**3GPP TSG RAN WG1 Meeting #120bis R1-2502088**

**Wuhan, China, April 7th-11th, 2025**

**Source: Moderator (Fujitsu)**

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

**Agenda Item: 9.9.1**

**Document for: Information**

# Introduction

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

# Plan for Online discussion





##### [Proposals for Monday Online]

[[FL proposal 4-2-v1]](#_[FL_proposal_4-2-v1]) Rx Beam Refinement – necessity of *repetition=on*

[[FL proposal 1-5-v1]](#_[FL_proposal_1-5-v1]) Timing reference of CSI-RS for L1-RSRP measurement

[[FL proposal 1-6-v1]](#_[FL_proposal_1-6-v1]) cell index for the list of CSI-RS resources

[[FL proposal 3-3-v1]](#_[FL_proposal_3-3-v1]) [RAN2 LS] max number of beams included in an event triggered report

[[FL proposal 3-4-v1]](#_[FL_proposal_3-4-v1]) RS type determination for event triggered reporting with event LTM2

[[FL proposal 5-2-v1]](#_[FL_proposal_5-2-v1]) SP CSI-RS resource for CSI acquisition

##### [Proposals for Monday offline]

[[FL proposal 5-1-v1]](#_[FL_proposal_5-1-v1]) High-level framework for CSI acquisition - Container and timeline issue

[[FL proposal 5-3-1-v1]](#_[FL_proposal_5-3-1-v1]) number of report configs and resource configs

##### [Proposals for Monday unofficial offline 17:00~ TBD the place]

[[FL proposal 5-1-v1]](#_[FL_proposal_5-1-v1]) High-level framework for CSI acquisition - Container and timeline issue

[[FL proposal 5-3-1-v1]](#_[FL_proposal_5-3-1-v1]) number of report configs and resource configs

##### [Proposals for Wednesday Online]

[[FL proposal 5-1-v1]](#_[FL_proposal_5-1-v1]) High-level framework for CSI acquisition - Container and timeline issue

[[FL proposal 5-3-1-v1]](#_[FL_proposal_5-3-1-v1]) number of report configs and resource configs

[[FL proposal 5-3-2-v1]](#_[FL_proposal_5-3-2-v1]) Structure of report config and resource config

[[FL proposal 5-5-v1]](#_[FL_proposal_5-5v1]) Contents of report and CSI resource configurations

[[FL proposal 5-4-v1]](#_[FL_proposal_5-4-v1]) Subset of CSI-RS configuration

##### [Proposals for Thursday Online]

Leftovers from Monday and Wednesday sessions

[[FL proposal 3-5-v1]](#_[FL_proposal_3-5-v1]) remaining issue for filtering

[[FL proposal 3-6-v1]](#_[FL_proposal_3-6-v1]) CPU for event triggered reporting

[[FL proposal 5-7-v1]](#_[FL_proposal_5-7-v1]) information provided by Cell switch command

# 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)

|  |  |  |
| --- | --- | --- |
| [**R1-2501686**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501686.zip) | LS on number of beam measurements in the measurement report MAC CE | RAN2, Huawei |
| [**R1-2501697**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501697.zip) | Reply LS to RAN1 on collision between SSB and RA occasion for LTM | RAN4, MediaTek |
| [**R1-2501793**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501793.zip) | Draft reply LS on number of beam measurements in the measurement report MAC CE | vivo |
| [**R1-2501855**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501855.zip) | Draft reply LS on number of beam measurements in the measurement report MAC CE | Spreadtrum, UNISOC |
| [**R1-2501967**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501967.zip) | Draft reply LS on number of beam measurements in the measurement report MAC CE | CATT |
| [**R1-2502114**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502114.zip) | Reply LS on number of beam measurements in the measurement report MAC CE | Lenovo |
| [**R1-2502148**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502148.zip) | Discussion on LS on number of beam measurements in the measurement report MAC CE | CMCC |

A reply LS is needed for [R1-2501686](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501686.zip), and handled under section 5.3.3
[R1-2501697](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501697.zip) Is handled under maintenance session

## Contributions under 9.9.1

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| --- | --- | --- |
| **[R1-2501756](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501756.zip)** | Discussion on measurements related enhancements for LTM | LG Electronics |
| [**R1-2501784**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501784.zip) | Discussion on measurements related enhancements for LTM | ZTE Corporation, Sanechips |
| [**R1-2501821**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501821.zip) | Discussion on measurements related enhancements for LTM | vivo |
| [**R1-2501849**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501849.zip) | Discussion on LTM enhancements | TCL |
| [**R1-2501879**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501879.zip) | Discussion on measurements related enhancements for LTM | Spreadtrum, UNISOC |
| [**R1-2501956**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501956.zip) | Discussion on measurement related enhancements for LTM | Lekha Wireless Solutions |
| [**R1-2502006**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502006.zip) | Discusssions on measurements related enhancements for LTM | CATT |
| [**R1-2502111**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502111.zip) | Measurements related enhancements for LTM | Lenovo |
| [**R1-2502132**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502132.zip) | Discussion on measurement related enhancements for LTM | Fujitsu |
| [**R1-2502172**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502172.zip) | Discussion on measurements related enhancements for LTM | CMCC |
| R1-2502201 | Discussion on measurements related enhancements for LTM | NEC |
| [**R1-2502206**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502206.zip) | Measurements related enhancements for LTM | InterDigital, Inc. |
| [**R1-2502214**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502214.zip) | Measurements related enhancements for LTM | Huawei, HiSilicon |
| [**R1-2502298**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502298.zip) | Discussions on measurement enhancement for LTM | OPPO |
| [**R1-2502329**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502329.zip) | Measurements related enhancements for LTM | Sony |
| [**R1-2502382**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502382.zip) | Views on Rel-19 measurement related enhancements for LTM | Samsung |
| [**R1-2502453**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502453.zip) | Discussion on measurements related enhancements for LTM | Xiaomi |
| [**R1-2502490**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502490.zip) | Discussion on measurements related enhancements for LTM | Sharp |
| [**R1-2502518**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502518.zip) | Discussion on measurements related enhancements for LTM | ETRI |
| [**R1-2502562**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502562.zip) | Measurement related enhancements for LTM | Ericsson |
| R1-2502628 | Measurement related enhancements for LTM | Apple |
| [**R1-2502653**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502653.zip) | Measurement related enhancements for LTM | Nokia |
| [**R1-2502749**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502749.zip) | Discussion on measurements related enhancements for LTM | KDDI Corporation |
| [**R1-2502778**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502778.zip) | Discussion on measurement related enhancements for LTM | NTT DOCOMO, INC. |
| [**R1-2502853**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502853.zip) | Measurements related enhancement for LTM | Qualcomm Incorporated |
| [**R1-2502891**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502891.zip) | Discussion on measurements related enhancements for LTM | Google |
| [**R1-2502929**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502929.zip) | LTM measurements related enhancements | MediaTek |

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| [**R1-2502087**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502087.zip) | FL plan for mobility enhancements in RAN1#120bis | Moderator (Fujitsu) |
| R1-2502088 | FL summary 1 of Measurements related enhancements for LTM | Moderator (Fujitsu) |
| R1-2502089 | FL summary 2 of Measurements related enhancements for LTM | Moderator (Fujitsu) |
| R1-2502090 | FL summary 3 of Measurements related enhancements for LTM | Moderator (Fujitsu) |
| R1-2502091 | Final FL summary of Measurements related enhancements for LTM | Moderator (Fujitsu) |
| R1-2502627 | Higher layer parameters for Rel-19 NR mobility enhancements Ph4 | Rapporteur (Apple) |
|  |  |  |

## Contributions under 9.15.6 – UE feature (For information)

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| --- | --- | --- |
| [**R1-2501786**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501786.zip) | Discussion on UE features for NR mobility enhancements Phase 4 | ZTE Corporation, Sanechips |
| [**R1-2501834**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501834.zip) | Discussion on UE features for NR mobility enhancements Phase 4 | vivo |
| [**R1-2501984**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2501984.zip) | Discussion on UE features for NR mobility enhancements Phase 4 | CATT |
| [**R1-2502138**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502138.zip) | UE Features for NR mobility enhancements Phase 4 | Nokia |
| [**R1-2502183**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502183.zip) | Discussion on UE features for NR mobility enhancements Phase 4 | CMCC |
| [**R1-2502247**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502247.zip) | UE features for NR mobility enhancements phase 4 | Huawei, HiSilicon |
| [**R1-2502299**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502299.zip) | Discussion on UE features for NR mobility enhancements | OPPO |
| [**R1-2502396**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502396.zip) | UE features for NR mobility enhancements Phase 4 | Samsung |
| [**R1-2502464**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502464.zip) | Discussion on UE features for NR mobility enhancements Phase 4 | Xiaomi |
| [**R1-2502563**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502563.zip) | UE features for NR mobility enhancements phase 4 | Ericsson |
| R1-2502644 | Rapporteur input on UE features for Rel-19 NR Mobility enhancements Ph4 | Apple |
| R1-2502741 | Summary of UE features for NR mobility enhancements Phase 4 | Moderator (AT&T) |
| [**R1-2502790**](https://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_120b/Docs/R1-2502790.zip) | Discussion on UE features for NR mobility enhancemens Phase4 | NTT DOCOMO, INC. |
| R1-2502869 | UE features for NR mobility enhancements Phase 4 | Qualcomm Incorporated |
| R1-2502869 | UE features for NR mobility enhancements Phase 4 | Qualcomm Incorporated |

# 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.

### [No issue] 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.

**Agreement(RAN1#120)**

* 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 (RAN1#120)**

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

**Conclusion (RAN1#120)**

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

##### [Conclusion]

No new issues are identified in this meeting.

### [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.

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

##### [Agreement of previous meetings]

The following conclusion was proposed by FL in RAN1#120, but not discussed due to lack of time.

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

##### [Summary of contributions]

* LG: RAN1 assumes the L3 mobility procedure and function based on the associated SSB are reused for timing reference of candidate cell CSI-RS measurement in LTM.
	+ The associated SSB is indicated explicitly in CSI-RS resource configuration.
	+ If there is no associated SSB, the UE is required to measure the CSI-RS resource based on the timing of the serving cell.
	+ If UE failed to detect the associated SSB, UE don’t monitor the related CSI-RS resource.
* Spreadtrum: The association between the candidate cells and the measurement CSI-RS resources can be determined based on the correspondence between the candidate cell and root SSB for the CSI-RS resource or root SSB for QCL source RS of the CSI-RS resource.
* CATT: Support the conclusion that the QCLed SSB of each CSI-RS should be reused as the timing reference for candidate cell CSI-RS measurements in LTM.
	+ For L1 event-triggered measurement, QCLed SSB of each CSI-RS should be reused as the timing reference for candidate cell CSI-RS measurements.
* Lenovo: Each CSI-RS resource associated with an LTM-CSI-ReportConfig is QCLed with an SSB associated with a same LTM-Candidate-ID.
	+ 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.
* 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.
* DOCOMO: UE shall base the timing of CSI-RS resource on the SSB QCLed with the CSI-RS resource where the SSB resource is found in LTM-SSB-Config-r18. i.e. support 1) below
	+ 1) Reuse SSB QCLed with the CSI-RS resource.
	+ 2) Reuse associatedSSB and refServCellIndex.

##### [FL observations]

All the companies mentioned that the timing of CSI-RS follows the associated SSB with the CSI-RS, it is not clear which is the common understanding:

* 1) Reuse SSB QCLed with the CSI-RS resource.
* 2) Reuse associatedSSB and refServCellIndex as defined for L3 mobility measurement

FL suggests clarifying this aspect based on the FL proposal in the last meeting.

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

Conclusion:

* RAN1 assumes the ~~legacy~~ procedure and function based on the associated SSB (i.e., QCLed SSB) are ~~re~~used for timing reference of candidate cell CSI-RS measurement in LTM
	+ From RAN1 point of view, associatedSSB in CSI-RS-Resource-Mobility and refServCellIndex defined in CSI-RS-ResourceConfigMobility are not needed

*FL note: the parts with yellow shadow are the modification from the last meeting*

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

|  |  |
| --- | --- |
| Company | Comment |
| Fujitsu | We support the conclusion. From RAN1 perspective, it is sufficient to use QCL relationship for the synchronization.  |
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### [High] 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

**Agreement(RAN1#120)**

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

**Agreement(RAN1#120)**

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

##### [Summary of contributions]

**Resolution of FFS**

* Vivo: Support the association between the CSI-RS resources and candidate cells is achieved by explicit signaling, i.e., a ltm-NZP-CSI-RS-ResourceList is associated with a ltm-CandidateIdList and the total number of elements included in both lists is the same.
* CATT Support explicitly configure the association between the measurement CSI-RS resources and candidate cells within a single resource set containing CSI-RS resources.
* Huawei: In the resource set configured for candidate cell RSRP measurement, a sequence of CSI-RS resource indices and a sequence of candidate cell indices are included, with each CSI-RS resource index associated with one candidate cell index.
* Samsung
	+ Alt1 (implicit association): association between the configured CSI-RS resource(s) and the candidate cell(s) can be based on association between the SSBs (QCL’ed with the configured CSI-RS resource(s)) and the candidate cells
	+ Alt2 (explicit association): each of the configured CSI-RS resource(s) is associated to an entry (a candidate cell ID) in the ltm-CandidateIdList – detailed signalling design is up to RAN2
* Ericsson: The CSI-RS resources of an LTM report configuration are explicitly associated with LTM candidate cells, just like SSB resources are.
* Nokia: Similar to Rel-18 LTM for SSBs, an *ltm-CandidateIdList* should be provided to indicate the candidate cells for the CSI-RSs specified in a single resource set.

**Provision of CSI-RS resources**

* Ericsson: Reuse LTM-TCI-Info to configure candidate cell CSI-RS resources for beam management
	+ *FL note: this is aligned with the RRC list proposed by rapporteur. FL thinks this issue can be handled under Rapporteur’s RRC parameter session*

**ResourceType for LTM CSI-RS**

* Huawei The time domain property (i.e., periodic or semi-persistent) of CSI-RSs associated with the same LTM CSI report should be same.
* Ericsson: For semi-persistent CSI-RS for LTM, keep legacy principles for SP CSI-RS: the LTM-CSI-ResourceConfiguration should indicate the resourceType semi-persistent, the network indicates when transmission is turned ON/OFF with a MAC CE, and reporting is a separate configuration.
	+ For semi-persistent CSI-RS, which is agreed to be supported for gNB scheduled reporting, the configuration should follow the legacy principles for SP-CSI-RS. The resourceType (semi-persistent) should be indicated in the resource configuration. The report configuration is separate. There is also a need to introduce a MAC CE indication when transmission is turned ON/OFF.
* *FL view: in the legacy RRC structure, a resource type configuration is given in a resource config. FL understanding is that we can follow the legacy configuration because the a CSI-reportConfig is associated with a LTM CSI resource config which contains a single CI resource set. This parameter has already captured in the rapporteur’s RRC parameter list, and hence it is not necessary to discuss here.*

**Activation/deactivation of SP CSI-RS resources**

* Huawei: Support to activate or deactivate all the CSI-RS resources from multiple candidate cells configured in LTM-CSI-ResourceConfig associated with the LTM CSI report by MAC CE.
	+ *FL view: it is recommended to submit a contribution directly to RAN2 as RAN1 has already sent an LS to RAN2 to define a MAC CE.*

##### [Summary of contributions]

Regarding the resolution of the FFS in the last meeting (i.e. FFS: how to associate between the measurement CSI-RS resources and candidate cells), clear majority mentions that explicit signaling would be the way to go, which FL agrees.

As mentioned above, other proposals can be handled under RRC parameter session by the rapporteur. Hence, they are not included in the FL proposal below.

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

* In the resource set configured for candidate cell L1-RSRP measurement, a sequence of candidate cell indices is included together with a sequence of CSI-RS resource indices, where each CSI-RS resource index is associated with one candidate cell index.

*FL note: this has already been captured in R1-2502627, and the intention is to clarify that the FFS is resolved*

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

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| Company | Comment |
| Fujitsu | We support FL proposal. |
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## gNB scheduled reporting

### [No issue] 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

##### [Conclusion]

No new issues are identified in this meeting.

### [Low] Active CSI-RS port and counting for gNB scheduled reporting

##### [Agreement in previous meetings]

No discussion so far

##### [Summary of contributions]

The following proposal is made by LG

* LTM CSI resources should be counted for the active CSI-RS ports or resources.
	+ FFS: whether it is counted as conventional active CSI-RS ports or resource in active BWP or newly introduced active CSI-RS ports or resource for LTM

##### [FL observation]

FL thinks companies needs more time to think about this issue because RAN1 hasn’t been discussed yet. Also, FL suggest taking the discussion for CSI acquisition and event triggered reporting should also be considered.

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

* Companies are encouraged to provide their views aiming at the consensus in RAN1#121
	+ LTM CSI resources should be counted for the active CSI-RS ports or resources.
		- FFS: whether it is counted as conventional active CSI-RS ports or resource in active BWP or newly introduced active CSI-RS ports or resource for LTM
* *FL note: this issue will not be treated during online/official offline discussion in RAN1#120bis.*

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

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| Company | Comment |
| Fujitsu | We think the active CSI-RS resources and ports for LTM should be defined with separate UE capability from those of serving cell. Otherwise, it will impact to legacy behavior for the UE such as beam management in the serving cell when lots of candidate cells and beams are configured. |
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### [Low] SpCell Inclusion for CSI-RS L1-RSRP measurement

##### [Summary of the contributions]

The following proposal is made by Nokia

* For CSI-RS-based measurements, multiple CSI-RSs may be configured in a cell, and different sets of UE-specific CSI-RSs may be assigned to different UEs. Also, there is no specific frequency parameter for a CSI-RS
* When *SPCellInclusion* is configured, it needs to be clarified that which frequency information should be used to determine which CSI-RSs from a measurement RS set belong to the current SpCell.
* When SpCellInclusion is configured, one of the following options can be used to determine the CSI-RSs from the current SpCell:
	+ Option 1: NZP-CSI-RS resources in [ltm-CSI-NZP-CSI-RS-ResourceList] associated with the current SpCell are the entries where PCI (given by ltm-CandidatePCI) and frequency information (given by ssb-Frequency for the SSBs QCLed with NZP-CSI-RSs) of the candidate cell associated with the LTM-CandidateId (given by the corresponding entry in ltm-CandidateIdList) is equal to the PCI and center frequency of cell-defining SSB of the current SpCell.
	+ Option 2: NZP-CSI-RS resources in [ltm-CSI-NZp-CSI-RS-ResourceList] associated with the current SpCell are the entries where PCI (given by ltm-CandidatePCI) and frequency information (absoluteFrequencyPointA) of the candidate cell associated with the LTM-CandidateId (given by the corresponding entry in ltm-CandidateIdList) is equal to the PCI and frequency associated with point A of the current SpCell.

##### [FL observation]

Since this is an issue for stage 3 and no RAN2 impact in terms of RRC and MAC CE is expected, it can be handled with low priority at this meeting. Thus, FL proposal is just gathering the companies view at this meeting aiming at the consensus at RAN1#121.

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

* Companies are encouraged to provide their views aiming at the consensus in RAN1#121
	+ When *SpCellInclusion* is configured for gNB configured reporting for L1-RSRP based on CSI-RS, one of the following options can be used to determine the CSI-RSs from the current SpCell:
		- Option 1: NZP-CSI-RS resources in [ltm-CSI-NZP-CSI-RS-ResourceList] associated with the current SpCell are the entries where PCI (given by ltm-CandidatePCI) and frequency information (given by ssb-Frequency for the SSBs QCLed with NZP-CSI-RSs) of the candidate cell associated with the LTM-CandidateId (given by the corresponding entry in ltm-CandidateIdList) is equal to the PCI and center frequency of cell-defining SSB of the current SpCell.
		- Option 2: NZP-CSI-RS resources in [ltm-CSI-NZp-CSI-RS-ResourceList] associated with the current SpCell are the entries where PCI (given by ltm-CandidatePCI) and frequency information (absoluteFrequencyPointA) of the candidate cell associated with the LTM-CandidateId (given by the corresponding entry in ltm-CandidateIdList) is equal to the PCI and frequency associated with point A of the current SpCell.
		- Note: Other options are not precluded
* *FL note: this issue will not be treated during online/official offline discussion in RAN1#120bis.*

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

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| Company | Comment |
| Fujitsu | We support Option 1 that the similar method for SSB can be used in Rel-18 LTM. |
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## 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

### [High] Report format and contents – maximum number of beams to report

##### [Summary of the contributions]

Question from RAN2 (R1-2501686)

* What should be the maximum number of beam-level measurement results that can be included in the MAC CE?

Summary of the contributions are provided as follows

* Maximum number of cells is 4, and maximum number of beams per cell is 4, then the total number of beams to report is 16
	+ ZTE, CATT, Ericsson, DOCOMO, vivo, Spreadtrum, Lenovo, CMCC
* Behaviour when SpCellInclusion is enabled (i.e. measurement result for current beam/cell is always included)
	+ Maximum number of cells is 4, i.e. 16 beams irrespective of SpCellInclusion
	+ Additionally contend, i.e. 17 beams in total
* Max number of beams depends on the LTM events
	+ 16 for events LTM3/4/5, and 0 for event LTM2.

##### [FL observation]

The majority view is 16 for beam-level measurement results that can be included in a MAC CE for event triggered reporting. One company proposed that the maximum number depends on the LTM event. However, FL’s thinks it is not the question from RAN2, i.e. it is not necessary to provide such information as RAN2 can further discussed this issue, if necessary.

On the other hand, at least one company has an understanding that an additional beam needs to be reported (i.e. totally 17) in a single MAC CE when current beam/cell is configured to be always included. However, FL understanding is that this is a different design from LTM gNB scheduled reporting in Rel-18. Thus, the group’s common understanding can be confirmed during the session.

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

Regarding the LS from RAN2 (R1-2501686) the following contents are included in the reply LS.

* RAN1 assumes at maximum 16 beams can be reported by a single event triggered reporting
	+ This is derived by 4 beams per cell x 4 cells at maximum, which includes the current cell/beam when configured to be always reported *(FL note: this yellow part is for online check)*

*FL note: as RAN2 asked the maximum number of beams in a report, it is not necessary to include the dependency on LTM event – it is up to RAN2.*

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

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| Company | Comment |
| Fujitsu | We support FL proposal. i.e., 16 includes current beam when SpCellInclusion is configured. |
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### [High] 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).

**Conclusion (RAN1#120)**

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

**For future meetings (RAN1#120)**

* 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.

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]

For the RS type determination for event triggered reporting with event LTM2, the companies’ view is summarized as follows.

* **Alt 1-1**: RS type is RRC configured
	+ Vivo, CATT, Fujitsu, MediaTek
	+ Justification: RAN2 has such agreement
* **Alt 1-2**: At least one candidate RS shall be configured
	+ Spreadtrum, Lenovo, Ericsson (Aligned with UEIBM event 1), Nokia (Aligned with UEIBM event 1), DOCOMO, Qualcomm
	+ Justification: RAN1 has similar agreement for UEIBM, and the network most like to configure candidate RSs even for event LTMs.
* UP to RAN2
	+ LG

##### [FL observation]

The situation of the companies’ proposal is quite similar to the previous meeting even though some companies changed their mind. FL agrees the argument for Alt 1-2 that candidate RS configuration is anyway necessary to perform the reporting to find a better cell than the current serving cell even for LTM2. Meanwhile, Alt 1-1 also works. In summary, FL thinks both options works properly, and we can go directly to the online session for quick approval.

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

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

* **Alt 1-1**: RS type is RRC configured
	+ Vivo, CATT, Fujitsu, MediaTek
	+ Justification: RAN2 has such agreement
* **Alt 1-2**: At least one candidate RS shall be configured
	+ Spreadtrum, Lenovo, Ericsson (Aligned with UEIBM event 1), Nokia (Aligned with UEIBM event 1), DOCOMO, Qualcomm
	+ Justification: RAN1 has similar agreement for UEIBM, and the network most like to configure candidate RSs even for event LTMs.

*FL note: the following is the companies view in the last meeting*

* 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

##### [Comments to 3-4-v1]

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| Company | Comment |
| Fujitsu | As FL mentioned, both alternatives work properly. In our understanding, RAN2 has made the agreement that ‘Network can configure which RS type (SSB or CSI-RS) is used for LTM event evaluation’. We think Alt 1-1 is more straightforward and aligned with the agreement. However, Alt1-2 is also fine for us as a compromise. |
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### [Mid] Filtering of measurement results for evaluation and reporting

##### [Agreement in previous meetings]

**Conclusion (RAN1#120)**

* 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.

##### [Summary of contributions]

The following proposal is made by Ericsson on top of the conclusion in the last meeting

* Historically, legacy requirements assumed 3 samples for serving cell L1-RSRP unless timeRestrictionFor-ChannelMeasurements is configured, in which case only one sample is used [1] (Clause 9.5.4.1). However, the LTM L1-RSRP measurement period in Rel-18 is based on single-shot measurements: Primarily due to lack of time, RAN1 missed to define timeRestrictionForChannelMeasurements for LTM CSI framework in Rel-18. Then RAN4 did not define the number of samples needed for the UE implementation filtering as it was linked to configuration of timeRestrictionForChannelMeasurements in the legacy serving cell requirements.
* For Rel-19 event triggered L1 RSRP measurement reporting it is important that the UE implementation filter can be configured to use either 1 or 3 measurement samples, just like legacy serving cell L1-RSRP measurements.
* We propose:
	+ Just like L1-RSRP on serving cells, the UE implementation filter for LTM L1-RSRP can use up to M measurement samples, where M can take the values 1 and 3 and is configured by the network.
	+ A straight-forward way to achieve this proposal is to configure timeRestrictionForChannelMeasurements for LTM CSI config.

##### [FL observation]

Even though this is a new issue for the filtering applied to event triggered reporting, FL thinks our early consensus is helpful to finalize the RRC parameter discussion. RAN1 can discuss the necessity to introduce a legacy parameter *timeRestrictionForChannelMeasurements* with two values, i.e.(ENUMERATED {configured, notConfigured}), and then the necessary procedure including the number of samples can be discussed in RAN4.

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

* A RRC parameter *timeRestrictionForChannelMeasurements,* as defined in the legacy operation, is introduced for L1-RSRP measurement for event triggered reporting *(FL note: need confirmation if this is restricted to event triggered reporting or gNB scheduled reporting is also included)*
	+ The detailed filtering behaviour on the number of samples is defined in RAN4

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

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| Company | Comment |
| Fujitsu | TS 38.214 said that “If the higher layer parameter *timeRestrictionForChannel-Measurements* in *CSI-ReportConfig* is set to "*notConfigured*", the UE shall derive the channel measurements for computing L1-RSRP value reported in uplink slot n based on only the SS/PBCH or NZP CSI-RS, no later than the CSI reference resource, (defined in TS 38.211[4]) associated with the CSI resource setting.”. So, it might be difficult to introduce the parameter as is of Rel-18 as the CSI reference resource is not defined yet in the event triggered reporting. In order to adopt this parameter, we need to discuss how to treat the CSI reference resource in the event triggered reporting. |
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### [Mid] CSI reference resource and processing units for event triggered reporting

##### [Summary of contributions]

* **Necessity of CPU involvement for event triggered reporting**
	+ YES: LGE, CATT, Fujitsu, Nokia
		- Justification: Efficient use of UE CPU resources
	+ NO: Qualcomm
		- Justification: Both event evaluation and reporting for event-triggered L1 measurement reporting are managed by the MAC layer
* **Number of CPUs for L1-RSRP measurement for event triggered reporting**
	+ O\_CPU = 1: LG, Nokia
* **CSI reference resource**
	+ No need to define: CATT
* **CPU occupancy time**
	+ Start point:
		- The first OFDM symbol of the earliest one of each transmission occasion of periodic CSI-RS/SSB resource of all the candidate cells for L1-RSRP measurements
	+ End point
		- Alt 1: the last symbol of the configured PUSCH carrying the MAC-CE report
		- Alt 2: $Z\_{3}^{'}$ symbols after the last symbol of the latest one of the CSI-RS/SSB resource of all the candidate cells for L1-RSRP measurements in each transmission occasion
		- Alt 3: the deactivation or reconfiguration of the event-triggered report
* **UE Capability**
	+ CPU capability for event triggered reporting shares the same capability with other (e.g. serving cell CPU) ? or separately defined?

##### [FL observation]

Only 5 companies provided their views on the necessity of CPU for event triggered reporting, and the detailed design if needed. The common understanding is that the report is performed by higher layer, hence the legacy behavior / spec description may not be applicable. Since no RRC impact is foreseen for this issue, FL suggestion is gathering the companies view on the necessity to define CPU for event triggered reporting first, and then RAN1 can decide the high level direction, i.e. whether to introduce CPU for event triggered reporting or not.

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

For the CPU occupancy rules for event triggered reporting, choose one option from the following:

* Option 1: no CPU involvement is necessary for event triggered reporting
* Option 2: CPU involvement is necessary for event triggered reporting, where OCPU = 1
	+ FFS: whether or how to share the UE capability for CPU with legacy operation (i.e. CPU used for serving cell) , and the definition of CPU occupancy time
		- Start point:
			* The first OFDM symbol of the earliest one of each transmission occasion of periodic CSI-RS/SSB resource of all the candidate cells for L1-RSRP measurements
		- End point
			* Alt 1: the last symbol of the configured PUSCH carrying the MAC-CE report
			* Alt 2: $Z\_{3}^{'}$ symbols after the last symbol of the latest one of the CSI-RS/SSB resource of all the candidate cells for L1-RSRP measurements in each transmission occasion
			* Alt 3: the deactivation or reconfiguration of the event-triggered report
			* Other alternatives are not precluded

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

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| Company | Comment |
| Fujitsu | We support Alt 2 of Option 2. Firstly, the CPU of Rel-18 LTM L1 measurement has been defined, so Rel-19 LTM also requires it. On the other hand, since the L1 measurement report is carried by MAC CE, PHY layer may not recognize the PUSCH carrying MAC CE. Hence, the CPU occupancy should be defined only for measurement duration and Alt 2 is aligned with this behavior. |
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### [Closed] Other issues

##### [Summary of contributions]

A proposal on configuration aspect is provided by Qualcomm

* For event evaluation and measurement reporting for Events LTM2, LTM3, and LTM5, the current SpCell and its corresponding RSs should always be included in the LTM measurement resource configuration associated with the report configuration.

*FL note: the same mechanism has already been introduced in Rel-18 and the agreement was made by RAN2. Similarly, FL expect that RAN2 will make the decision if necessary.*

A proposal on Rx beam assumption is provided by Nokia

* 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.
* RAN1 should discuss whether/how to ensure appropriate Rx beams (e.g., wide versus refined Rx beams) are consistently used for measurements across serving cell and different LTM candidate cells.

*FL note: at this moment, the interest level of Rx beam is not so high according to the discussion in section 5.4.2. Thus FL would like to suggest not spending time for this issue at this moment, and to encourage offline discussion with other companies to get more support.*

##### [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.

### [Mid] 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: CATT, Nokia?
	+ 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. only *repetition=off* is supported: Spreadtrum, Huawei, Ericsson, MediaTek, Nokia?
	+ 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 meetings, 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 yet.

FL postponed the discussing until now, but it’s time to make the decision as the potential RRC parameters are proposed by the rapporteur, and only “off” is captured in R1-2502627. FL understands this reflects the situation very well, and it would be worthwhile confirming this to conclude the discussion.

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

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

##### [Comments to 4-2-v1]

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| Company | Comment |
| Fujitsu | We support FL proposal that the measurement overhead is too large if *repetition=on* is supported for periodic and semi-persistent CSI-RS resource. |
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### [Closed] Other issues

##### [Summary of proposal]

The following proposal is made by KDDI

* Support mTRP operation for the target cell in Rel-19.

*FL note: at this moment, the interest level of Rx beam is not so high based on the discussing in the past. Thus FL would like to suggest not spending time for this issue at this moment, and to encourage offline discussion with other companies to get more support.*

##### [Conclusion]

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

## CSI acquisition for candidate cell(s)

### [High] Remaining issues for CSI acquisition framework – report container and time domain property of the report considering timeline issue

##### [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)

**Agreement(RAN1#120)**

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.

##### [Summary of contributions]

This section focuses on the remaining issue on the CSI-acquisition framework, i.e. container and timeline which is related to the yellow highlighted part in the RAN1#120 agreement above.

* **Issue 1: Container**
	+ Option 1: to use UCI
		- Supported by 20 companies: LGE, ZTE, vivo, CATT, Lenovo, Fujitsu, CMCC, Huawei, OPPO, SONY, Samsung, Xiaomi, Sharp, ETRI, NEC, Apple, Nokia, KDDI, DOCOMO, Google
		- Justification: Mechanism has already been specified and no latency due to the processing by higher layer
		- Concern: potential timeline issue
	+ Option 2: to use MAC CE
		- Supported by 5 companies: IDC, SONY, Ericsson, Qualcomm, MediaTek
		- Justification, there is no issue on timeline
		- Concern: RAN2 workload to define a new MAC CE format to convey UCI
* **Issue 2: Whether and how to solve the timeline issue? If timeline is not satisfied when UCI is used, how the CSI is reported? (note: timeline definition will be separately discussed)**
	+ **Issue 2-1: How to avoid the blind detection at gNB ?**
		- Option 2-1-1: report the lowest CQI index (out of range) when the timeline is unsatisfied
		- Option 2-1-2: report an indication of if valid CSI is available (by UCI or MAC CE)
		- Option 2-1-3: report an indication of when valid CSI is available after cell switch (by UCI or MAC CE)
		- Option 2-1-4: gNB controls the timing of CSC and first PUSCH to avoid the presence of occurrence of blind detection
	+ **Issue 2-2: How to provide the second opportunity to report the CSI when the timeline is not satisfied for the 1st occasion?**
		- Option 2-2-1: If valid CSI is not available at the predefined first PUSCH, some additional PUSCHs could be used instead.
			* Option 2-2-1-1: CG-PUSCH could be reserved until valid CSI has been reported
			* Option 2-2-1-2: multiple (CG and/or DG) PUSCHs can be used to convey valid CSI after the 1st occasion, and the number of PUSCHs can be configured by RRC
		- Option 2-2-2: gNB requests CSI after cell switch completion, i.e. no spec impact
* **Issue 3: if UCI is adopted, which PUSCH is used to convey first UCI report? (note possibility of second, 3rd … transmission is captured in issue 2-2.**
	+ For RACH-less LTM
		- DG-PUSCH or CG-PUSCH where RRC reconfiguration complete message is transmitted.
	+ For RACH-based LTM
		- Option 3-1: DG-PUSCH or CG-PUSCH where RRC reconfiguration complete message is transmitted.
		- Option 3-2: PUSCH scheduled by RAR UL grant, for both CFRA and CBRA
		- Option 3-3: PUSCH scheduled by RAR UL grant for both CFRA and DG-PUSCH or CG-PUSCH where RRC reconfiguration complete message is transmitted for CBRA

##### [FL observation]

FL thinks we can firstly discuss the container and timeline issue in this meeting.

For issue 1: For the container, i.e. UCI vs MAC CE, FL thinks UCI is a good option to reuse the existing RAN1 specifications as much as possible. The potential issue occurring when the timeline is not satisfied needs carefully assessed, and the solution needs to be introduced if necessary. On the other hand, MAC CE has no/less issue on the timeline issue because the UCI can be reported whenever it is ready. Also, blind detection will not be required thanks to MAC CE container. Nevertheless, RAN2 needs to define a new report format, which would be a major concern.

For issue 2-1 and 2-2, all the options work in some sense, but FL thinks the solutions are for optimization and no strong necessity to have, even though nice to have.

To simplify the system design and to minimize the workload in RAN1 and RAN2, FL suggestion is to adopt option 1 + option 2-1-1 + option 2-2-2 as a starting point of the discussion in this meeting.

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

* For the container of LTM CSI report for a target cell,
	+ Option 1: to use UCI (FL suggestion)
		- Supported by 20 companies: LGE, ZTE, vivo, CATT, Lenovo, Fujitsu, CMCC, Huawei, OPPO, SONY, Samsung, Xiaomi, Sharp, ETRI, NEC, Apple, Nokia, KDDI, DOCOMO, Google
	+ Option 2: to use MAC CE
		- Supported by 5 companies: IDC, SONY, Ericsson, Qualcomm, MediaTek
* For the LTM CSI report to the target cell,
	+ Option 2-1-1: a UE reports the lowest CQI index (out of range) when time timeline of CSI measurement and reporting is not satisfied (FL suggestion)
	+ Option 2-1-2: a UE reports an indication of if valid CSI is available (FFS by UCI or MAC CE) together with the CSI report
	+ Option 2-1-3: a UE reports an indication of when valid CSI is available after cell switch (by UCI or MAC CE) together with the CSI report
	+ Option 2-1-4: gNB controls the timing of CSC and first PUSCH timing to avoid the presence of occurrence of blind detection, i.e. no spec impact
	+ FFS: the definition of timeline
* If valid CSI is not available at the predefined first PUSCH,
	+ Option 2-2-1:, some additional PUSCHs could be used to convey the valid CSI.
		- Option 2-2-1-1: CG-PUSCH could be reserved until valid CSI has been reported
		- Option 2-2-1-2: multiple (CG and/or DG) PUSCHs can be used to convey valid CSI after the 1st occasion, and the number of PUSCHs can be configured by RRC
	+ Option 2-2-2: gNB requests CSI after cell switch completion, i.e. no spec impact (FL suggestion)

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

|  |  |
| --- | --- |
| Company | Comment |
| Fujitsu | We support UCI as the container for the benefits of short latency and less specification impact. Our assumption for the CSI report procedure is as follow; For the case that the UE does not meet the timeline of CSI processing, the UE can repeatedly transmit out-of-range (OoR) of CQI index on the CG or DG PUSCHs (e.g., the first several PUSCHs) until the CSI is ready. And then, the UE can report the CSI multiplexing to the UL resource when the CSI is ready. The number of PUSCHs for the CSI report repetition can be configured via RRC. From this behavior, the target cell can avoid the blind detection of the CSI report regardless of timeline fulfillment. For Option 2-2-2, the UE needs to measure the CSI again after the completion of CSC, it occurs no benefit compared to legacy CSI acquisition in terms of latency. As a summary, we support Option1 + Option2-1-1 + Option2-2-1-2. |
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### [High] Time domain property of CSI-RS resource

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

**Agreement(RAN1#120)**

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.

##### [Summary of contributions]

The discussion of this section focuses on the time domain property for CSI-RS resource for CSI acquisition, i.e. support of semi-persistent (SP) CSI-RS and/or aperiodic (AP) CSI-RS resource on top of periodic CSI-RS.

* **Support of SP CSI-RS resource**
	+ Support (17): ZTE, vivo, Spreadtrum, CATT, Lenovo, Fujitsu, CMCC, Huawei, Samsung, ETRI, Ericsson, Apple, Nokia, KDDI, DOCOMO, Qualcomm, Google
		- Justification: the same mechanism as L1-RSRP measurement report with gNB scheduled reporting. Reduction of energy consumption for both UE and network. Avoiding unnecessary inter-cell interference.
	+ Concern (1): MediaTek
		- Justification: periodic CSI-RS is sufficient
* **Support of AP CSI-RS resource**
	+ Support: ZTE, TCL
* **Mechanism to trigger SP CSI-RS resources**
	+ SP CSI-RS should be activated before reception of LTM Cell Switch Command MAC CE for early CSI acquisition if SP CSI-RS is supported.
		- A MAC CE should be used to activate/deactivate SP CSI-RS resource set of candidate cell for CSI measurement, where MAC CE design is up to RAN2.
	+ Semi-persistent CSI-RS measurement after CSC can be automatically activated by CSC
	+ Enhance the existing TCI-State activation/deactivation MAC-CE for Candidate cell to activate the SP-CSI-RS based measurement before reception of CSC MAC-CE.

##### [FL observation]

Considering the number of supporting companies for SP CSI-RS, FL believes it can be agreed in this meeting. For the detailed mechanism, it is natural to use a MAC CE for activation and deactivation based on the legacy design. RAN1 can ask RAN2 to work on the detailed design of MAC CE.

In addition, it is proposed to introduce automatic activation by Candidate Cell TCI States Activation/Deactivation MAC CE. This might be reasonable if the UE starts CSI acquisition only for the candidate cells associated with the activated TCI states. This can be further discussed, but FL thinks this automatic mechanism is an optimization given the introduction of a new MAC CE. The necessity should be carefully assessed

Finally, it is also proposed to introduce AP CSI-RS resource. FL suggestion is to finalize the basic design using P (and potentially SP) CSI-RS first, and then come back if time allows.

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

* In addition to periodic CSI-RS resource, semi-persistent CSI-RS resource is supported for candidate/target cell CSI acquisition for intra- and inter- CU/DU scenarios
	+ Support of semi-persistent CSI-RS resource is subject to UE capability.
* A new 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
* FFS the mechanism to automatically activate/deactivate the semi-persistent CSI-RS resource, e.g. by Candidate Cell TCI States Activation/Deactivation MAC CE *(FL note: check if this FFS can be kept or not)*
* Send an LS to RAN2 and RAN3 to inform this agreement

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

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| Company | Comment |
| Fujitsu | We support FL proposal. For the FFS, we are fine to continue discussion but it is not necessary. |
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### [High] Configuration structure for CSI report and CSI-RS resource

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

**Agreement(RAN1#120)**

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.

##### [Summary of contributions]

**Number of CSI-RS resource configurations and report configurations**

The companies view on the number of report configs / CSI-RS resources are summarized as follows

|  |  |  |
| --- | --- | --- |
|  | Alt 1 (single report config) | Alt 2 (multiple report config) |
| Alt X (single CSI-RS resource) | TCL, Spreadtrum, Huawei, Apple, MediaTek | TCL |
| Alt Y(multiple CSI-RS resource) | CATT, Fujitsu, CMCC, OPPO, SONY, Samsung, Xiaomi, Ericsson, NEC, KDDI, DOCOMO, Qualcomm,  | LG, vivo, Lenovo, IDC, SONY, Sharp, NEC, Nokia, Google |

Justifications for each alternative are summarized as follows:

* **Alt 1 + Alt X**: Simple. Not necessary to have multiple configurations for CSI-RS resource and reporting as the reported CSI is used only for a short period
* **Alt 1 + Alt Y**: Sufficiently flexible. The indication of report configuration can be simplified while sufficient flexibility for beam selection can be provided
* **Alt 2 + Alt Y**: Fully flexible. Choice of report and CSI resource configuration is important for FR2

**RRC structure**

Even though very detailed proposals are provided by the companies, FL thinks that we can focus on the high-level discussion at this stage to help the rapporteur’s discussion

* CSI report configuration
	+ **Alt. 1-1:** Provided under ServingCellConfig
		- Justification: Same as in legacy report configuration
	+ **Alt. 1-2:** Provided (somewhere) under LTM-config
		- Justification: Report configuration is provided/used for each candidate cells, and the report configuration should be kept even after cell switch
		- Nokia mentioned that outside of the ltm-CandidateConfig, though
	+ Note that RAN1 assumes the report configuration for CSI acquisition is shared between the source cell, the target cell and the UE, which may have RAN2 and RAN3 spec impact
* CSI-RS resources, resource set and resource configurations
	+ **Alt. 2-1**: LTM-CSI-ResourceConfig provides multiple CSI-RS resource sets for CSI acquisition, where each resource set is associated with different candidate cell
	+ **Alt. 2-2**: LTM-CSI-ResourceConfig provides a single CSI-RS resource set for CSI acquisition, which includes multiple CSI-RS resources associated with each candidate cells
	+ Resource set configuration for CSI acquisition is provided without repetition and trs-info parameters

##### [FL observation]

For the number of CS-RS resources and resource configurations, Alt 1 + Alt Y has slight majority support compared with other alternatives. FL understands that this combination gives a good balance between complexity and flexibility considering FR2 operation.

As for the structure of CSI report configuration, FL agrees the report configuration is shared from target cell to the serving cell (and to UE) because the report is performed to the target cell while the configuration is conducted under the serving cell. With this fact, it would be straightforward to provide report configuration under LTM-config. The details on the structure can be discussed under rapporteur’s RRC parameter session.

Finally for the relationship between resource set and resource configuration, FL thinks that having different resource set for each candidate cell is a natural interpretation from the agreement in RAN1#120, i.e. only report config(s) associated with the target cell is eventually used. Thus, Alt 2-1 above is proposed as a way forward.

In summary the following two FL proposals can be made in this meeting.

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

*FL note Alt 1 + Alt Y is chosen from the agreement at RAN1#120 because it has the majority support and good balance between flexibility and complexity*

* For a candidate cell,
	+ A single CSI report configuration is configured
	+ Multiple CSI-RS resources for CMR can be associated with a CSI report configuration

##### [FL proposal 5-3-2-v1]

*FL note: Alt 1-2 and 2-1 are chosen from the “Summary of contributions” above*

* CSI report configuration for LTM CSI acquisition is provided under LTM-config
	+ Note: RAN1 assumes the report configuration for CSI acquisition is shared between the source cell, the target cell and the UE
* A *LTM-CSI-ResourceConfig* configuration provides multiple CSI-RS resource sets for CSI acquisition, where each resource set is associated with each candidate cell
	+ Resource set configuration for CSI acquisition is provided without *repetition* and *trs-info*

##### [Comments to 5-3-1-v1 and 5-3-2-v1]

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| --- | --- |
| Company | Comment |
| Fujitsu | **[FL proposal 5-3-1-v1]**: We support the FL proposal. A single report per a candidate cell is enough since CSI acquisition for LTM aims minimal CSI for the faster cell switching. For the number of CSI-RS resources, we can consider the indicated TCI state by CSC may have wider beam than that of CSI-RS resources for CQI. In this case, the UE needs to measure one or more beams within the indicated TCI state.**[FL proposal 5-3-2-v1]**: We support the FL proposal. For the subsequent LTM, the CSI report configuration should be configured under LTM-config. Otherwise, the serving cell should configure the CSI report configuration for all candidate cells at every time after cell switch. For CSI-RS resource set configuration, it is straightforward and simple that each resource set is associated with each candidate cell. |
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### [High] Subset of CSI-RS resources for CSI measurement before CSC

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

**Agreement(RAN1#120)**

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.

##### [Summary of contributions]

Regarding the additional mechanism to indicate the subset of CSI-RS for CSI acquisition (before CSC), companies’ views are summarized as follows:

* Issue 1-1: Whether or not such a mechanism is needed
	+ Option 1-1: Specify a mechanism to indicate subset of CSI-RS resources for CSI measurement
	+ Option 1-2: Can be left to UE implementation:
	+ Option 1-3: Introduce UE capability on the number of candidate cell or CSI-RSs. Up to network configuration on top of that
* Issue 1-2: Indication mechanism, if Option 1-1 above is supported
	+ Introduce a new MAC CE
	+ Reuse the existing field in DCI format, e.g. CSI request field
	+ Implicitly indicated by candidate cell TCI state activation/deactivation MAC CE:
		- Measure CSI-RS resource(s) associated with activated joint or DL TCI state for candidate cell
		- SP CSI-RS resource(s) are also implicitly activated
	+ Implicitly indicate by a MAC CE for SP CSI-RS resources activation/deactivation
	+ Implicitly indicated by the cell indicator field in PDCCH order

Another discussion point is the timing to start the CSI measurement before CSC. Related to this, it is also proposed to disable/enable CSI reporting together with CSI measurement

* Issue 2: Timing to start the CSI measurement before CSC
	+ After RRC configuration
	+ After receiving a MAC CE to trigger CSI measurement
	+ After receiving candidate cell TCI state activation/deactivation MAC CE
	+ UE implementation
* Issue 3: Activation/deactivation of CSI acquisition (i.e. measurement and reporting)
	+ a UE can be provided by the network whether a candidate cell is enabled or not for CSI acquisition

##### [FL observation]

As issue 1-1, 1-2 and 2 has some dependency, FL suggestion is focusing on issue 1-1 first and conclude in this meeting. On top of that, we can try our best to further narrow down the details for issues 1-2, 2 and 3 using the available remaining time.

For issue 1-1, FL analysis for each option is summarized as follows:

* Option 1-1: Specify a mechanism to indicate subset of CSI-RS resources for CSI measurement
	+ Justification: measurement overhead reduction at UE side
	+ Concern: Additional spec impact (depending on the solution)
* Option 1-2: Can be left to UE implementation:
	+ Justification: simple, UE knows which TCI state is likely be selected from the L1-RSRP measurement results
	+ Concern: gNB cannot control CSI measurement by a UE before CSC
* Option 1-3: Introduce UE capability on the number of candidate cell or CSI-RSs. Up to network configuration on top of that
	+ Justification: This is a usual mechanism, and no specific solution is necessary.
	+ Concern: RRC reconfiguration cannot be expected due to subsequent property for LTM

RAN1 is encouraged to select one option considering the benefit and drawback for each option.

##### [FL proposal 5-4-v1]

Companies are encouraged to provide their view on the following proposal.

For the subset selection of the measurement CSI-RS resource(s) from the configured CSI-RS resources before CSC, down-select one option from the following:

* Option 1-1: Specify a mechanism to indicate subset of CSI-RS resources for CSI measurement
* Option 1-2: Can be left to UE implementation:
* Option 1-3: Introduce UE capability on the number of candidate cell or CSI-RS resources. On top of that gNB can configure appropriate CSI-RSs

##### [Comments to 5-4-v1]

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| --- | --- |
| Company | Comment |
| Fujitsu | We support Option 1-1. In order to reduce the measurement overhead, RAN1 needs to specify the mechanism. For Option 1-2, we think it works properly only when the UE measures the CSI for all of the configured candidate cells whose L1 measurement is reported to the serving cell, but there is some possibility to mismatch between serving cell’s intention and UE selection if the UE measures the CSI for the part of the configured candidate cells. For Option 1-3, the number of candidate cells to be measured is restricted since the serving cell will indicate only a few candidate cell(s) with higher RSRP which requires RRC reconfiguration to satisfy UE capability when handover will likely happen. This is not aligned with subsequent LTM concept. |
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### [Mid] Contents of report and CSI-RS configurations

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

The following figure is provided in the FLS for reference. The issues in this section are equivalent to Open issue 1 below.



##### [Summary of contributions]

Restrictions on the CSI configurations

* Number of ports for CSI-RS resource
	+ - Up to 4: Spreadtrum
		- Up to 32: vivo
		- Up to 128 CMCC, Ericsson
* Codebook configurations for report configuration
	+ Type I: Spreadtrum, CATT, ZTE, Huawei, vivo, Nokia, OPPO, Ericsson, DOCOMO, Fujitsu, Google, CMCC, Apple
	+ Rel-19 eType I: ZTE
* Report quantity for report configuration
	+ cri-RI-PMI-CQI: LG, CATT, ZTE, Huawei, Nokia, OPPO, Lenovo, Ericsson, Fujitsu, DOCOMO, Google, CMCC
	+ cri-RI-PMI-CQI if SRS transmission is supported: ZTE, Fujitsu
	+ CQI for Rank1 only: MediaTek
* Report frequency configuration for report configuration
	+ Wideband CQI/PMI: Huawei, CMCC, vivo, OPPO, Lenovo, Fujitsu, Ericsson, Nokia
	+ Subband CQI/PMI: CMCC
* Others
	+ Samsung
		- Regarding the supported CSI reporting modalities (e.g. report quantities and codebooks/codebook configurations) for CSI acquisition for candidate cell(s), RAN1 should do at least the following:
		- Feasibility assessment via various aspects of all the supported CSI reporting modalities in relation to the CSI-RS measurement aspects, in the context of the reception/application of LTM CSC and the corresponding RACH procedure before making down-selection
		- Benefit assessment via the customary system-level simulation with the user perceived throughout (UPT) statistics as the metrics, using L1-RSRP as the baseline, and fully reusing the Rel-19 CSI EVM (cf. AI 9.2.2).
	+ DOCOMO
		- Support one CMR in the report, i.e. IMR
	+ LG:
		- LTM CSI-RS resource only dedicated for the CQI acquisition is not supported

##### [FL observation]

In this meeting, FL would like to suggest focusing on the issues that many companies are interested in. Considering the proposals by the companies, FL understands that the mechanism for CSI acquisition can be simplified to achieve a less complicated system design. Also, many companies proposed that excessive performance optimization is not important as the time period LTM CSI acquisition applied is very short. Given this analysis, it would be good idea to introduce some constraints for report and/or CSI-RS configurations. FL proposal is to take the options majority supports.

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

* For the number of CSI-RS ports, select one option from the following for LTM CSI acquisition
	+ - Option 1. Up to 4: Spreadtrum
		- Option 2. Up to 32: vivo
		- Option 3. Up to 128 CMCC, Ericsson
* For the codebook configurations in report configuration, only typeI-SinglePanel is supported for LTM CSI acquisition
	+ *FL note: Rel-19 eType I (ZTE) is excluded because of the lack of support. This can be discussed further offline/online*
* For the report quantity in report configuration, only cri-RI-PMI-CQI is supported for LTM CSI acquisition
	+ *FFS: whether the rank is limited to 1 (MTK) – This may also have some impact on the number of ports for CSI-RS resource. Can be discussed further online/offline*
	+ *FL note: cri-RI-PMI-CQI is excluded as SRS is not proposed/supported for CSI acquistion*
* For report frequency configuration in report configuration, wideband CQI and wideband PMI are supported for LTM CSI acquisition
	+ *FL note: Subband CQI/PMI is excluded because of the lack of support. Can discuss further*

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

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| Company | Comment |
| Fujitsu | We support the FL proposal.  |
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### [Low] CSI-RS processing capability

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

The following figure is provided in the FLS for reference. The issues in this section are equivalent to Open issue 7 below.



##### [Summary of contributions]

The discussion points for CPU related issues can be categorized before and after CSC:

CSI measurement **before** CSC

* **Number of CPUs**
	+ No proposals
* **CPU occupancy time**
	+ Start point:
		- Alt. 1: one or more symbols starting from the last symbol of the uplink slot carrying the acknowledgment for the LTM configuration
		- Alt. 2: SP CSI-RS: the first symbol after 3 msec of the last symbol of HARQ-ACK information for the semi-persistent CSI-RS activation MAC CE
		- Alt. 3: P CSI-RS: the first symbol of earliest CSI-RS resource after RRC configuration
	+ End point
		- Alt. 1: the last symbol of the downlink slot carrying the cell switch command
		- Alt 2: the last symbol of the uplink slot carrying the acknowledgment for the cell switch command
		- Alt 3: if the CSI-RS is associated with target cell: the last symbol of the UL resource carrying the report
		- Alt 4: if the CSI-RS is not associated with target cell: the last symbol of HARQ-ACK corresponding to LTM CSC MAC CE.
	+ Note: start and end point may be affected by the triggering mechanism
* **CSI reference resources**
	+ N/A
* **Active CSI-RS resources**
	+ Alt .1: CSI-RS resources for candidate cells provided by LTM-CSI-SSB-ResourceSet should be counted as active.
	+ Alt. 2: Periodic CSI-RS resources for candidate cells provided by LTM-CSI-SSB-ResourceSet should be counted as active when
		- there is an activated TCI state in the cell and,
		- they are associated with an active CSI report configuration.
	+ Alt.3: Semi-persistent CSI-RS resources for candidate cells provided by LTM-CSI-SSB-ResourceSet should be counted as active when
		- there is an activated TCI state in the cell,
		- the semi-persistent CSI-RS resources is activated, and
		- they are associated with an active CSI report configuration.
	+ Alt.4: not counted as active

CSI measurement **after** CSC

* **Number of CPUs**
	+ No proposals
* **CPU occupancy time**
	+ Start point:
		- Alt. 1: the first symbol after the PDSCH carrying the LTM CSC MAC CE
		- Alt. 2: the end of the PUCCH with HARQ-ACK corresponding to the PDSCH carrying the LTM CSC
		- Alt. 3: the first symbol of earliest CSI-RS resource after 3 msec of the last symbol of HARQ-ACK information for the LTM CSC MAC CE
		- Alt. 4: no need to be defined
	+ End point:
		- Alt 1: the last symbol of the uplink resource carrying the initial CSI report
* **CSI reference resources**
	+ Alt. 1: Define reduced set of potential CSI reference resources.
		- If the CSI reference resource is still defined with respect to the uplink slot in which CSI is reported, the UE needs to calculate CSI for multiple potential CSI reference resources which could result in additional computation load.
		- To avoid this, it may be necessary to modify the definition of CSI reference resource in time domain (e.g. every N slots) such that the number of possibilities is kept to reasonable level, while avoiding that the CSI report is excessively outdated.
	+ Alt. 2: Define the following CSI reference resource for early CSI report of candidate cell for a CSI reporting in a first PUSCH in uplink slot ‘n’:
		- For Capability #1 UE (measurement only after CSC), the CSI reference resource is defined in time domain as $n-n\_{CSI-ref}$, where $n\_{CSI-ref}$ is the smallest value greater than or equal to $\left⌊{Z'}/{N\_{symb}^{slot}}\right⌋$ and no earlier than the last symbol of CSC MAC-CE command.
		- For Capability #2 UE (measurement before and after CSC) , the CSI reference resource is defined in time domain as $n-n\_{CSI-ref}$, where $n\_{CSI-ref}$ is the smallest value greater than or equal to $\left⌊{Z'}/{N\_{symb}^{slot}}\right⌋$.
	+ Alt.3: Consider following 2 options
		- Option 1 – Use existing time constraints defined for DCI-triggered aperiodic CSI reporting by introducing a CSI reference resource associated with the report. FFS: Define CSI reference resource
		- Option 2 – If there is at least one measurement RS occasion associated with the CSI reporting configuration after the measurement triggering point (i.e., application of the RRC configuration for early measurement or application of the cell switch command for baseline UE) such that the time gap between the RS occasion and the reporting slot is greater than a predefined duration (e.g., Z’).
		- FFS: An additional timeline requirement for the minimum duration between the triggering command and the reporting slot.
* **Definition of active CSI-RS resources**
	+ Alt .1: CSI-RS resources for candidate cells provided by LTM-CSI-SSB-ResourceSet and CSI-RS resources for serving cell provided by CSI-SSB-ResourceSet are counted as active

Others

* **UE Capability**
	+ RAN1 to clarify whether the number of active CSI-RS ports or active CSI-RS resources, in both the serving and target cells, for early CSI acquisition measurements should be counted towards the current maximum UE limit of active CSI-RS ports/resources or as a separate limit.

##### [FL observation]

Due to the variety of discussion point for CPU related issues on CSI acquisition, FL sees the difficulties to progress the discussion considering other issues that have potential impacts on RAN2, i.e. RRC and/or MAC CE. Thus, no proposal is made for this issue at this meeting.

##### [FL proposal 5-6-v1]

No FL proposal is made in this meeting. Companies are encouraged to analyze the proposals by companies until RAN1#121.

##### [Comments to 5-6-v1 if any]

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| --- | --- |
| Company | Comment |
| Fujitsu | For ‘after CSC’ measurement, our first preference is that the restriction related CSI processing is not needed since the UE may perform the procedure only related with cell switch. |
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### [Paused] Information provided by cell switch command

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

The following figure is provided in the FLS for reference. The issues in this section are equivalent to Open issue 4 below.



##### [Summary of contributions]

* ZTE:
	+ CSI reporting configuration is determined by candidate cell ID same as target cell ID provided by Target Configuration ID field in LTM Cell Switch Command MAC CE.
	+ CSI-RS resources for CSI measurement should be obtained by the determined CSI reporting configuration based on candidate cell ID same as target cell ID provided by Target Configuration ID field in LTM Cell Switch Command MAC CE if CSI-RS measurement is performed after reception of LTM cell switch command MAC CE.
	+ Note that only one CSI reporting configuration is configured for a candidate cell.
* CMCC
	+ The Candidate Cell ID in the CSC MAC CE can be reused to activate the CSI report for CSI acquisition.
* IDC
	+ UE reports CSI of candidate cell according to the CSI report configuration associated to the TCI state indicated in the cell switch command.
* OPPO
	+ The UE can be requested to report the CSI measurement of target cell indicated by the CSC and the CSC indicate one explicit indicator to request the UE to report the corresponding CSI measurement.
* Sharp
	+ Support an additional field in the CSC MAC CE to explicitly indicate which CSI report configuration is to be applied.
* NEC
	+ The CSI report configuration for the target cell can be determined based on the Target Configuration ID indicated by the LTM CSC.
	+ The CSI-RS resource (i.e., CMR) for the target cell can be determined based on the TCI state ID indicated by the LTM CSC.
* Nokia
	+ After the cell switch command, the UE acquires the CSI only associated with the target cell and the indicated TCI state.
	+ The cell switch command should indicate the report configuration to be used for reporting.
* DOCOMO
	+ For the selection of CSI resource(s) for measurement and a CSI report configuration for the report after reception of cell switch command, support the following.
	+ CSI report configuration is associated with target configuration ID in cell switch command MAC CE.
	+ CSI resource is the CSI-RS configured in the TCI state indicated in cell switch command MAC CE.
* Qualcomm
	+ Only a subset of CSI-RS resource(s) that are the same or QCLed with the QCL RS(s) in the activated/indicated TCI state(s) should be measured.

##### [FL observation]

Because the discussion here highly depends on the outcome of the configuration aspect discussed in section 5.5.3:

* If Alt 1 (A single CSI report configuration is configured) is adopted
	+ CSI report configuration is determined by candidate cell ID same as target cell ID provided by Target Configuration ID field in LTM Cell Switch Command MAC CE
		- i.e. no new field in CSC is necessary
* Else if Alt 2 (Multiple CSI report configurations can be configured) is adopted
	+ CSI report configurations are determined by candidate cell ID same as target cell ID provided by Target Configuration ID field in LTM Cell Switch Command MAC CE
		- A solution to determine one CSI report configuration from the multiple report configurations is needed, e.g. introduce a new filed in CSC

Then,

* If Alt X (A single CSI-RS resource for CMR is associated with a CSI report configuration) is adopted
	+ A single CSI-RS resource can eventually be selected based on the target cell ID.
* Else if Alt Y (Multiple CSI-RS resources for CMR can be associated with a CSI report configuration) is adopted,
	+ TCI state indicated in CSC can be used to down-select the CSI-RS resources for CSI measurement after CSC
		- same or QCLed with the QCL RS(s)
	+ Another solution is just to use CRI – no down selection for CSI-RS resources by e.g. TCI state indicated in CSC

For our efficient discussion during the meeting, the discussion of this section is paused until FL proposal 5-3-1 is concluded.

##### [FL proposal 5-7-v1]

FL proposal will be made after FL proposal 5-3-1 is concluded: the discussion of this section is paused

## Conditional intra-CU LTM

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

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

None

##### [Summary of contributions]

* vivo
	+ Activated Candidate TCI state(s), other than the TCI state associated with the triggered beam, should be deactivated upon CLTM procedure being triggered.
* CATT
	+ No need to define beam application time for NR Rel-19 RACH-less C-LTM.
* Ericsson
	+ A high-level description of C-LTM should be added to TS 38.213 Section 21. The description should capture at least:
	+ Configuration and evaluation of CLTM execution conditions in the UE,
	+ A UE receiving TA value for the target cell by higher layer signalling or by UE-based TA estimation, applying the TA value in its initial uplink transmissions, if the TA value is valid.
	+ TS 38.213 Section 21 should be updated to describe the following aspects of conditional LTM:
		- TCI state to be applied upon CLTM execution,
		- The timeline for CLTM execution.
			* In one alternative, the application time is defined to start at the time of the RS transmission occasion with which the C-LTM execution conditions are met.
	+ Note that, to update this part in 38.213, RAN4 need to agree on the interruption time requirements for C-LTM

##### [FL observation]

FL thinks RAN1 needs some discussions how the timeline for C-LTM execution (i.e. beam application time in RAN1) is defined because current description refers to the timing of CSC as the starting point of beam application time. It is also noted that RAN2 may not consider this aspect in their discussion.

For other part, FL understanding is that the editor of TS 38.214 can take care of capturing the agreement in RAN2.

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

* Companies are encouraged to provide their views aiming at the consensus in RAN1#121
	+ Whether and how to define the beam application time for C-LTM, especially the start timing
		- Option 1: beam application time is not defined for C-LTM
		- Option 2: the start timing (i.e. the timing of C-LTM is executed) is informed from higher layer
		- Option 3: the beam application time is defined to start at the time of the RS transmission occasion with which the C-LTM execution conditions are met
		- Other options are not precluded
* *FL note: this issue will not be treated during online/official offline discussion in RAN1#120bis.*

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

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