3GPP TSG RAN WG1 Meeting #118bis **R1-2408356**
Hefei, China, September 9-12, 2024

FL plan for mobility enhancements in RAN1#118bis

Agenda Item:	9.9.1
Source:	Moderator (Fujitsu)
Document for:	Information

WID update at RAN#105

Updated WID in RP-242356

- Specify support for inter-CU Layer1/Layer 2 Triggered Mobility (LTM) [RAN2, RAN3]
  - Prioritize the case when CU is acting as MN when DC is not configured
  - When DC is configured, inter-CU LTM can be configured either in MN or in SN but not both at the same time. For such cases:
    - As secondary priority, support the case where CU is acting as SN and MN is unchanged
    - As secondary priority, support the case where CU is acting as MN and SN is unchanged or SN is released
  - Specify support for subsequent LTM mobility procedures aiming to avoid RRC configuration between cell switches as per Rel-18 LTM
    - Coordination with SA3 needed with respect to security key handling
  - Note: Rel. 18 intra-CU LTM procedure is considered as baseline for adding inter-CU support
- Measurements related enhancements for purpose of supporting LTM: [RAN2, RAN1]
  - Measurement related enhancements are applicable to Intra-CU MCG/SCG LTM and Inter-CU MCG/SCG LTM
  - Specify necessary components to support event triggered L1 measurement reporting [RAN2, RAN1]
    - ~~RAN1 and RAN2 to progress independently on the event triggered measurements objectives of their respective MIMO and Mobility enhancement WIs. Review progress at RAN#105 to see if any modification of objectives is required to avoid/manage any overlap in the work~~
  - Specify support for CSI-RS measurements for LTM procedures and enable CSI-RS based beam management ~~, and/or other necessary physical layer operations on candidate cells before LTM~~ [RAN1]
  - Specify CSI acquisition on candidate cell(s) based on CSI-RS before or during LTM cell switch [RAN1]

NOTE: RAN1 WG to decide on whether to support CSI report before or during the LTM cell switch, as part of the CSI acquisition procedure.

- Specify support of conditional Intra-CU LTM [RAN2, RAN3, RAN1]
  - Specify UE evaluated conditions for triggering LTM
  - Aim to support conditional LTM including subsequent LTM
  - Limit specifying the conditional LTM to the scenario where the UE is in non-DC
    - ~~Prioritise intra-CU LTM~~
  - Checkpoint at RAN#107 to review the objective on whether Intra-CU conditional LTM can be specified to DC scenarios and if so, to which cases ~~at RAN#105~~. RAN WG work to not start before this checkpoint
- Specify RRM requirements related to the above objectives as necessary [RAN4]

L1 measurement based on CSI-RS

- **High priority**: Discuss and decide whether to introduce L1-SINR based on CSI-RS taking into account the following outcome of the offline discussion at RAN#118
  - Motivation for L1-SINR
    - Better cell choice especially for inter-frequency
  - Issues on the introduction of L1-SINR
    - Interference is not stable for one shot
    - Configuration aspect, IM → can be reused the legacy BM configurations?
    - CSI-RS based only or SSB as well ?
    - RAN4 impact
- **High priority:** Support of intra- and inter-frequency measurement
  - Majority views that intra- and inter-frequency measurement is needed for CSI-RS based L1 measurement
  - The detailed work should be done in RAN4, but some companies thinks RAN1 work is also needed i.e. defining necessary RRC parameters
  - We can agree to introduce (or assume the introduction of) both intra- and inter-frequency measurement while looking at the potential RAN1 spec impact.
- **High priority:** Configuration of CSI-RS
  - Structure of CSI-RS: LTM-TCI-info in Rel-18 has already included CSI-RS
    - If this can be reused, what is the missing RRC parameters?
    - The RRC structure (completely reuse this or add a new IE) is up to RAN2
  - Time domain property for CSI-RS transmission, i.e. support of semi-persistent and/or aperiodic CSI-RS transmission
    - without these, candidate cells are required to always transmit CSI-RS
    - with this, coordination between serving cell and candidate cell(s) may be required
  - Type of CSI-RS, i.e. for mobility
    - Potential benefit: CSI-RS for mobility has already been configured for L3 mobility, which may be reused for LTM purpose
    - Question: the benefit to introduce two configuration (i.e. CSI-RS for BM and mobility) for the same purpose

Agreement

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

Agreement

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

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

gNB scheduled reporting

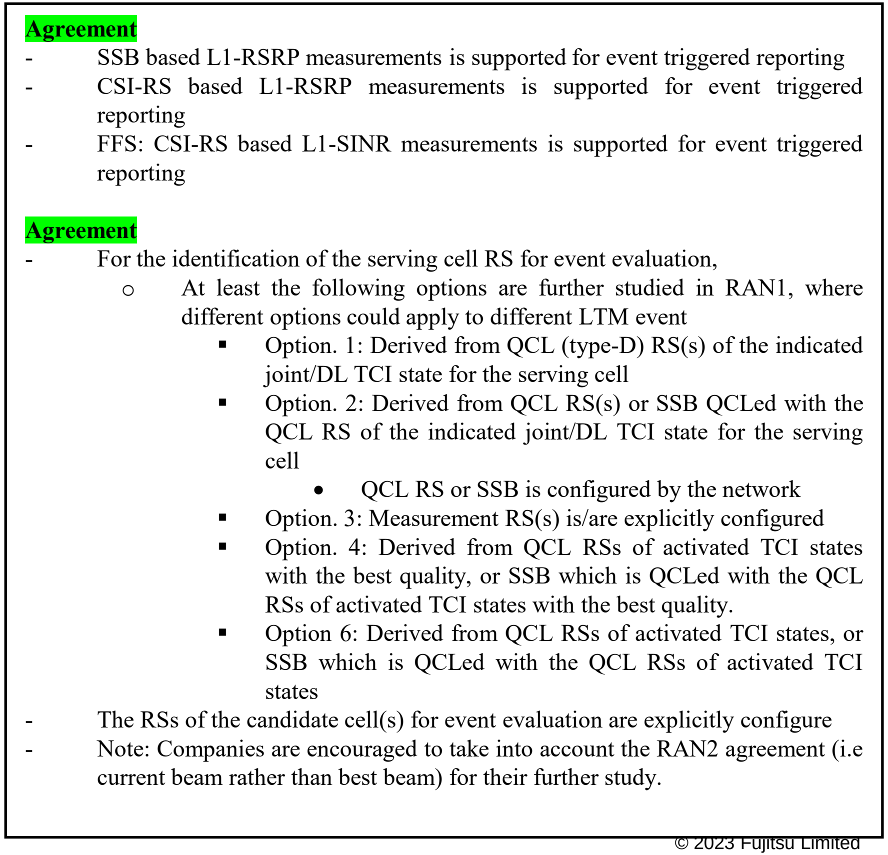
- **Mid priority:** Clarify the details of “Rel-18 LTM CSI reporting framework is the **baseline** “ → What is the necessary modification of the reporting framework in Rel-18 to support CSI-RS based L1-measurement report?
  - CSI-RS indicator, legacy CRI?, needs to be included in the report format instead of SSBRI
  - Can other parts be reused from Rel-18 design?
    - L cells x M beams, where L and M are configurable
    - 7-bit absolute value and 4-bit differential value
    - Periodic report on PUCCH, semi-persistent report on PUCCH/PUSCH, and aperiodic report on PUSCH
    - Configuration of SpCellInclusion
    - No filtering
- **Low priority:** How to include CSI-RS configurations for candidate cells in the report configuration (LTM-CSI-ReportConfig)
  - Check if RAN2 will work on it
  - RAN1 can start the discussion after the decision on L1-SINR to solve everything all together

Agreement

- 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

Event triggered reporting

- **Direction**
  - The whole design of event triggered reporting is led by RAN2
  - RAN1 discussion shall be explicitly triggered by RAN2
- **Issue to be handled in RAN1#118bis**
  - **High priority:** Identification of the serving cell RS for event evaluation, where the followings need to be considered
    - down selection of the options listed in RAN1#118
    - necessity to support pre-rel-17 TCI framework for serving cell
      - note: option 5 has already been deleted due to companies' concern
    - LTM events (potentially) agreed in RAN2
  - **Low priority:** Necessity of specified filtering mechanism
    - Filtering event evaluation and reporting should be separately discussed
    - Time domain and cell level needs to be discussed
    - → FL suggestion is to wait until RAN2 finishes their discussion on event evaluation, including TTT



Agreement

- 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

Agreement

- 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.

Beam Management based on CSI-RS

No agreement at RAN1#118

- **Observation from RAN1#118 contributions**
  - No many input from companies.
  - It is pointed out that LTM-TCI-Info-r18 is designed to provide full set of CSI-RS configurations
  - Rel-18 mechanism has the following restriction on QCL type (section 21 of TS 38.213)
    - *The UE may assume that DM-RS antenna ports for PDCCH receptions and for PDSCH receptions are quasi co-located with the SS/PBCH block or the TRS in the TCI state with respect to quasi co-location 'typeA' and 'typeD' properties, when applicable. The UE does not expect to be indicated quasi co-location 'typeA' properties when a SS/PBCH block is configured as a source RS of the TCI state.*
    - There was a proposal to modify this restriction to configure CSI-RS for BM (for QCL typeD)
    - Another opinion is that CSI-RS based beam management can be supported by setting “TRS for both QCL typeA and type D”, which can be realized by Rel-18 mechanism

→ More analysis and input from companies are encouraged in RAN1#118bis

CSI acquisition

No agreement at RAN1#118

- **Potential issues – initial thought by FL**
  - Framework: timing of measurement and reporting
    - Measurement and report before cell switch command (CSC)
      - report is transmitted to the serving cell
      - report is transmitted to the corresponding candidate cell
    - Measurement CSC and reporting after CSC
    - Measurement and reporting after CSC
      - Triggered by cell switch command
  - Container
    - FL assumes to use UCI
  - Time domain property of CSI-RS transmission and reporting
    - Periodic, aperiodic and semi-persistent
  - Other configurations
    - Quantity, frequency configuration, codebook etc.
  - UE Capability for the measurements
    - It might be unrealistic for a UE to perform CSI-acquisition, especially measurement, for all configured candidate cells
    - On the other hand, CSI for candidate cells other than target cell would be useless
    - Support of intra- and/or inter- frequency: Measurement gap is required for inter-frequency CSI-acquisition
  - **Low priority:** Report configuration structure
    - Can CSI-ReportConfig or LTM-CSI-ReportConfig be reused?

→ RAN1 discussion will start from high level design

Conditional Intra-CU LTM

- RAN1 can wait for the progress in RAN2/3 as RAN1 is not a leading group of this objective

Note: Other necessary physical layer operations

- Based on the Chair’s guidance at RAN1#118, the following items were discussed in RAN#105, and only item 1 was approved and clearly captured in the WID
  - Item 1: CSI acquisition for candidate cell be before cell switch
  - Item 2: Dynamic update of measurement RS or candidate cells to perform L1-measurement
  - Item 3: Enhancement on TRS in candidate TCI states to enable faster tracking
  - Item 4: UL-based measurement
  - Item 5: Early DL beam management
  - Item 6: Retention of activated candidate TCI states after cell switch
  - Item 7: TA acquisition based on CSI-RS
  - Item 8: Autonomous TCI state activation by event triggered report

- FL has no plan to discuss item 2 - 8 at RAN1#118bis
  - For item 7, the implication is that SSB is used for TA acquisition

Thank you