS resource utilization in CSI reporting, we recommend prioritizing either SP and/or AP CSI-RS. |
| Samsung | For periodically configured CSI-RSs, the UE can start measuring the CSI-RSs after a time period upon reception of CSC MAC CE – such behaviour can be interpreted as at least “aperiodic” CSI-RS after CSC MAC CE. OK to at least support periodic CSI-RS. |
| Lenovo | Fine with the proposal. But we think SP CSI-RS and aperiodic CSI-RS should also be supported. |
| vivo | Fine with this proposal for measurement before the reception of LTM CSC MAC CE. However, for the case of measurement after the reception of LTM CSC MAC CE, aperiodic CSI-RS resources are more reasonable and should be considered.  |
| TCL | **FL proposal 5-2-v1**: We support this proposal and believe that AP CSI-RS should be supported. |
| LGE | We support the proposal. |
| Xiaomi | FL proposal 5-2-v1: support.For UE without capability to support measurement before reception of LTM CSC MAC CE, semi-persistent or AP CSI-RS can be considered.  |

##### [Conclusion]

The proposal in this section is now covered by FL proposal 5-1. Thus, the discussion of this section is closed without any further proposal .

### [Closed] 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.

##### [Conclusion]

The proposal in this section is now covered by FL proposal 5-1. Thus, the discussion of this section is closed without any further proposal .

### [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.