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# Views on scope for NR Mobility enhancements in Rel-19

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# Background – RAN chair's summary (RP-232745)

- References: RWS-230488, RP-231540, RP-232618
- Potential objectives:
  - Specify support for inter-CU Layer 2 Mobility (LTM)
    - Prioritize the case when CU is acting as MN when DC is not configured
    - Whether to additionally support e.g. when CU is acting SN? (focus on practical deployments)
      - In this case, ~~whether~~ it is supported for ~~EN-DC and/or~~ NR-DC only~~?~~
  - Measurements related enhancements for purpose of supporting LTM:
    - Specify event triggered L1 measurement reporting for triggering LTM → depending on the detailed discussion in RAN#102, resolve how to avoid overlapping with similar objective in MIMO WI
    - Specify support for CSI-RS measurements for LTM procedures and enable CSI-RS based beam management and/or other physical layer operations on candidate cells before LTM
  - Support of conditional mobility (including set of candidate cells, UE evaluated mobility conditions, ability for UE to perform subsequent mobility procedures without need for RRC configuration) along with short mobility interruption time (similar to that achievable with LTM).
    - Next Step question to consider the most appropriate approach to achieve this aim. For example, by specifying conditional triggering of LTM, or specifying support of Early TA or RACHless (as defined for LTM) to be used as part of layer 3 CHO, or possibly other approaches. If this questions cannot be concluded during the Rel-19 scoping discussion then it may be possible to start with a RAN2 study phase.
  - Anything else (e.g., RAN4 related)?

# Motivation

Rel-19 RAN2-led WI

- Expanding usage scenarios
  - Rel-18 LTM does not support inter-CU mobility and security key change
  - Lack of a mobility mechanism for inter-gNB handover that provides short latency and interruption time at handover as well as offers wide applicability to different scenarios
  - Inter-CU LTM for MN and SN
    - SN deployed in FR2 is of practical importance and LTM can especially be useful for FR2 where frequent handovers may be expected
- Need for optimized measurements and reporting in LTM
  - To reduce reporting overhead, UE power consumption, interruption, and improve performance
- Further robustness improvement of LTM
  - Unlike the L3-based CHO that is designed to improve mobility robustness by having UE autonomously execute handover when configured execution condition is met, LTM can be executed only upon UE reception of the LTM switch command from the serving cell
- Reduce LTM delays due to backhaul latency for inter-DU LTM

# Enhancements (1/3)

Rel-19 RAN2-led WI

- Inter-CU LTM
  - Can provide support for inter-gNB handover while offering reduced latency and interruption time at handover as well as wide applicability to different scenarios
    - Extend/leverage early UL/DL synchronization and LTM L1-based measurements of Rel-18 LTM to inter-CU LTM to preserve latency/interruption benefits
    - Applicable scenarios as in Rel-18 LTM (e.g. inter/intra-frequency, FR1, FR2, etc)
  - Inter-CU LTM for DC
    - Prioritize inter-CU LTM for MN and additionally consider inter-CU LTM for SN, i.e. identify additional changes needed to support it
      - SN deployed in FR2 is of practical importance and LTM can especially be useful for FR2 where frequent handovers may be expected

# Enhancements (2/3)

Rel-19 RAN2-led WI

- Measurements/reporting enhancements
  - Event-triggered L1 measurement reporting
    - Can reduce reporting overhead as compared to periodically configured measurement reports for LTM, while still providing the network with a useful information for the LTM switch decision
    - Reuse the design from MIMO WI and specify additional specifics for LTM (e.g. configuration for LTM candidate cell measurement reporting)
  - CSI-RS based gNB and UE beam management extended to candidate cell
    - The refined beam can therefore be used right after the cell LTM switch command
    - CSI feedback for a candidate LTM cell, e.g. based on the refined gNB/UE beam pair
      - Therefore, the optimized rate parameters can be used right after the LTM cell switch command
    - Dynamic update of L1 measurement/reporting configurations
      - MAC CE could choose specific configuration (out of a set of configurations provided to the UE) that includes the set of cells and potentially other reporting parameters related to that set
      - Event-triggered L1 measurement reporting can enhance usefulness of the dynamic update of L1 measurement/reporting as the serving cell can dynamically choose the reporting candidate cell set based on the triggered measurement reports

# Enhancements (3/3)

Rel-19 RAN2-led WI

- Conditional LTM
  - UE-initiated LTM execution based on the configured conditions(s) to improve LTM robustness
    - UE performs LTM autonomously when a configured condition is met
      - L1/L2-based triggers, e.g. L1 measurements, BFD
    - Execution of Conditional LTM
      - With and without source cell notification, specify resources to use on target cell – e.g. configured SR/SRS/CG, DG for intra-DU case
    - Target cell synchronization
      - Early synchronization (before Conditional LTM execution) – UE-based synchronization or early LTM RACH with RAR/MAC CE providing the TA
  - Work on LTM-specific solution (not CHO enhancement)
- Cell activation/deactivation at the LTM cell switch
  - Joint cell activation/deactivation and SpCell update signaling
  - Reduces delays to update cell activation/deactivation status at LTM switch
- Inter-DU optimizations to alleviate backhaul latency
  - Consider solutions where UE will be provided with an appropriate TCI state to use for the first Tx on the target cell without the need to delay LTM execution due to source-target DU communication about the TCI

# Proposed WI Objectives

Rel-19 RAN2-led WI

- Specify procedures and signaling for LTM support of inter-CU scenarios [RAN3, RAN2]
  - Signaling for configuration of inter-CU candidate cells, L1 measurements, DL/UL early synchronization
  - L1/L2 signaling to facilitate inter-CU LTM switch, while leveraging as much as possible from Rel-18 LTM
  - Inter-CU LTM for DC
    - Prioritize inter-CU LTM for MN and additionally consider inter-CU LTM for SN
- Specify procedures and signaling for LTM measurements/reporting enhancements [RAN1, RAN2]
  - Event-triggered L1 measurement reporting
  - CSI-RS based gNB and UE beam management for LTM candidate cells
  - CSI feedback for candidate LTM cells
  - Dynamic update of L1 measurement/reporting configurations
- Specify procedures and signaling for Conditional LTM support [RAN2, RAN3]
  - Signaling for configuration of Conditional candidate cells, execution conditions/triggers, DL/UL early synchronization
  - L1/L2 signaling to facilitate Conditional LTM switch, while leveraging as much as possible from Rel-18 LTM
  - Work on LTM-specific solution (not CHO enhancement)

# Proposed WI Objectives

Rel-19 RAN2-led WI

- Specify joint cell activation/deactivation and LTM switch signaling [RAN2]
- Specify inter-DU optimizations for target cell TCI state management to alleviate backhaul latency [RAN1, RAN2, RAN3]
- Specify mechanisms for full support of LTM on MCG and SCG without cross-CG restrictions [RAN2]

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# Thank you

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