Reducing Handover Interruption with L1/L2 Triggered Mobility

3GPP RAN Release 18

# Introduction - The Need for Speed

- **Challenge:** New and emerging extended reality (XR) and time-critical communication (TCC) use cases require a significant reduction in handover interruption time. This also benefits delay-sensitive smartphone apps.

- **Solution:** Layer 1/Layer 2 (L1/L2) Triggered Mobility (LTM) in 5G Advanced.

- Speeds up the handover procedure.

- Reduces interruption in data transmission and reception.

- **LTM Mechanism:** Pre-configures User Equipment (UE) with a handover command for an LTM candidate cell and triggers the switch with lower-layer signaling.

- **Advantage:** Allows early downlink (DL) and uplink (UL) synchronization before the cell switch, speeding up target cell access.

- **Future:** LTM is being implemented in 5G Advanced networks and UE chipsets and is expected to be foundational for 6G mobility

Handover in Mobile Systems - An Overview

- **Purpose of Handover:** Ensure UE is always connected to the cell with the best signal quality.

- **Goal:** Handover from source to target cell as quickly as possible with minimal interruption.

- **Current 5G (L3 Handover):**

- Source base station (gNB) sends a handover command (RRC message - Layer 3) to UE.

- Interruption: **50-90ms** in a well-tuned network.

- **5G Beam Management:**

- Handles UE movement across different beams in the same cell, especially in higher frequency bands.

- Interruption: Few milliseconds due to lower-layer signaling.

- **Limitations of L3 Handover for TCC:** Interruption is too large for TCC and XR.

- **Previous Attempts & Limitations:**

- Dual Active Protocol Stack (DAPS): Difficult to implement, significant limitations.

- Conditional Handover (CHO): Reduces handover failure risk by providing configurations for potential target cells.

- Inter-cell Beam Management: Short interruption but cumbersome over larger areas as it operates without RRC reconfigurations.

- **LTM's Advantage:** Extends inter-cell beam management to handle RRC reconfigurations, combining multiple-candidate configurations (like CHO) with efficient signaling.

L1/L2 Triggered Mobility - How it Works
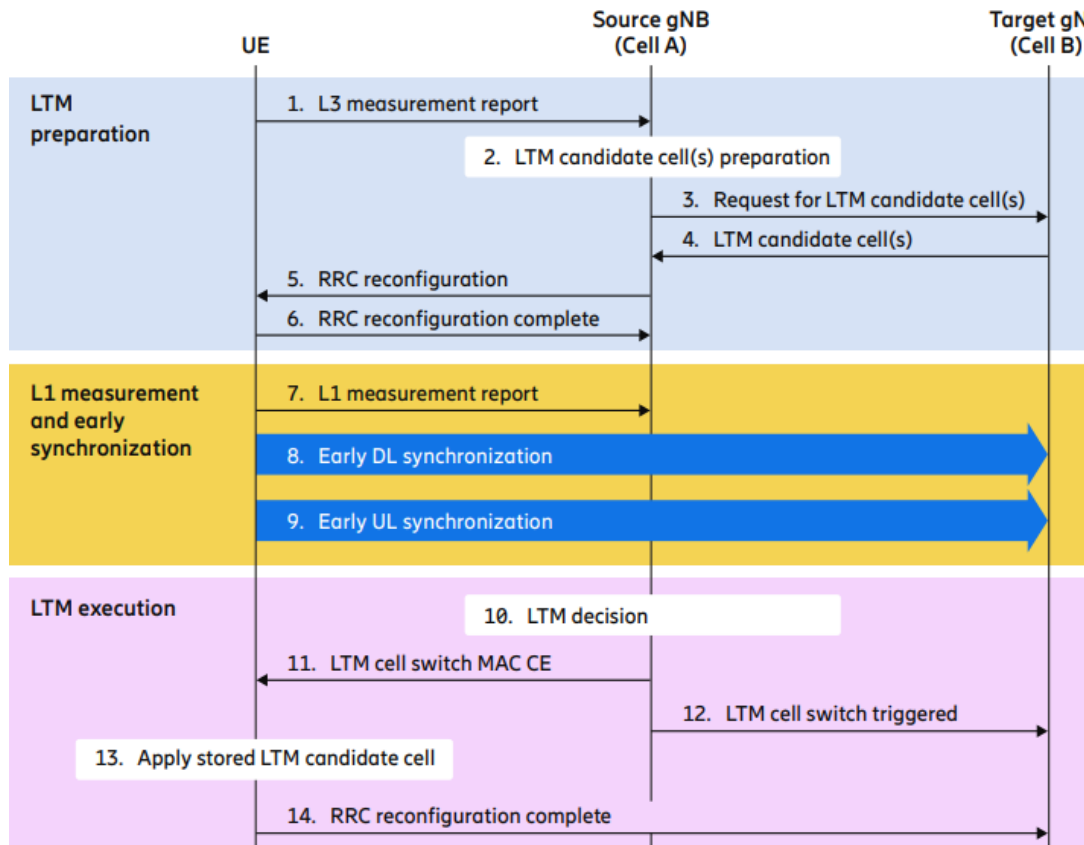
- **Core Principle:** Network triggers handover via L2 signaling, relying on L1 measurements from the UE.

- **Benefits:** Faster handover, pre-synchronization with LTM candidate cell (target cell), reduced execution time, signaling overhead, and connectivity interruption.

- **LTM Procedure (Key Phases - Illustrated in Figure 2):**

1. **LTM Preparation (Steps 1-6):**
   - UE receives configurations for one or more LTM candidate cells.

2. **L1 Measurement and Early Synchronization (Steps 7-9):**
   - UE uses configurations for L1 measurement and pre-synchronizes with candidate cells.
   - **Early DL Synchronization:** UE determines DL receive timing of candidate cells.
   - **Early UL Synchronization:** Network determines Timing Advance (TA) of candidate cells.

3. **LTM Execution (Steps 10-14):**
   - UE performs the LTM cell switch to a selected candidate cell.