**3GPP TSG-RAN WG4 Meeting # 106 R4-23XXXXX**

**Athens, Greece, 27 February –03 March, 2023**

**Agenda item:** 9.23.7

**Source:** Moderator (MediaTek Inc.)

**Title:** Topic summary for [106][222] NR\_Mob\_enh2\_part1

**Document for:** Information

# Introduction

This document is the email discussion summary for [104-e][237] NR\_Mob\_enh2 with the following topics covered

* Topic 1: General and work plan
* Topic 2: LTM - General aspects and scenarios (AI 9.23.3.1)
* Topic 3: LTM - L1-RSRP measurement requirements (AI 9.23.3.2)
  + The proposals submitted to other AI but related to L1-RSRP measurement are also captured here.
* Topic 4: LTM - L1/L2 inter-cell mobility delay requirements (AI 9.23.3.3)
  + The proposals submitted to other AI but related to Cell switch delay requirements are also captured here.

*Note: Some proposals which highly depend on RAN1/2 progress or other issues’ outcome are not captured in the summary.*

# Topic #1: General and work plan (AI 9.23.1)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2300926 | MediaTek Inc., Apple | ***Proposal 1: RAN4 to endorse the RF work plan for Further NR Mobility Enhancements as presented in this contribution.***  *Proposal 2: RAN4 to endorse the updated RRM work plan for Further NR Mobility Enhancements as presented in this contribution.* |

## Open issues summary

### Sub-topic 1-1: Work plan

**Issue 1-1: Work plan proposals**

*Note: As the updated part is mainly for improvement on SCell/SCG setup delay, the updated work plan will be discussed in thread [106][223] NR\_Mob\_enh2\_part2.*

* Proposals
  + Option 1: work plan in R4-2300926
* Recommended WF
  + Discuss in thread [106][223] NR\_Mob\_enh2\_part2.

# Topic #2: LTM - General aspects and scenarios (AI 9.23.3.1)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2300097 | Qualcomm Incorporated | **Reference Signal during LTM Measurements and after LTM Handover**  **Proposal 1: LTM requirements are applicable only when a QCL source reference signal of “PDCCH ordered PRACH to an LTM candidate cell before LTM handover” or “an active TCI state to be used immediately after LTM handover” is the same or one of the reference signals configured and used for LTM L1-RSRP measurements from the cell.**  **UE TCI State Management for Timing and Frequency Tracking with LTM Cell**  **Observation 1: Intra-frequency LTM L1-RSRP measurement requires a UE to keep track of fine timing and frequency synchronization with SSB from non-serving cell, which may result in the UE not being able to support as many active TCI states with the current serving cell as UE capability.**  **Proposal 2: RAN4 to discuss whether and how to address a potential issue where the total number of active TCI states from a serving cell plus the total number of SSBs to perform intra-frequency L1-RSRP measurements from LTM cells exceed the UE capability on the number of total active TCI states, e.g. requirement applicability rule in terms of latency requirements, etc.** |
| R4-2300227 | Apple | **Proposal 1: UE is not required to perform simultaneous Rx or Tx with both source cell and target cell during LTM for both intra-frequency and inter-frequency scenario, i.e., UE does not receive or transmit data on source cell after ACK transmission on cell switch command during cell switch delay.**  **Proposal 2: inter-frequency L1-RSRP measurement shall be supported.**  **Proposal 3: using MG for inter-frequency L1-RSRP can be considered as a baseline. As an enhancement, inter-frequency L1-RSRP measurement without MG can be discussed later once RAN4 finishes the baseline design.**  **Proposal 4: scenario wherein the SSBs of SpCell and the target cell are on different frequency layers is considered as inter-frequency LTM.**  **Proposal 5: regarding whether to consider RTD of serving cell and neighbour cell larger than one CP for intra-frequency L1-RSRP measurement:**   * Start the discussion from case 1: RTD of serving cell and neighbour cell within one CP for SSB based L1-RSRP measurement. * FFS on case 2: RTD>CP. If case 2 has to be included, it shall be supported based on UE capability.   **Observation 1: without clear picture of UE behaviours during LTM procedure, it is challenging for companies to determine whether and how to support async case. If decision has to be made at this point, the conclusion may be pessimistic.**  **Proposal 6: whether to support sync and async can be discussed after L1 measurement and cell switch procedures are stable.**  **Proposal 7: Network shall configure L1 measurement on a neighbor cell after receiving L3 measurement report on that cell. No need to define specific requirements for downlink synchronisation before cell switch since it has already been covered by existing L3 measurement requirements.** |
| R4- 2300295 | China Telecom | **Observation 1: DAPS is beneficial to mobility enhancement. But it brings more workload and is not closely related to the main objective in WID.**  **Proposal 1: Deprioritize simultaneous data Rx/Tx with both source cell and target cell during cell switch delay.**  **Proposal 2: Inter-frequency cell switch is that the SSB of Pcell and/or PScell and the candidate target cell are on different frequency layers.**  **Observation 2: Both intra-frequency and inter-frequency are in the scope and it is important for the deployment of network.**  **Observation 3: Inter-frequency measurement will extend the measurement delay.**  **Proposal 3: Cover inter-frequency L1-RSRP measurement scenario and study the procedure to reduce the delay caused by it.**   * **For FR1, reuse the intermedia result of L3 measurement as L1-RSRP measurement result.** * **For FR2, FFS.**   **Proposal 4: Need not to restrict the RTD between serving cell and neighbour cell to be within CP for SSB-based L1-RSRP measurement.**  **Proposal 5: Confirm whether to support non-synchronous after confirming the conclusion of issue 1-5-1.** |
| R4-2300466 | Intel Corporation | **Proposal 1: Suggest to identify each component and corresponding interruption in cell switch first and design basic delay/interruption requirement for cell switch, since cell role change in CA is just a special case of cell switch.**  **Proposal 2: Suggest to re-use intermediate result of L3 inter-frequency measurement for L1 inter-frequency measurement.**  **Proposal 3: No need to restrict the RTD between serving cell and neighbour cell to be within CP.**  **Proposal 4: No need to define sync and async scenarios for LTM.** |
| R4-2300552 | CATT | **Proposal 1: UE does not receive or transmit data on source cell after ACK transmission on cell switch command during cell switch delay.**  **Observation 1: The definition of inter-frequency L1/L2 based mobility in option 2 is based on RAN2 agreed to focus on PCell mobility first at the previous meeting.**  **Proposal 2: For the definition of inter frequency L1/L2 based mobility, both option 1 and option 2 are feasible.**  **Observation 2: RAN1 and RAN2 have agreed to support inter-frequency L1-RSRP measurement in previous meetings, so RAN4 also tends to not exclude inter-frequency L1-RSRP measurement.**  **Proposal 3: From RAN4 perspective, cover inter-frequency L1-RSRP measurement is feasible.**   * **Without gap: The case may not be a typical scenario in practical application, RAN4 can consider lower its priority.** * **With gap: Prefer to share MG with L1 and L3 measurement, the priority of using MG in detail to ensure that the measurement delay will not be too long compared with intra-request L1-RSRP measurement need to be further discussed.**   **Observation 3: Considering that if [x] is a fixed value, it means that once UE chooses to support RTD greater than x, it means that no matter what value the RTD is, UE can handle it, so few UEs choose so. It is more reasonable to have a set of values instead of a fixed value.**  **Proposal 4:** **For SSB based L1-RSRP, discuss whether RTD between serving cell and non-serving cell is larger than [x]us. Whether UE supports out of [x]us depends on UE capability.**   * **[x]us can be a set of values, including, for example, CP and other larger RTD value that UE can tolerate.**   **Proposal 5: RAN4 not to define sync and async scenarios for LTM requirements.**  **Proposal 6: Not consider FR2-2 in LTM.** |
| R4-2300870 | CMCC | ***Proposal 1: for the definition of inter-frequency cell switch delay requirements, it is proposed to firstly discuss whether to differenate intra-frequency and inter-frequency for cell switch delay requirements.***  ***Proposal 2: if cell switch delay requirements differentiate intra-frequency and inter-frequency, the inter-frequency cell switch is proposed as that the SSBs of serving cell(s) and the corresponding candidate target cell(s) are on different frequency layers, otherwise, it is intra-frequency cell switch.***  ***Proposal 3: if cell switch delay requirements do not differentiate intra-frequency and inter-frequency, no need to have the definition of inter-frequency cell switch (i.e. cell switch delay requirements are generic for both intra-frquency and inter-frequency , similar like HO delay requirements).***  ***Proposal 4: for L1/L2 based inter-cell mobility, it is proposed to consider inter-frequency measurement.***  ***Proposal 5: for the relation between L3 measurement and L1 measurement, it is proposed to wait for RAN1/2 progress.*** |
| R4-2300890 | xiaomi | **Proposal 1: RAN4 not to consider simultaneous reception with both source cell and target cell during LTM for both intra-frequency and inter-frequency L1/L2 mobility.**  **Proposal 2: RAN4 to support inter-frequency L1-RSRP measurement in Rel-18 LTM.**  **Proposal 3: RAN4 to consider inter-frequency L1-RSRP measurement as a baseline in Rel-18 LTM.**  **Proposal 4: RAN4 to support synchronous and asynchronous scenarios for LTM.**  **Proposal 5: For synchronous scenario, the timing offset between source cell and target cell defined in Rel-17 inter-cell BM requirement can be reused, e.g. timing offset between source cell and target cell is smaller than CP.** |
| R4-2300927 | MTK | **Proposal 1: Not discuss whether to consider simultaneous data Rx/Tx with both source cell and target cell during cell switch delay any more. Discuss the interruption time during cell switch delay directly.**  **Proposal 2: Not consider FR2-2 in LTM.**  **Proposal 3: Inter-frequency cell switch is defined as SSBs of SpCell and the target cell are on different frequency layers.** |
| R4-2300971 | NTT DOCOMO, INC. | **Observation 1: Clearly the UE cannot Rx/Tx data simultaneously from source and target cell during DL synchronization part and UL synchronization part**  **Proposal 1: The possible duration that the UE attempt to do simultaneous data Rx/Tx with both source cell and target cell is Tcmd + Tprocessing,2.**  **Proposal 2: The possible scenario which can achieve simultaneous Rx/Tx is the scenario without synchronization part which is the target cell is a current serving SCell (i.e., role change).**  **Proposal 3: Inter-frequency cell switch should be defined where the SSBs of active serving cell(s) and the corresponding candidate target cell(s) are on different frequency layers.**  **Proposal 4: It is better to start the case that the SSBs of SpCell and the target cell are on different frequency layers for inter-frequency cell switch study.**  **Proposal 5: It is firstly specified that inter-frequency L1-RSRP measurement without gap provided the center frequency and SCS of the SSB of the neighbor cell are different from the SSB of the serving cell, but the SSB of the neighbor cell is in the active BWP of serving cell.**  **Proposal 6: According to the definition of SS-RSRP measurement specified in 38.215, the measurement value is SSS power. Thus, RTD is not needed to be restricted by CP length. However, at least RTD should be less than symbol duration of smaller SCS between source and target cell.**  **Proposal 7: Synchronous and non-synchronous is the problem whether UE can measure L1-RSRP correctly or not. Therefore it should be defined by RTD value.** |
| R4-2301202 | ZTE | **Proposal 1: DAPS plus LTM is out of scope in Rel-18.**  **Proposal 2: UE is not required to receive or transmit data on source cell(s) after ACK transmission for cell switch command during the cell switch delay.**  **Proposal 3: For L1/L2 based inter-cell mobility, inter-frequency measurement need to be considered.**  **Observation 1: There is no legacy definition of sync and async for L3 HO in current spec.**  **Proposal 4: It is unnecessary to define synchronous and non-synchronous in LTM.** |
| R4-2301658 | OPPO | **Proposal 1: Inter-frequency cell switch is assumed that where the SSBs of SpCell and the target cell are on different frequency layers.**  **Proposal 2: As compromise, RAN4 considers to only define cell switch requirements without gap.**  **Proposal 3: Suggest to support intra-frequency and inter-frequency L1-RSRP measurement without gap in this release, and consider requirements with MG or NCSG at later phase or releases.**  **Proposal 4: RAN4 to focus on the case RTD between serving cell and neighbour cell within CP firstly.**  **Proposal 5: Whether to support sync and async can be discussed after L1 measurement procedure become clearer and more stable.** |
| R4-2301704 | vivo | **Proposal 1 For L1 measurement performed by UE on target cell without prior precise uplink/downlink sync to target cell, it is proposed to re-use the legacy R15 L3 UE measurement behaviour assumption, i.e. measurement delay requirement and accuracy requirements follows, as much as possible, L3 measurement requirements, as specified in 9.2 to 9.3, 10.1.2 to 10.1.5, of TS 38.133, respectively.**  **Proposal 2 For L1 measurement performed by UE on target cell with prior precise uplink uplink/downlink sync to target cell, it is proposed to re-use the legacy R15/R16/R17 L1 UE measurement behaviour assumption, i.e. measurement delay requirement and accuracy requirements follows, as much as possible, R15/R16/R17 L1 measurement requirements as specified in 9.5, 10.1.19 to 10.1.20, of TS 38.133, respectively.**  **Proposal 3 RAN4 strive to specify DL/UL synchronization requirements during LTM cell switch in a general manner, i.e. to cover both cases that they are done before/after cell switch.**  **Proposal 4 RAN4 to clarify DL/UL synchronization assumption for L1 measurements performed on target cell, especially if L1 measurement is performed before cell switch, but DL/UL synchronization is done after cell switch.**  **Proposal 5 If ‘simultaneous data Rx/Tx’ means whether UE need to set up 2 active RLC entities to different DUs in the inter-DU cell switch, it should be discussed in RAN2, and RAN4 proceeds current discussion with the assumption of only one active RLC entity, if this assumption is needed.**  **Proposal 6 If ‘simultaneous data Rx/Tx’ means whether 2 physical data channels can be set up simultaneously between source cell and target cell, it should be supported, following the same rules for ICBM or CA.**  **Proposal 7 If ‘simultaneous data Rx/Tx’ means whether UE needs to physically transmitting or receiving to both source and target cells at the same time, RAN4 should discuss the ‘simultaneous data Rx/Tx’ in a case-by-case manner. Therefore, RAN4 not to further clarify ‘simultaneous data Rx/Tx’, but to further discuss the corresponding RRM requirements and the feasibility of ‘UE simultaneous Rx/Tx’ laying behind.**  **Proposal 8 For ICBM scenario in R18 LTM, RAN4 not to specify any new CSI-RS based L1 measurement requirements, following the same rule of R17 ICBM. For non-ICBM scenario in R18 LTM, even if RAN1 agrees to support CSI-RS based L1 measurement on candidate cells, RAN4 may further discuss whether to specify new requirements for CSI-RS based L1 measurement on candidate cell in R18, including the definition of intra-f/inter-f in CSI-RS based L1 measurements.**  **Proposal 9 In R18 LTM, for inter-frequency cell switch, RAN4 only specify RRM requirements for the case when the same number of serving cells is assumed between current active CellGroupConfig (i.e. including both current SpCell and SCells) and target CellGroupConfig:**   * **For the case when only SpCell switch is performed, i.e. without SCell in the target cell group, inter-frequency cell switch is defined as the case where the SSBs of SpCell and the target SpCell are on different frequency layers.** * **For the case when SpCell switch and SCell switch are simultaneously performed, i.e. a new SCellConfig is included in the target CellGroupConfig, inter-frequency cell switch is defined as the case where the SSB frequency layer of any target serving cell (can be either target SpCell or SCell) is not in the list of frequency layers of SSBs of current serving cells.**   **Proposal 10 RAN4 to support inter-frequency L1 measurement by re-using L3 measurement behaviour assumption for the UE, i.e. assuming UE uses inter-mediate L3 measurement results in the L1L2-based measurement triggering and reporting.**  **Proposal 11 RAN4 to re-use sync condition defined for DAPS as the sync condition for LTM. Based on RAN2 conclusion, RAN4 only needs to specify requirements under sync condition in R18 LTM.**  **Proposal 12 For Rx timing difference between source cell and target cell, RAN4 to discuss and support UE capability based approach:**   * **For baseline UE, the Rx/Tx timing between source cell and target cell is within CP.** * **For UE with higher capability, UE may support N group of cells, while the Rx/Tx timing difference within each group is less than CP. N is reported as UE capability, and at least N = 2 should be considered in RRM requirements and test cases design.** * **The above capability is not applied to L3 measurement/reporting of the UE, and not applied to L1/L2 measurement/reporting if the intermediate result of L3 measurement is used in the reporting.** |
| R4-2301825 | Huawei | **Proposal 1: For inter-frequency L1/L2 mobility, not to consider simultaneous RX/TX on serving cell and target cell during cell switch delay.**  **Proposal 2: Inter-frequency cell switch is the case that the SSBs of SpCell and the target cell are on different frequency layers.**  **Proposal 3: Introduce requirements for the following inter-frequency cell switch scenario:**   * **Target Pcell/SCell is current SCell/PCell, i.e., current SCell/Pcell is configured as candidates.** * **Switch to inter-frequency cell that is not a current serving cell**   **Proposal 4: Network configures L1 measurement on a neighbour cell after receiving L3 measurement report on that cell.** |
| R4-2302242 | Nokia, Nokia Shanghai Bell | **Proposal 1: RAN4 to define at least two interruption delay scenarios. Scenario 1: Active TCI state switch for LTM; Scenario 2: Interruption time less than L3 HO**  **Proposal 2: Deprioritize DAPS based simultaneous data Rx/Tx with both source cell and target cell during LTM switch.**  **Observation 1: One of the key objectives of LTM is to minimise the interruption delay (in specific scenarios).**  **Observation 2: Intra-frequency LTM interruption delay is expected to be lower than inter-frequency delay. Therefore, RAN4 should focus on defining scenarios and conditions where interruption delay can be minimised.**  **Proposal 3: RAN4 to focus first on intra-frequency LTM scenarios and subsequently define inter-frequency LTM scenarios.**  **Proposal 4: Inter-frequency cell switch is defined as the switch from the source cell to target cell in which the SSB of the source cell is of different frequency layer and of different sub carrier spacing as that of the target cell.**  **Proposal 5: No need to restrict the RTD between serving cell and neighbour cell to be within CP for SSB-based L1-RSRP measurement** |
| R4-2302659 | Ericsson | 1. RAN4 to agree that UE can transmit and receive simultaneously with source and target cell during role change case. 2. From capturing in the LTM HO requirements section point of view, no definition is required. For discussion purpose, RAN4 to reuse inter-frequency definition in L3 measurement for inter-frequency LTM similar as legacy inter-frequency HO. 3. RAN4 to define requirements for both intra-frequency and inter-frequency LTM. 4. RAN4 not to define sync and async scenarios for LTM requirements. |
| R4-2302662 | Ericsson | 1. RAN4 to discuss downlink synchronisation requirements for UE before receiving cell switch command. 2. UE to meet the same transmit timing requirements as legacy HO after receiving the cell switch command. |

## Open issues summary

*Before Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1 Simultaneous data Rx/Tx in source cell and target cell?

*Background：Based on chair’s guidance in RAN4#104bis, more clarification on “simultaneous data Rx/Tx” is needed.*

**Issue 2-1-1: Simultaneous data Rx/Tx in source cell and target cell?**

*In moderator’s view, RAN4 usually defines the interruption requirements, scheduling restriction and measurement restriction to handle the conflicts. Moderate suggests* *discussing what interruption requirements, scheduling restriction and measurement restriction to define instead of discussing whether simultaneous Rx/Tx in source cell and target cell is allowed.*

* Proposals
  + Option 1 (MTK, Intel): Suggest to identify each component and corresponding interruption in cell switch first and design basic delay/interruption requirement for cell switch
  + Option 2 (Apple, CATT, ZTE, CTC, Nokia, Xiaomi): RAN4 not to consider or deprioritize that UE does not receive or transmit data on source cell after ACK transmission on cell switch command during cell switch delay, i.e., not consider DAPS plus LTM.
  + Option 4 (Huawei): For inter-frequency L1/L2 mobility, not to consider simultaneous RX/TX on serving cell and target cell during cell switch delay.
  + Option 5 (DOCOMO, vivo, Ericsson): There are some possible scenarios that UE can transmit and receive simultaneously with source and target cell
    - Option 5a (DOCOMO): The possible duration that the UE attempt to do simultaneous data Rx/Tx with both source cell and target cell is Tcmd + Tprocessing,2.
    - Option 5b (DOCOMO, Ericsson): UE can transmit and receive simultaneously with source and target cell during role change case.
    - Option 5c (vivo):
      * If ‘simultaneous data Rx/Tx’ means whether UE need to set up 2 active RLC entities to different DUs in the inter-DU cell switch, it should be discussed in RAN2, and RAN4 proceeds current discussion with the assumption of only one active RLC entity, if this assumption is needed.
      * If ‘simultaneous data Rx/Tx’ means whether 2 physical data channels can be set up simultaneously between source cell and target cell, it should be supported, following the same rules for ICBM or CA.
      * If ‘simultaneous data Rx/Tx’ means whether UE needs to physically transmitting or receiving to both source and target cells at the same time, RAN4 should discuss the ‘simultaneous data Rx/Tx’ in a case-by-case manner. Therefore, RAN4 not to further clarify ‘simultaneous data Rx/Tx’, but to further discuss the corresponding RRM requirements and the feasibility of ‘UE simultaneous Rx/Tx’ laying behind.
* Recommended WF
  + Recommend agree on
    - Discuss what interruption requirements, scheduling restriction and measurement restriction to define instead of discussing whether simultaneous Rx/Tx in source cell and target cell is allowed.

### Sub-topic 2-2 Definition of inter-frequency cell switch

**Issue 2-2-1:** **Definition of inter-frequency cell switch**

*Moderator thinks it is better to align the definition with L3 HO.*

* Proposals
  + Option 1 (Apple, CTC, CATT, MTK, DOCOMO, OPPO, vivo, Huawei, Nokia, Ericsson): Inter-frequency cell switch is defined where the SSB of Pcell and/or PScell and the candidate target cell are on different frequency layers.
    - CATT, DOCOMO, vivo: pending on the exact scenario.
  + Option 2 (CATT, DOCOMO, CMCC, vivo): Inter-frequency cell switch is defined where the SSBs of active serving cell(s) and the corresponding candidate target cell(s) are on different frequency layers
    - CMCC: pending on whether to differentiate intra-frequency and inter-frequency for cell switch delay requirements.
* Recommended WF
  + Inter-frequency cell switch is defined where the SSB of Pcell and/or PScell and the candidate target cell are on different frequency layers.

### Sub-topic 2-3 Definition of synchronous and non-synchronous

**Issue 2-3-1: Definition of synchronous and non-synchronous**

*From moderator’s view, for L1-RSRP measurement, we can discuss RTD limitation directly without such a definition; for other LTM related requirements, moderator hasn’t seen the necessary for such a definition yet. Therefore, moderator suggests holding on the discussion on this issue unless there is a justified need.*

* Proposals
  + Option 1 (Intel, CATT, ZTE, Ericsson): It is unnecessary to define sync and async scenarios for LTM requirements.
  + Option 2 (vivo): RAN4 to re-use sync condition defined for DAPS as the sync condition for LTM. Based on RAN2 conclusion, RAN4 only needs to specify requirements under sync condition in R18 LTM.
  + Option 3 (DOCOMO): Synchronous and non-synchronous is the problem whether UE can measure L1-RSRP correctly or not. Therefore it should be defined by RTD value.
  + Option 4 (Xiaomi): For synchronous scenario, the timing offset between source cell and target cell defined in Rel-17 inter-cell BM requirement can be reused, e.g. timing offset between source cell and target cell is smaller than CP.
* Recommended WF
  + Not define synchronous and non-synchronous scenarios for LTM unless it is necessary.

### Sub-topic 2-4 Requirements for DL/UL synchronization before cell switch command

**Issue 2-4-1: Whether to specific requirements for downlink/uplink synchronisation before cell switch**

*As far as moderator know, RAN1 haven’t concluded on how to trigger downlink synchronization on neighbour cell yet. They are also discussing how to send RAR to UE for downlink synchronization on neighbor cell. We can* *wait for more progress in RAN1 and hold on the discussion.*

* Proposals
  + Option 1 (Apple): No need to define specific requirements for downlink synchronisation before cell switch since it has already been covered by existing L3 measurement requirements.
  + Option 2 (Intel): If TCI state switch command can be sent before cell switch, depending on progress of RAN1, RAN4 may need to further discuss how to update current requirement for TCI activation, e.g. timing offset, active BWP.
  + Option 3 (QC): RAN4 to discuss whether and how to define delay and interruption requirements for PDCCH ordered PRACH transmission to LTM cell for which UE needs additional processing to build and load RF scripts. It is also up to decisions from other working groups.
  + Option 4 (Ericsson):
    - RAN4 to study interruption requirements due to PRACH transmission
    - RAN4 to discuss the DL synchronization requirements and the number of cells for which DL pre-synchronization can be maintained at the UE.
    - RAN4 to discuss downlink synchronisation requirements for UE before receiving cell switch command.
* Recommended WF
  + Wait for more progress in RAN1.

### Sub-topic 2-5 Whether to consider FR2-2

**Issue 2-5-1: Whether to consider FR2-2**

* Proposals
  + Option 1 (MTK, CATT): Not consider FR2-2 in LTM.
* Recommended WF
  + Not consider FR2-2 in R18 LTM.

### Sub-topic 2-6 others

**Issue 2-6-1: Whether to consider inter-frequency LTM**

*In moderator’s understanding, “LTM” includes both cell switch and L1 measurement. As for inter-frequency L1 measurement, we will discuss in issue 3-3-1.*

*As for inter-frequency cell switch, according to RAN4#105 agreement, RAN4 will define requirements for inter-frequency cell switch.*

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| **Issue 1-3-1: Whether to cover inter-frequency cell switch**  **< Agreement >**:   * Introduce requirements for inter-frequency cell switch   + - Which scenarios to define cell switch requirements is up to RAN4 discussion.     - FFS: whether to support inter-frequency L1-RSRP measurement. |

*In moderator’s view, we don’t need to discuss this issue anymore.*

* Proposals
  + Option 1 (Nokia): RAN4 to focus first on intra-frequency LTM scenarios and subsequently define inter-frequency LTM scenarios.
  + Option 2 (Ericsson): RAN4 to define requirements for both intra-frequency and inter-frequency LTM.
* Recommended WF
  + No more discussion.

**Issue 2-6-2: Transmit timing requirements after receiving the cell switch command**

*According to the following RAN4#105 agreement, in moderator’s view, we don’t need to discuss this issue anymore.*

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| **Issue 1-7-1: transmit timing accuracy**  **< Agreement >**:   * Transmit timing accuracy requirements for any uplink transmission after cell switch should follow existing requirements. |

* Proposals
  + Option 1 (Ericsson): UE to meet the same transmit timing requirements as legacy HO after receiving the cell switch command.
* Recommended WF
  + No more discussion.

**Issue 2-6-3: Others**

* Proposals
  + Option 1 (QC): LTM requirements are applicable only when a QCL source reference signal of “PDCCH ordered PRACH to an LTM candidate cell before LTM handover” or “an active TCI state to be used immediately after LTM handover” is the same or one of the reference signals configured and used for LTM L1-RSRP measurements from the cell.
* Recommended WF
  + Need more discussion

# Topic #3: LTM - L1-RSRP measurement requirements (AI 9.23.3.2)

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2300098 | Qualcomm Incorporated | **Observation 1: Both Rel-15 serving cell L1-RSRP measurement and Rel-17 non-serving cell L1-RSRP measurement do not require a separate FFT engine or cell search.**  **Proposal 1: L1-RSRP measurement for LTM should not require a separate FFT engine or cell search.**  **Observation 2: There is no L1-RSRP requirement for the case where UE has not sent a valid L3 measurement report during the last 5 seconds in Rel-17 non-serving cell measurement.**  **Proposal 2: RAN4 to define L1-RSRP measurement for LTM cell only when the following conditions are met:**   * **If the LTM cell is not one of the current SCells, UE has sent a valid L3 measurement report of the cell during the last [X] seconds. FFS on X, e.g. X=5, and the following case:**   + **The LTM cell is contiguous to one of the current serving cells, if applicable for LTM scenario** * **The SSB of the LTM cell has the same SCS as the SSB of the serving cell if the SSBs have the same centre-frequency, i.e. do not consider the case of inter-frequency with the same centre-frequency for LTM.**   **Proposal 3: For LTM intra- and inter-frequency L1-RSRP measurements, if the LTM measurement resource is within the UE active BWP,**   * **If RTD between the serving cell and the target LTM cell is equal to or smaller than the length of CP**   + **No impact on the existing CSSF is expected**   + **LTM L1-RSRP measurement period can be in a similar form to R17 non-serving cell L1-RSRP measurement period requirement**   + **Measurement restriction on LTM SSB can be the same as R17 non-serving cell L1-RSRP measurement restriction requirement**   + **Scheduling availability on LTM SSB can be the same as R17 non-serving cell L1-RSRP scheduling availability requirement** * **If RTD between the serving cell and the target LTM cell is larger than the length of CP**   + **No impact on the existing CSSF is expected**   + **There may be impacts on the following requirements if UE does not have a separate FFT engine for the LTM L1-RSRP measurements**     - **LTM L1-RSRP measurement period**     - **Measurement restriction on LTM SSB**     - **Scheduling availability on LTM SSB** |
| R4-2300228 | Apple | **Observation 1: L3 measurement is essential for UE to acquire timing information, improve L1 measurement accuracy and reduce L1 measurement latency on neighbour cells.**  **Proposal 1: Network shall configure L1 measurement on a neighbor cell after receiving L3 measurement report on that cell.**  **Proposal 2: Candidate cell L1-RSRP measurements can be measured within SMTC.**  **Proposal 3: RAN4 shall not assume intermediate results of L3 measurement can be reused for L1 measurement.**  **Observation 2: it is premature to conclude L1 and L3 measurement can always be performed simultaneously on the same frequency layer.**  **Proposal 4: definition of known/unknown in L1 measurement on neighbour cell can be defined based on the existing definitions in L1-RSRP measurements for a cell with different PCI from serving cell:**   * **In L1-RSRP measurement for neighbour cell, target cell is considered as known if the following conditions are met in this requirement:**   + **The UE has sent a valid L3 measurement report during the last X seconds, and**   + **The SSB from the target cell remains detectable according to the cell identification requirements specified in clause 9.2 and 9.3.** * **Otherwise, it is unknown**   **Proposal 5: not define L1-RSRP measurement delay requirement for unknown cells. Whether unknown case needs to be included in cell switch requirement in LTM procedure can be discussed separately.**  **Proposal 6: For intra-frequency L1-RSRP measurement on neighbour cell, use the requirements for L1 measurement on NSC in R17 as a baseline.**  **Proposal 7: requirements for inter-frequency can be discussed after RAN4 concludes other related issues, such as whether to use measurement gap and so on.**  **Proposal 8: Reuse legacy value SNR= -3dB as side condition of intra-frequency L1-RSRP measurement accuracy requirements.** |
| R4- 2300296 | China Telecom | **Proposal 1: L3 measure is important to indicate the candidate cell(s) for L1 measurement before UE performs L1 measurement, except**   * **For FR1, the Tx beams and Rx beam are same for L1-RSRP measurement and L3 measurement, we could reuse the intermedia result of L3 measurement as L1-RSRP measurement result.**   **Proposal 2: The intermediate results of L3 measurement could be reused for L1 measurement when the Tx beams and Rx beams for L1-RSRP measurement and L3 measurement are same. Otherwise, require additional L1-RSRP measurement.** |
| R4-2300467 | Intel Corporation | **Observation 1: From signalling procedure of RAN2 and RAN3, L3 measurement results need to be reported for LTM preparation, which is before L1 measurement is configured.**  **Proposal 1: RAN4 to define L1 measurement requirements for known cell case only, i.e. L3 measurement is reported before.**  **Proposal 2: In LTM, purpose of L1 measurement and report is for both beam management and mobility.**  **Observation 2: Rel-17 inter-cell L1 measurement framework is not designed for mobility purpose and there are many limitations.**  **Proposal 3:** **Rel-17 ICBM is not suitable to be used as baseline for L1 measurement in LTM as it’s not designed for mobility purpose.**  **Observation 3: With intermediate L3 result, UE can still report the beam index and RSRP. After cell switch, Data can still be received by rough beam initially and further update by L1-RSRP measurement.**  **Observation 4: For intra-frequency case, if L1-RSRP measurement is performed before cell switch, at least N times measurement delay will be needed compared with the case that L1-RSRP measurement is performed after cell switch.**  **Observation 5: For inter-frequency case, much longer delay or data interruption will be expected if L1-RSRP measurement is performed before cell switch.**  **Observation 6: The total delay of LTM will be extended due to the large latency of L1 measurement before cell switch.**  **Observation 7: Beam switch is not equal to cell switch, For each HO, extra delay and interruption is needed. Rough beam based measurement report is more robust compared with fine beam.**  **Proposal 4: Intermediate L3 measurement result can be used for L1 report in LTM.**  **Proposal 5: L1 report configurations for beam management and LTM are differentiable.** |
| R4-2300553 | CATT | **Observation 1: Given that UE always needs to perform cell detection, L3 measurement will always exist. It is a more appropriate approach to select a limited number of candidate cells through L3 measurement, and then the network configure L1/L2 related measurement related to candidate cells.**  **Proposal 1:** **Network shall configure L1 measurement on a neighbor cell after receiving L3 measurement report on that cell.**  **Proposal 2:** **Candidate cell L1-RSRP measurements can be measured within SMTC.**  **Proposal 3: It is suggested to discuss the issue after issue 2-1-1 having a conclusion.** |
| R4-2300555 | CATT | **Proposal 1: Whether to relax the restriction on SFN offset alignment is related to the relationship between L3 measurement and L1 measurement.**   * **If UE performs L3 measurement before L1 measurement, the restriction on the *sfn-SSB-Offset* can be relaxed.** * **Otherwise, it depends on UE implementation.** * **FFS: Relaxing the restriction on the *sfn-SSB-Offset*** **can be an optional capability of UE.** * **FFS: Introduction of SMTC.**   **Proposal 2: If UE support FG6-1a, it is possible to relax the BWP setting restriction, that is, the SSB for L1-RSRP measurement of non-serving cell may not be in the active BWP.**   * **RAN4 should further discuss this issue after the RAN meeting reaches the conclusion on FG6-1a.**   **Proposal 3:** **For SSB based L1-RSRP, whether Rx time difference between serving cell and non-serving cell is larger than [x]us depends on UE capability.**   * **[x]us can be a set of values.** * **FFS: Introduction of SMTC for larger RTD.** * **FFS: Specific values in the set.** **(i.e. CP and other larger RTD values that UE can tolerate)** |
| R4-2300891 | xiaomi | **Observation 1: For synchronous case, L3 measurement report is not needed before configuring L1 measurement.**  **Observation 2: For asynchronous case, L3 measurement report is required before configuring L1 measurement.**  **Proposal 1: L1-RSRP measurement for Rel-18 LTM is defined under known cell condition. If needed, L3 measurement report is required before L1 measurement configuration.**  **Proposal 2: RAN4 not to define L1-RSRP measurement delay requirement for unknown cells.**  **Proposal 3: RAN4 not to define intra-frequency L1-RSRP measurement requirement in Rel-18.**  **Proposal 4: RAN4 to define the requirement for intra-frequency L1-RSRP measurement with type 1 MG in first phase.**  **Proposal 5: RAN4 to consider to define the requirement for intra-frequency L1-RSRP measurement with NCSG or ‘needforgap’ or type2 MG in late phase/release.**  **Proposal 6: RAN4 to consider whether to use the gap shared with L3 measurement or to configure a dedicated gap for L1-RSRP measurement.**  **Proposal 7: For intra-frequency L1-RSRP measurement delay, the requirement of L1-RSRP measurement for Rel-17 NSC can be used as a baseline.**  **Proposal 8: The condition of BWP setting, e.g. the SSB from the cell with different PCI completely contained in the active BWP or associated with initial downlink BWP of the UE, can be relaxed if the measurement gap for L1-RSRP measurement is introduced in Rel-18 LTM.**  **Proposal 9: If the same L1 measurement resources are configured for both serving cell and intra-frequency neighbour cell, the condition of ‘sfn-SSB-Offset’ is not needed.**  **Proposal 10: The condition of Rx timing difference cannot be relaxed, e.g. the timing difference of arrival at UE between the SSBs of serving cell and cell with different PCI is less than CP length of the corresponding SCS.** |
| R4-2300928 | MTK | **Observation 1: For SSB based intra-frequency L1 measurement, it is possible that SSB of neighbor cell is not in the active BWP if UE supports FG6-1a.**  **Proposal 1: For SSB based intra-frequency L1 measurement, prioritize the case that SSB for intra-frequency L1 measurement is in the active BWP in this WI:**   * **FFS whether to define the requirements for the case that SSB for intra-frequency L1 measurement is not in the active BWP.**   **Proposal 2: For R18 L1/L2 mobility, Network shall configure L1 measurement on a neighbor cell after receiving L3 measurement report on that cell.**  **Proposal 3: Serving cell and intra-frequency neighbor cell can have different sfn-SSB-Offset if UE performs L3 measurement before L1 measurement.**  **Proposal 4: For intra-frequency L1-RSRP measurement, start from the case that RTD of serving cell and neighbor cell is within one CP.**  **Proposal 5: Side condition in intra-frequency L1-RSRP measurement accuracy requirements is SNR=-3dB.**  **Observation 2: The measurement delay of L1 inter-frequency measurement may be longer than L3 measurement.**  **Observation 3: In FR1, the measurement results of L3-RSRP and L1-RSRP of the same beam would be almost the same.**  **Proposal 6: Deprioritize the discussion on inter-frequency L1-RSRP measurement.**  **Observation 4: The pros and cons of using rough beam and fine beam for L1 measurement:**   |  |  | | --- | --- | | **L1 measurement report using rough beam** | **L1 measurement report using fine beam** | | **Pros**:   1. No negative impact to L3 measurement delay due to sharing or less interruption. 2. No limitation on RTD. 3. Low workload in RAN4.   **Cons**:   1. Use rough beam immediately after cell switch. 2. it is not fair to compare neighbor cell with rough and serving cell with fine beam 3. FFS: Pre-sync on DL is workable. | **Pros**:   1. No change to current RAN4 assumption on fine/rough beams 2. Higher data rate is expected immediately after cell switch with fine beam.   **Cons**:   1. Extend L3 measurement delay or more interruption with dedicated MG |   **Observation 5: The benefit is marginal from using intermediate results from L3 measurements for L1-RSRP report compared to using L3 measurement report for cell switch.** |
| R4-2300972 | NTT DOCOMO, INC. | **Proposal 1: Since the purpose of this work is utilizing L1-RSRP measurement instead of L3 measurement, L3 measurement report should not be the prerequisite. At least in cell switch case, UE can measure L1-RSRP with no additional candidate cell information. In LTM case, RAN2 progress is needed.**  **Proposal 2: Since the purpose is HO, the RX beam can be same as L3 measurement and thus reuse intermediate results of L3 measurement. It also means L1-RSRP measurement and L3 measurement can be done simultaneously at least they are on the same frequency layer.** |
| R4-2301054 | ZTE | ***Proposal 1. L3 measurement report is not the prerequisite of L1 measurement configuration.***  ***Proposal 2. Candidate cell L1-RSRP measurements could be measured within SMTC.***  ***Proposal 3. Proposal to use L3 measurement framework as a baseline for LTM HO for intra-frequency and inter-frequency L1 measurement.***  ***Proposal 4. L1-RSRP measurement delay requirements need more further discussion.***  ***Proposal 5. Proposal to use legacy value of L3 measurement for L1/L2 mobility.*** |
| R4-2301659 | OPPO | **Observation 1: Network can determine whether to configure L1 measurement on a neighbor cell after receiving L3 measurement report on that cell.**  **Proposal 1: Fine to wait for more progress from RAN1/RAN2 on the reporting procedure.**  **Observation 2: L1-RSRP measurement delay requirements depend on the conclusion of the definition and scenarios of intra-frequency and inter-frequency L1-RSRP measurement in LTM.**  **Proposal 2: The requirements for the case that target SSB is not within active BWP can be hold on after the conclusion of BWP operation without restriction.**  **Proposal 3: Reuse legacy value SNR=-3dB for intra-frequency L1-RSRP measurement of L1/L2 based inter-cell mobility.** |
| R4-2301705 | vivo | **Proposal 1 L3 measurement on the corresponding candidate cell is also the perquisite of inter-cell L1 measurements in R18, except the case when intermediate results from L3 measurements is used in L1/L2 reporting for both serving cell and candidate cell, if supported in R18.**  **Proposal 2 If L1/L2 reporting of L3 measurement results is agreed in efeRRM WI, the same mechanism can be re-used in R18 LTM.**  **Proposal 3 RAN4 makes the following clarifications for intra-frequency L1 measurement on de-activated SCell:**   * **The L1 measurement performed on de-activated SCell is performed outside gaps.** * **The inter-mediate results of L3 measurements is used in L1/L2 reporting.** * **Interruption defined for L3 measurements on de-activated SCell is re-used.**   **Proposal 4 In case inter-mediate results of L3 measurement is used in L1/L2 reporting, there is NO need to restrict requirement applicability of L1 measurements that the RS to be measured has to be within the active BWP.**  **Proposal 5 For L1 measurement on candidate cells after precise synchronization, which is normally used for beam managements, fine Rx beam is assumed. For the case when inter-mediate result of L3 measurement is reported in L1/L2, the rough Rx beam is assumed for the corresponding measurement.**  **Proposal 6 For L1 measurement on candidate cells after precise synchronization, RAN4 to define the L1-RSRP requirements when SSB of candidate cell is fully overlapped with SMTC, but SSB of serving cell is not overlapped with SMTC. In this case, the sharing factor between L3 and L1 measurement defined for serving cell can be re-used for candidate cell.**  **Proposal 7 RAN4 not to introduce any restriction on SFN offset alignment in R18 inter-cell L1-RSRP measurement requirements, based on the common understanding that it is an error configuration when the SSBs for L1-RSRP measurement and SMTCs are fully non-overlapped.** |
| R4-2301826 | Huawei | **Proposal 1: In common understanding, network configures L1 measurement on a neighbour cell after receiving L3 measurement report on that cell.**  **Proposal 2: For LTM,**  **For FR1 intra-frequency L1-RSRP measurement,**   * **If the SSB periodicity of L1-RSRP measurement is the same as SMTC on this frequency, L3-RSRP physical sample can be used for L1-RSRP measurement.** * **If SSB periodicity of L1-RSRP is smaller than SMTC, for the location where no L3-RSRP measurement is performed, UE shall perform L1-RSRP measurement additionally.**   **For FR1 inter-frequency L1-RSRP measurement (assuming legacy gap is needed), L3-RSRP physical sample can be used for L1-RSRP measurement.**  **For FR2 L1-RSRP measurement, L3-RSRP physical samples can NOT be used for L1-RSRP measurement.**  **Proposal 3: Specify requirements for**  **-Inter-frequency SSB-Based L1measurement with gap: The target cell’s SSB is not contained in the DL active BWP.**  **-Inter-frequency SSB-Based L1measurement without gap: The target cell’s SSB is completely contained in the DL active BWP.**  **Proposal 4: For SSB based L1-RSRP inter-frequency measurement with legacy gap:**   * **In FR1, SSB based L1-RSRP can be performed simultaneously with L3-RSRP measurement;** * **In FR2, either L1 measurement sharing with L3 gap, or a dedicated measurement gap for L1-RSRP can be considered.**   **Proposal 5: For SSB based L1-RSRP inter-frequency measurement with NCSG:**   * **In FR1, SSB based L1-RSRP measurement can be performed simultaneously with L3-RSRP measurement;** * **In FR2, SSB based L1-RSRP measurement is to be shared with L3 measurement with NCSG. The measurement delay with NCSG is the same as that with shared legacy gap.**   **Proposal 6: Open to discuss SSB based L1-RSRP inter-frequency measurement with Needforgap in Rel-18.**  **Proposal 7: The conclusion on FG 6-1a can be reused for intra-frequency L1-RSRP measurement where SSB from neighbor cell is not within active BWP.**  **Proposal 8: Reuse legacy value SNR=-3dB in intra-frequency L1-RSRP measurement accuracy.**  **Proposal 9: For intra-frequency inter-cell L1-RSRP measurement, if there are more than 1 neighbour cell, the sharing factor (PSC and PCDP) in R17 ICBM shall be modified.** |
| R4-2301828 | Huawei | **Proposal 1: For L1 intra-frequency measurement, if UE ever reported time index when performed L3 measurement on the non serving cell, the restriction of sfn-SSB-Offset can be removed, otherwise SFN offset alignment compared with serving cell is needed for intra-frequency L1-RSRP.**  **Proposal 2: To perform SSB based L1 RSRP measurement, both scenarios where non-serving cell SSB is covered within serving cell active BWP and not covered within active BWP can be supported. The conclusion on FG 6-1a can be reused for SSB based intra-frequency L1-RSRP measurement where SSB from neighbor cell is not within active BWP.**  **Proposal 3: RAN4 is supposed to support the scenario that RTD between the SSBs of serving cell and cell with different PCI is larger than CP length of the corresponding SCS. UE capability can be considered.** |
| R4-2302243 | Nokia, Nokia Shanghai Bell | **Proposal 1: Existing L1-RSRP measurement requirements for a cell with different PCI than serving cell can be applied for LTM.**  **Proposal 2: RAN4 focuses on SSB-based L1-RSRP intra-frequency measurements first**  **Proposal 3: Discuss the L1-RSRP measurement accuracies and whether they can be improved for LTM**  **Proposal 4: RAN4 to define L1-RSRP measurement accuracy requirement for non-serving cell.**  **Observation 1: If the candidate LTM cells are always known, it is not necessary to define the L1-RSRP measurement delay requirements for unknown cells.**  **Observation 2: RAN4 can assume that the candidate cells are always known to the UE prior to the configuration of LTM.**  **Proposal 5: For rel-18 LTM, RAN4 can assume that UE has transmitted a L3 measurement report to the network prior to L1 measurement configuration.**  **Proposal 6: RAN4 waits for RAN2 agreements on LTM timer before defining L1-RSRP measurement delay requirement for unknown cells.**  **Proposal 7: RAN4 waits for RAN1 decision on how to get L1-RSRP measurement results** |
| R4-2302660 | Ericsson | 1. If a cell is reported L3 measurement report in last X seconds, it is considered as known cell, otherwise unknown cell for LTM requirements purpose 2. RAN4 shall agree that L3 measurement report is not the prerequisite of L1 measurement configuration on a neighbour cell. 3. RAN4 to define L1 measurement requirements for both known and unknown cells. 4. RAN4 to assume L3 measurement framework as baseline for LTM measurement framework other than following ICBM framework. 5. To achieve similar mobility performance as L3 mobility, RAN4 to assume same RX beam for L3 measurement and L1 measurement for LTM. 6. RAN4 to reuse intermediate results of L3 measurement for L1 measurement. 7. To achieve fine beam selection after HO, RAN4 can assume ICBM approach for some candidate cells. 8. RAN4 to agree that LTM L1-RSRP is a mix of L3 HO measurement and L1 ICBM measurement framework 9. In hybrid LTM framework, RAN4 to agree that some cells are measured following the L3 measurement and some other cells are measured following ICBM 10. In hybrid LTM framework, RAN4 to discuss and decide on the event that triggers the change from L3 measurement to ICBM measurement. 11. If RAN4 agrees on this hybrid LTM measurement framework, RAN4 should send LS to RAN2. 12. Measurement requirements of ICBM alone shall not be taken as baseline for L1 measurement requirements of LTM 13. RAN4 to discuss L1 measurement delay requirements considering mix of L3 and ICBM frameworks. 14. RAN4 to discuss the tightening of intra-frequency L1-RSRP measurement accuracy for L1/L2 mobility. 15. RAN4 to consider same side condition of L3 measurement as baseline. 16. RAN4 to define inter-frequency L1-RSRP measurement accuracy requirements on non-serving cell 17. Candidate cell L1-RSRP measurements can be measured within SMTC. |
| R4-2302662 | Ericsson | 1. RAN4 to consider RTD>CP for L1/L2 mobility candidate cell measurements. 2. RAN4 to discuss downlink synchronisation requirements for UE before receiving cell switch command. 3. UE to meet the same transmit timing requirements as legacy HO after receiving the cell switch command. 4. RAN4 to agree that for LTM measurements, sfn-SSB-Offset of the neighbour cell need not to be same as the serving cell. 5. RAN4 to agree that SSB for intra-frequency L1-RSRP measurement need not be in the active BWPs. 6. RAN4 to define requirements for intra-frequency L1-RSRP measurement with MG |

## Open issues summary

### Sub-topic 3-1 General principles

**Issue 3-1-1: Basic assumption for L1 measurement on neighbour cell**

* Proposals
  + Proposal 1 (QC): L1-RSRP measurement for LTM should not require a separate FFT engine or cell search.
* Recommended WF
  + Need more discussion

**Issue 3-1-2: DL/UL synchronization assumption for L1 measurements**

* Proposals
  + Proposal 1 (QC): RAN4 to discuss whether and how to address a potential issue where the total number of active TCI states from a serving cell plus the total number of SSBs to perform intra-frequency L1-RSRP measurements from LTM cells exceed the UE capability on the number of total active TCI states, e.g. requirement applicability rule in terms of latency requirements, etc.
  + Proposal 2 (vivo): RAN4 to clarify DL/UL synchronization assumption for L1 measurements performed on target cell, especially if L1 measurement is performed before cell switch, but DL/UL synchronization is done after cell switch.
* Recommended WF
  + Need more discussion

**Issue 3-1-3: Whether to** **use** **intermediate L3 measurement results in L1 measurement reporting**

*As some companies point out, in FR2 the legacy common understanding is rough beam for L3 measurement and fine beam for L1 measurement. At least in legacy framework, intermediate L3 measurement results can not be used in the L1 measurement reporting in FR2. But in FR1, moderator thinks at least it is possible if L1-RSRP measurement is limited within SMTC.*

*The positions of the companies with related contributions are summarized as below:*

* *DOCOMO, ZTE and Intel support using intermediate L3 measurement results in L1 measurement reporting in both FR1 and FR2*
* *CTC supports using intermediate L3 measurement results in L1 measurement reporting in FR1.*
* *Huawei thinks it is possible for FR1 but have some limitation, and it is not applicable to FR2.*
* *Apple is against using intermediate L3 measurement results in L1 measurement reporting in both FR1 and FR2.*
* *vivo and Ericsson think both two frameworks can be supported and further discuss how to determine which framework to use for different purposes or scenarios.*

*If we don’t conclude on this issue, there will be several issues blocked. To make progress, Moderator suggests following the majority view and agree on:*

* + - *At least assume fine beam for FR2 L1-RSRP measurement.* 
      * *FFS: L3 measurement framework will be also used for L1-RSRP report in FR2*
      * *FFS: which framework(s) to use for L1-RSRP report in FR1.*

*Note: Conclude on the two sub-bullets no later than RAN4#107.*

* Proposals
  + Option 1 (DOCOMO, ZTE, Intel): use L3 measurement framework as a baseline for LTM HO for intra-frequency and inter-frequency L1 measurement, i.e.,
    - re-use intermediate result of L3 inter-frequency measurement for L1 inter-frequency measurement.
    - assume same RX beam for L3 measurement and L1 measurement
    - Option 1a (Intel):
      * L1 report configurations for beam management and LTM are differentiable.
  + Option 2 (Apple): RAN4 shall not assume intermediate results of L3 measurement can be reused for L1 measurement.
  + Option 3 (CTC):
    - For FR1, reuse the intermediate result of L3 measurement as L1-RSRP measurement result.
    - For FR2, FFS.
  + Option 4 (Huawei):
    - For FR1 intra-frequency L1-RSRP measurement,
      * If the SSB periodicity of L1-RSRP measurement is the same as SMTC on this frequency, L3-RSRP physical sample can be used for L1-RSRP measurement.
      * If SSB periodicity of L1-RSRP is smaller than SMTC, for the location where no L3-RSRP measurement is performed, UE shall perform L1-RSRP measurement additionally.
    - For FR1 inter-frequency L1-RSRP measurement (assuming legacy gap is needed), L3-RSRP physical sample can be used for L1-RSRP measurement.
    - For FR2 L1-RSRP measurement, L3-RSRP physical samples can NOT be used for L1-RSRP measurement.
  + Option 5 (vivo, Ericsson): support hybrid measurement framework
    - Option 5a (vivo):
      * For L1 measurement performed by UE on target cell with prior precise uplink uplink/downlink sync to target cell, it is proposed to re-use the legacy R15/R16/R17 L1 UE measurement behaviour assumption.
      * For L1 measurement performed by UE on target cell without prior precise uplink/downlink sync to target cell, it is proposed to re-use the legacy R15 L3 UE measurement behaviour assumption.
    - Option 5b (Ericsson): RAN4 to agree that LTM L1-RSRP is a mix of L3 HO measurement and L1 ICBM measurement framework
      * To achieve similar mobility performance as L3 mobility, RAN4 to assume same RX beam for L3 measurement and L1 measurement for LTM. RAN4 to reuse intermediate results of L3 measurement for L1 measurement.
      * To achieve fine beam selection after HO, RAN4 can assume ICBM approach for some candidate cells.
      * In hybrid LTM framework, RAN4 to agree that some cells are measured following the L3 measurement and some other cells are measured following ICBM
      * In hybrid LTM framework, RAN4 to discuss and decide on the event that triggers the change from L3 measurement to ICBM measurement.
  + Option 6 (Nokia): RAN4 waits for RAN1 decision on how to get L1-RSRP measurement results
* Recommended WF
  + Recommend agree on
    - At least assume fine beam for FR2 L1-RSRP measurement.
      * FFS: L3 measurement framework will be also used for L1-RSRP report in FR2
      * FFS: which framework(s) to use for L1-RSRP report in FR1.

Note: Conclude on the two sub-bullets no later than RAN4#107.

**Issue 3-1-4: Whether L1 measurement configured after receiving L3 measurement report on that cell**

*As the agreed LTM framework in R2-2213332 and the agreed procedure in R3-226050, L3 measurement results need to be reported before L1 measurement is configured. Moderator suggests following RAN2 and RAN3 running CR and the majority view in RAN4.*

* Proposals
  + Option 1 (Apple, Huawei, CATT, Xiaomi, MTK, Nokia, Intel): Network shall configure L1 measurement on a neighbor cell after receiving L3 measurement report on that cell
  + Option 2 (ZTE, Ericsson, [DOCOMO]): L3 measurement report is not the prerequisite of L1 measurement configuration.
  + Option 3 (OPPO): wait for RAN1/2 progress
  + Option 4 (vivo): L3 measurement on the corresponding candidate cell is also the perquisite of inter-cell L1 measurements in R18, except the case when intermediate results from L3 measurements is used in L1/L2 reporting for both serving cell and candidate cell, if supported in R18.
* Recommended WF
  + Recommend agree on:
    - Network shall configure L1 measurement on a neighbour cell after receiving L3 measurement report on that cell.

**Issue 3-1-5:** **Whether to define L1-RSRP measurement delay requirement for unknown cell?**

* Proposals
  + Option 1 (QC, Apple, Intel, Xiaomi): RAN4 to define L1 measurement requirements for known cell case only.
  + Option 2 (Nokia): RAN4 waits for RAN2 agreements on LTM timer before defining L1-RSRP measurement delay requirement for unknown cells.
  + Option 3 (Ericsson): RAN4 to define L1 measurement requirements for both known and unknown cells.
* Recommended WF
  + Pending on issue 3-1-4

**Issue 3-1-6:** **known cell condition for L1-RSRP measurement**

* Proposals
  + Option 1 (Apple, QC, Ericsson):
    - In L1-RSRP measurement for neighbour cell, target cell is considered as known if the following conditions are met in this requirement:
      * The UE has sent a valid L3 measurement report during the last [5] seconds, and
      * The SSB from the target cell remains detectable according to the cell identification requirements specified in clause 9.2 and 9.3.
    - Otherwise, it is unknown
* Recommended WF
  + Recommend agree on Option 1.

**Issue 3-1-7: Whether candidate cell L1-RSRP measurements can be measured within SMTC?**

*There are three folds to allow L1-RSRP measurements within SMTC:*

* *Use R15/R16/R17 L1-RSRP measurement framework*
  + *Intra-frequency L1-RSRP measurement, L1-RSRP can be measured within SMTC if SSB occasions are fully overlapped with SMTC in FR2*
  + *Inter-frequency L1-RSRP measurement (if supported): UE may have to perform L1 measurement within SMTC overlapped with gap*
* *If using L3 measurement framework (using L3 intermediate results for L1 report), L1-RSRP measurement would be measured within SMTC*

*Option 1 is reasonable independent of other issues. Moderator recommends agree on Option 1.*

* Proposals
  + Option 1 (Apple, CATT, ZTE, Ericsson): Candidate cell L1-RSRP measurements can be measured within SMTC
* Recommended WF
  + Recommend agree on
    - Candidate cell L1-RSRP measurements are allowed to be measured within SMTC.

### Sub-topic 3-2 Intra-frequency L1-RSRP measurement delay requirement

**Issue 3-2-1: Intra-frequency L1-RSRP measurement requirements**

* Proposals
  + Option 1 (QC, Apple, Xiaomi, Nokia): For intra-frequency L1-RSRP measurement on neighbour cell, use the requirements for L1 measurement on NSC in R17 as a baseline
    - Option 1a (QC): if the LTM measurement resource is within the UE active BWP,
      * If RTD between the serving cell and the target LTM cell is equal to or smaller than the length of CP
        + No impact on the existing CSSF is expected
        + LTM L1-RSRP measurement period can be in a similar form to R17 non-serving cell L1-RSRP measurement period requirement
        + Measurement restriction on LTM SSB can be the same as R17 non-serving cell L1-RSRP measurement restriction requirement
        + Scheduling availability on LTM SSB can be the same as R17 non-serving cell L1-RSRP scheduling availability requirement
      * If RTD between the serving cell and the target LTM cell is larger than the length of CP
        + No impact on the existing CSSF is expected
        + There may be impacts on the following requirements if UE does not have a separate FFT engine for the LTM L1-RSRP measurements

LTM L1-RSRP measurement period

Measurement restriction on LTM SSB

Scheduling availability on LTM SSB

* + Option 2 (Huawei): For intra-frequency inter-cell L1-RSRP measurement, if there are more than 1 neighbour cell, the sharing factor (PSC and PCDP) in R17 ICBM shall be modified.
* Recommended WF
  + Recommend agree on
    - For intra-frequency L1-RSRP measurement on neighbor cell, use the requirements for L1 measurement on NSC in R17 as a baseline:
      * FFS: whether to consider multiple neighbor cells in a frequency layer,
      * FFS: whether to consider timing difference between neighbor cell and serving cell larger than a CP.

**Issue 3-2-2:** **Whether to consider RTD of serving cell and neighbour cell larger than one CP for intra-frequency L1-RSRP measurement**

* Proposals
  + Option 1 (Apple, Xiaomi, OPPO, MTK): Start the discussion from RTD of serving cell and neighbour cell within one CP for SSB based L1-RSRP measurement.
  + Option 2 (CTC, Intel, Nokia, DOCOMO): No need to restrict the RTD between serving cell and neighbour cell to be within CP for SSB-based L1-RSRP measurement
    - DOCOMO: RTD is not needed to be restricted by CP length. However, at least RTD should be less than symbol duration of smaller SCS between source and target cell.
  + Option 3 (Huawei, Apple, CATT, vivo): For SSB based intra-frequency L1 measurement, RAN4 is supposed to support the scenario that RTD between the SSBs of serving cell and cell with different PCI is larger than CP length of the corresponding SCS. UE capability can be considered.
    - Option 3a (Apple): FFS on RTD>CP. If RTD>CP has to be included, it shall be supported based on UE capability.
    - Option 3b (CATT): For SSB based L1-RSRP, discuss whether RTD between serving cell and non-serving cell is larger than [x]us. Whether UE supports out of [x]us depends on UE capability.
      * [x]us can be a set of values, including, for example, CP and other larger RTD value that UE can tolerate.
    - Option 3c (vivo): For Rx timing difference between source cell and target cell, RAN4 to discuss and support UE capability based approach:
      * For baseline UE, the Rx/Tx timing between source cell and target cell is within CP.
      * For UE with higher capability, UE may support N group of cells, while the Rx/Tx timing difference within each group is less than CP. N is reported as UE capability, and at least N = 2 should be considered in RRM requirements and test cases design.
      * The above capability is not applied to L3 measurement/reporting of the UE, and not applied to L1/L2 measurement/reporting if the intermediate result of L3 measurement is used in the reporting.
* Recommended WF
  + Recommend agree on:
    - For SSB based intra-frequency L1 measurement, support the scenario that RTD between the SSBs of serving cell and neighbour is larger than CP length of the corresponding SCS with additional UE capability.

**Issue 3-2-3: Whether sfn-SSB-Offset alignment can be relaxed?**

* Proposals
  + Option 1 (CATT, MTK, Huawei): The restriction of sfn-SSB-Offset can be removed If UE performs L3 measurement before L1 measurement.
    - Option 1a (Huawei): For L1 intra-frequency measurement, if UE ever reported time index when performed L3 measurement on the non serving cell, the restriction of sfn-SSB-Offset can be removed, otherwise SFN offset alignment compared with serving cell is needed for intra-frequency L1-RSRP.
  + Option 2 (Xiaomi): If the same L1 measurement resources are configured for both serving cell and intra-frequency neighbour cell, the condition of ‘sfn-SSB-Offset’ is not needed
  + Option 3 (vivo): RAN4 not to introduce any restriction on SFN offset alignment in R18 inter-cell L1-RSRP measurement requirements, based on the common understanding that it is an error configuration when the SSBs for L1-RSRP measurement and SMTCs are fully non-overlapped.
* Recommended WF
  + Need more discussion.

**Issue 3-2-4: Whether SSB for intra-frequency L1 measurement should be covered by serving cell active BWP**

* Proposals
  + Option 1 (CATT, MTK, Huawei, [xiaomi]): If UE support FG6-1a, it is possible to that the SSB for L1-RSRP measurement of non-serving cell may not be in the active BWP
  + Option 2 (vivo): In case inter-mediate results of L3 measurement is used in L1/L2 reporting, there is no need to restrict requirement applicability of L1 measurements that the RS to be measured has to be within the active BWP
* Recommended WF
  + Pending on Issue 3-1-3.

**Issue 3-2-5: Whether to specify requirements for SSB for intra-frequency L1 measurement not covered by serving cell active BWP**

* Proposals
  + Option 1 (OPPO, CATT, MTK): The requirements for the case that target SSB is not within active BWP can be hold on after the conclusion of BWP operation without restriction
  + Option 2 (Huawei): The conclusion on FG 6-1a can be reused for intra-frequency L1-RSRP measurement where SSB from neighbour cell is not within active BWP.
  + Option 3 (xiaomi): RAN4 not to define requirement for intra-frequency L1-RSRP measurement with gap in Rel-18.
* Recommended WF
  + Recommend agree on Option 1.

**Issue 3-2-6: intra-frequency L1 measurement on de-activated SCell**

*To moderator’s knowledge, L1-RSRP measurement is not supported on deactivated SCell in RAN1/2 yet. We can discuss this issue after RAN1/2 supports L1-RSRP measurement on deactivated SCell first if they have such discussion.*

* Proposals
  + Option 1 (vivo):
    - The L1 measurement performed on de-activated SCell is performed outside gaps.
    - The inter-mediate results of L3 measurements is used in L1/L2 reporting.
    - Interruption defined for L3 measurements on de-activated SCell is re-used.
* Recommended WF
  + No more discussion this meeting.

### Sub-topic 3-3 inter-frequency L1-RSRP measurement requirements

**Issue 3-3-1: Whether to cover inter-frequency L1-RSRP measurement**

* Proposals
  + Option 1 (MTK, Nokia): RAN4 focuses on SSB-based L1-RSRP intra-frequency measurements first
  + Option 2 (QC, Apple, CMCC, CATT, ZTE, xiaomi, DOCOMO, OPPO, Intel): RAN4 to support inter-frequency L1-RSRP measurement in Rel-18 LTM
    - Option 2a (Apple, CATT, Xiaomi): Prioritize inter-frequency L1-RSRP with MG.
    - Option 2b (DOCOMO, OPPO): Prioritize inter-frequency L1-RSRP measurement without gap in this release
    - Option 2c (Huawei): Specify requirements for
      * + Inter-frequency SSB-Based L1measurement with gap: The target cell’s SSB is not contained in the DL active BWP.
        + Inter-frequency SSB-Based L1measurement without gap: The target cell’s SSB is completely contained in the DL active BWP.
    - Option 2d (QC): RAN4 to define L1-RSRP measurement for LTM cell only when the following conditions are met:
      * If the LTM cell is not one of the current SCells, UE has sent a valid L3 measurement report of the cell during the last [X] seconds. FFS on X, e.g. X=5, and the following case:
      * The LTM cell is contiguous to one of the current serving cells, if applicable for LTM scenario
      * The SSB of the LTM cell has the same SCS as the SSB of the serving cell if the SSBs have the same centre-frequency, i.e. do not consider the case of inter-frequency with the same centre-frequency for LTM.
    - Option 2e(Intel):
      * Suggest to re-use intermediate result of L3 inter-frequency measurement for L1 inter-frequency measurement.
* Recommended WF
  + Need more discussion.

**Issue 3-3-2: inter-frequency L1-RSRP measurement with MG**

* Proposals
  + Proposal 1 (xiaomi):
    - RAN4 to consider whether to use the gap shared with L3 measurement or to configure a dedicated gap for L1-RSRP measurement.
    - **RAN4 to define the requirement for inter-frequency L1-RSRP measurement with type 1 MG in first phase.**
    - **RAN4 to consider to define the requirement for inter-frequency L1-RSRP measurement with NCSG or ‘needforgap’ or type2 MG in late phase/release.**
  + Proposal 1 (Huawei): For SSB based L1-RSRP inter-frequency measurement with legacy gap:
    - In FR1, SSB based L1-RSRP can be performed simultaneously with L3-RSRP measurement;
    - In FR2, either L1 measurement sharing with L3 gap, or a dedicated measurement gap for L1-RSRP can be considered.
* Recommended WF
  + Discuss further after concluding on issue 3-3-1.

**Issue 3-3-3: inter-frequency L1-RSRP measurement with NCSG**

* Proposals
  + Proposal 1 (Huawei): For SSB based L1-RSRP inter-frequency measurement with NCSG:
    - In FR1, SSB based L1-RSRP measurement can be performed simultaneously with L3-RSRP measurement;
    - In FR2, SSB based L1-RSRP measurement is to be shared with L3 measurement with NCSG. The measurement delay with NCSG is the same as that with shared legacy gap.
* Recommended WF
  + Discuss further after concluding on issue 3-3-1.

**Issue 3-3-4: Inter-frequency L1-RSRP measurement requirements**

* Proposals
  + Option 1 (QC): For LTM inter-frequency L1-RSRP measurements, if the LTM measurement resource is within the UE active BWP,
    - If RTD between the serving cell and the target LTM cell is equal to or smaller than the length of CP
      * No impact on the existing CSSF is expected
      * LTM L1-RSRP measurement period can be in a similar form to R17 non-serving cell L1-RSRP measurement period requirement
      * Measurement restriction on LTM SSB can be the same as R17 non-serving cell L1-RSRP measurement restriction requirement
      * Scheduling availability on LTM SSB can be the same as R17 non-serving cell L1-RSRP scheduling availability requirement
    - If RTD between the serving cell and the target LTM cell is larger than the length of CP
      * No impact on the existing CSSF is expected
      * There may be impacts on the following requirements if UE does not have a separate FFT engine for the LTM L1-RSRP measurements
      * LTM L1-RSRP measurement period
      * Measurement restriction on LTM SSB
      * Scheduling availability on LTM SSB
  + Option 2 (Apple): Requirements for inter-frequency can be discussed after RAN4 concludes other related issues, such as whether to use measurement gap and so on
* Recommended WF
  + Need more discussion after concluding issue 3-3-1.

### Sub-topic 3-4 L1-RSRP measurement accuracy

**Issue 3-4-1: side condition of intra-frequency L1-RSRP measurement accuracy requirements**

* Proposals
  + Option 1 (Apple, MTK, OPPO, Huawei): Reuse legacy value SNR= -3dB
  + Option 2 (ZTE, Ericsson): SNR =-6dB (same as L3 measurement)
* Recommended WF
  + Need more discussion.

**Issue 2-3-2: L1-RSRP measurement accuracy requirements**

***Considering that* *measurement accuracy requirements are discussed in performance part, moderator suggest not discussing this issue in this meeting.***

* Proposals
  + Proposal 1 (Nokia, Ericsson): Discuss the L1-RSRP measurement accuracies and whether they can be improved for LTM
  + Proposal 2 (Nokia): RAN4 to define L1-RSRP measurement accuracy requirement for non-serving cell.
  + Proposal 3 (Ericsson): RAN4 to define inter-frequency L1-RSRP measurement accuracy requirements on non-serving cell
* Recommended WF
  + No more discussion.

# Topic #4: LTM - L1/L2 inter-cell mobility delay requirements (AI 9.23.3.3)

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| R4-2300099 | Qualcomm Incorporated | **Delay and Interruption Requirements due to UL Activation and Transmission for LTM Cell**  **Proposal 1: RAN4 to discuss whether and how to define delay and interruption requirements for PDCCH ordered PRACH transmission to LTM cell for which UE needs additional processing to build and load RF scripts. It is also up to decisions from other working groups.**  **Proposal 2: When one of SCells is promoted to PCell upon LTM-based handover, RAN4 to discuss whether and how to differently define LTM based handover delay and interruption requirements depending on whether the SCell is for DL-only or both DL/UL. It is also up to decisions from other working groups.**  **RRC Processing Delay for LTM Measurement and Handover**  **Proposal 3: RAN4 to not assume UE can always finish a processing of RRC configurations for LTM cells before LTM handover command reception, e.g. the processing and loading the configuration before the LTM handover command reception can be limited to measurement related configurations of the LTM cells. And RAN4 to not assume the processing and loading the measurement configuration of the LTM cell before LTM handover command reception means the entire downlink configuration of the LTM target cell is processed and loaded.** |
| R4-2300229 | Apple | **Proposal 1: Not define cell switch delay requirements for the case “PCell change with PSCell change”.**  **Proposal 2: Define cell switch delay requirements for the following scenarios:**   * **PCell change without SCell change** * **Intra-SN PSCell change without SCell change**   **Proposal 3: FFS whether to define cell switch delay requirements for the following scenarios:**   * **PCell change with SCell change** * **Role change between PCell and SCell in the same CG.**   **Proposal 4: similar with legacy handover requirements, RAN4 shall target at a set of general requirements which can cover both intra and inter-frequency, considering they may only have some difference in one or two components in cell switch delay equation.**  **Proposal 5: The starting point of cell switch delay for PCell/PSCell is that UE receives cell switch command.**  **Proposal 6: for RACH-based cell switch, cell switch delay for PCell/PSCell ends at the time when UE shall be able to transmit the first PRACH preamble to the target cell.**  **Proposal 7: for RACH-less cell switch, cell switch delay for PCell/PSCell ends at the time when UE shall be able to perform the first UL transmission on the indicated beam of the target cell.**  **Proposal 8: The baseline of RACH-based Cell switch delay requirements for PCell/PSCell is Tdelay = Tcmd + Tprocessing + Tsearch + T∆ + Tmargin + TIU, where:**   * Tcmd is the time for UE to process the cell switch command * Tprocessing is the execution preparation time, including RF retuning, baseband retuning, security update if needed, etc. * Tsearch is the time required to search the target cell when the target cell is not already known when the cell switch command is received by the UE. If the target cell is known, then Tsearch = 0 ms. FFS for unknown case. * T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ can be up to Trs . T∆ can be 0 under certain conditions which are FFS. * **Tmargin is time for SSB post-processing. Tmargin can be up to 2ms unless T∆ = 0.** * TIU is the uncertainty in acquiring the first available PRACH occasion in the new cell.   **Proposal 9: The baseline of RACH-less Cell switch delay requirements for PCell/PSCell is Tdelay = Tcmd + Tprocessing + Tsearch + T∆ + Tmargin + TIU, where:**   * Tcmd is the time for UE to process the cell switch command * Tsearch is the time required to search the target cell when the target cell is not already known when the cell switch command is received by the UE. If the target cell is known, then Tsearch = 0 ms. FFS for unknown case, if RACH-less for unknown target cell is supported. * Tprocessing is the execution preparation time, including RF retuning, baseband retuning, security update if needed, etc. * T∆ is time for fine time tracking and acquiring full timing information of the target cell. T∆ can be up to Trs . T∆ can be 0 under certain conditions which are FFS. * **Tmargin is time for SSB post-processing. Tmargin can be up to 2ms unless T∆ = 0.** * TIU is the uncertainty in acquiring the first PUSCH transmission occasion or SR on PUCCH.   **Proposal 10: reuse execution time defined in CHO as the processing time in LTM cell switch delay requirements.**  **Proposal 11: The components of L1/L2 cell switch interruption Tinterruption are the components of L1/L2 inter-cell mobility delay except Tcmd.** |
| R4- 2300297 | China Telecom | **Proposal1: The starting point of cell switch delay for PCell/PSCell is that UE receives cell switch command.**  **Proposal2: For RACH-based cell switch, cell switch delay for PCell/PSCell ends at UE transmitting PRACH to the target cell.**  **Proposal3: For RACH-less cell switch, cell switch delay for PCell/PSCell ends at UE performs the first DL/UL reception/transmission on the indicated beam of the target cell.**  **Proposal 4: For RACH-based case,**  **Tdelay = Tcmd + Tsearch + Tprocessing + Tmargin + TIU + T∆,**  **where, TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell.**  **Proposal 5: Wait for RAN2 progress to add other components.**  **Proposal 6: For RACH-less case, the cell switch delay could be shown as**  **Tdelay = Tcmd + Tsearch + Tprocessing + Tmargin + TIU + T∆,**  **where, Tcmd, Tsearch, Tprocessing, T∆ and Tmargin are same as those of RACH-based cell switch. TIU is the uncertainty in the first DL/UL reception/transmission on the indicated beam.**   * **If do not consider unknown cell case for RACH-less cell switch, Tsearch could be excluded.**   **Proposal 7:Wait for RAN2 progress to specify Tcmd.**  **Proposal 8: The time for UE processing could been reduced if some procedures have been done before UE receive the cell switch command.**  **Proposal 9: For RACH-based cell switch, Tsearch equals to 0 when target cell is known or target cell is current active Scell.**  **Proposal 10: Tinterruption are the components of L1/L2 inter-cell mobility delay except Tcmd.**  **Proposal 11: Agree with the proposal on known cell conditions of MTK in last meeting.** |
| R4-2300467 | Intel Corporation | **Proposal 1: Not define cell switch delay requirements for the case “PCell change with PSCell change”.**  **Proposal 2: Define cell switch requirement for PSCell change without SCell change first. FFS whether to define requirement for PSCell change with direct SCell activation.**  **Proposal 3: Suggest to re-use legacy L3 HO requirement structure.**  **Proposal 4: The starting point of cell switch delay is that UE receives cell switch command.**  **Proposal 5: For RACH-based case, cell switch delay for PCell/PSCell ends at UE transmitting PRACH to the target cell.**  **Proposal 6: The cell switch delay need to consider pre-sync and without pre-sync cases.**  **Observation 1: beam indication can be sent together with cell switch command. At Rel-17 unified TCI framework will be supported.**  **Proposal 7: if DL TCI state switch is included in cell switch command, there is no extra delay if fine time tracking is already included in cell switch delay requirement or obtained by pre DL-sync.**  **Proposal 8: If UL TCI state switch is included in cell switch command, possible extra delay is expected due to non-maintained PL-RS. Further discuss whether to consider non maintained PL-RS case.**  **Proposal 9: If TCI state switch command can be sent before cell switch, depending on progress of RAN1, RAN4 may need to further discuss how to update current requirement for TCI activation, e.g. timing offset, active BWP.**  **Proposal 10: Only define cell switch requirement for known TCI state case in LTM.** |
| R4-2300554 | CATT | **Proposal 1: Not define cell switch delay requirements for the case “PCell change with PSCell change”.**  **Proposal 2: Define cell switch delay requirements at least for the two scenarios:**   * **PCell change without SCell change** * **PSCell change without SCell change**   **FFS: define cell switch delay requirements for SCell at PCell/PSCell change.**  **Proposal 3: If companies want to address or clarify some issues before the UE receives cell switch command, it can be further discussed, but it is not suggested to define the LTM delay requirement.**  **Proposal 4: The starting point of cell switch delay for PCell/PSCell is that UE receives cell switch command**  **Proposal 5: For RACH-based cell switch, cell switch delay for PCell/PSCell ends at UE transmitting PRACH to the target cell.**  **Proposal 6: It may wait for RAN2 progress.**   * **If the time of UE decoding RRC pre-configuration (Tprocessing, 1) is before the cell switch command, then the extra execution time is not required.** |
| R4-2300869 | CMCC | ***Proposal 1: it is proposed to define cell switch delay requirements for following scenarios:***   * ***PCell change without SCell change***   + ***Target Pcell/SCell can be current SCell/Pcel*** * ***PCell change with SCell change***   + ***Target Pcell/SCell can be current SCell/Pcell*** * ***NR-DC with PCell change*** * ***NR-DC scenario PSCell change without MN involvement***   ***Proposal 2: whether to specify cell switch delay requirements for intra- frequency and inter-frequency case seperately is related with the starting point of cell switch delay for PCell/PSCell***   * ***If the starting point of cell switch delay for PCell/PSCell is that UE receives cell switch command, no need to differentiate intra- and inter-frequency, similar like existing HO delay requirements.*** * ***If the starting point of LTM delay requirements is the time when UE receives the RRC LTM configuration, it is necessary to different intra-frequency and inter-frequency case for cell switch delay requirements since measurement delay is covered by cell switch delay and the measurement delay requirements are different for intra- and inter-frequency case.***   ***Proposal 3: for L1/L2-based inter-cell mobility, the cell switch delay equals the applicable RRC procedure delay plus the interruption time.***  ***Proposal 4: the starting point of cell switch delay is that UE receives cell switch command.***  ***Proposal 5: for RACH-based cell switch, the ending point is the transmission of new PRACH to the target cell.***  ***Proposal 6: for RACH-less cell switch, the ending point is the first DL/UL reception/transmission on the indicated beam of the target cell.***  ***Proposal 7: For RACH-based cell switch, the cell switch delay is proposed as:***  ***Tdelay = Tcmd +Tsearch + TIU + Tprocessing + T∆ + Tmargin ms***   * ***Tcmd is RRC procedure delay*** * ***Tsearch is the time required to search the target cell*** * ***TIU is the interruption uncertainty in acquiring the first available PRACH occasion in the new cell*** * ***Tprocessing is time for UE processing*** * ***T∆ is time for fine time tracking and acquiring full timing information of the target cell*** * ***Tmargin is time for SSB post-processing***   ***Proposal 8: Tsearch = 0 for following cases:***   * ***the target cell is known, or*** * ***DL synchronization for candidate cell(s) is performed before cell switch command***   ***Proposal 9: Tprocessing = 0 for the case that DL synchronization for candidate cell(s) is performed before cell switch command***  ***Proposal 10: the time for time tracking T∆ = 0 for the case that DL synchronization for candidate cell(s) is performed before cell switch command*** |
| R4-2300892 | xiaomi | **Proposal 1: The starting point of cell switch delay is the time when UE receives the cell switch command, e.g. MAC CE.**  **Proposal 2: For RACH-based cell switch, the ending point of cell switch delay is the time when UE starts the transmission of new PRACH on the target cell.**  **Proposal 3: For RACH-less cell switch, the ending point of cell switch delay is the time when UE starts to transmit valid CSI report of target cell.**  **Proposal 4: The MAC CE decoding delay should be defined in cell switch delay requirement.**  **Observation 1: The delay of DL synchronization of target cell should not be accounted in cell switch delay requirement.**  **Proposal 5: The UE processing time in term of software processing time and baseband preparation time are considered in cell switch delay requirement.**  **Proposal 6: Fine timing tracking delay is considered in cell switching delay.**  **Proposal 7: For RACH-based cell switch, the RACH uncertainty delay is considered in cell switching delay.**  **Proposal 8: For RACH-less cell switch, the CSI reporting delay is considered in cell switching delay.**  **Proposal 9: The active TCI state switching delay needs to be considered in cell switch delay requirement.**  **Proposal 10: For L1/L2 based inter-cell mobility, the cell switch delay should consider the following components:**   * **Cell switch command processing delay, e.g. MAC decoding delay;** * **UE processing delay, e.g. the software processing time and baseband preparation time;** * **Fine timing tracking delay;** * **RACH uncertainty delay (only for RACH-based cell switch);** * **Valid CSI reporting delay (only for RACH-less cell switch);** * **Active TCI state switching delay;** |
| R4-2300929 | MTK | **Proposal 1: Only define requirements for serving cell change within one CG.**  **Proposal 2: Define cell switch delay requirements for the two scenarios at first:**   * PCell change without SCell change * PSCell change without SCell change.   FFS: define cell switch delay requirements for SCell at PCell/PSCell change.  **Proposal 3: For the scenario “PCell change with SCell change”, PCell switch delay is not extended by SCell changes, i.e., UE is supposed to perform SCell change after cell switch of PCell is finished.**  **Proposal 4: If time permits, define cell switch delay requirements for SCell at PCell change and focus on single non-PUCCH SCell.**  **Proposal 5: The start point of cell switch delay for PCell/PSCell is that UE receives cell switch command.**  **Proposal 6: For RACH-based cell switch, cell switch delay for PCell/PSCell ends at UE transmitting PRACH to the target cell.**  **Proposal 7: For RACH-less cell switch, cell switch delay for PCell/PSCell ends at UE transmitting SR on PUCCH or PUSCH on the target cell.**  **Proposal 8: Known cell conditions in LTM:**   |  | | --- | | **The target cell is known if it has been meeting the following conditions:**  **- During the last 5 seconds before the reception of the cell switch command:**  **- the UE has sent a valid L1 [or L3] measurement report for the target cell and**  **- One of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in clause 9.3,**  **- One of the SSBs measured from the target cell also remains detectable during the cell switch delay according to the cell identification conditions specified in clause 9.3.**  **otherwise it is unknown.** |   **Proposal 9: Known TCI state conditions in LTM:**   |  | | --- | | **The TCI state is known if the following conditions are met:**  **- During the period from the last transmission of the RS resource used for the L1-RSRP measurement reporting for the target TCI state to the completion of cell switch, where the RS resource for L1-RSRP measurement is the RS in target TCI state or QCLed to the target TCI state**  **- cell switch command is received within 1280 ms upon the last transmission of the RS resource for beam reporting or measurement**  **- The UE has sent at least 1 L1-RSRP report for the target TCI state before the cell switch command**  **- The TCI state remains detectable during the cell switching period**  **- The SSB associated with the TCI state remain detectable during the cell switching period**  **- SNR of the TCI state ≥ -3dB**  **Otherwise, the TCI state is unknown.** |   **Observation 1: TΔ may equals to Tfirst-RS. The interruption time of cell switch may be as long as L3 handover.**  **Proposal 10: Further discuss whether UE can perform T/F fine tracking (TΔ) if needed at first and then L1/L2/L3 processing (Tprocessing,2) to reduce the interruption time during cell switch.**  **Observation 2: If the target cell is an active SCell, L1 reconfiguration is necessary, and it is up to NW configuration whether L2/L3 reconfiguration is needed.**  **Observation 3: If the target cell is an inter-frequency cell of source SpCell, L1 reconfiguration is necessary.**  **Observation 4: For intra-frequency cell switch, L1 reconfiguration may be needed depending on NW configuration.**  **Proposal 11: To avoid defining too much Tprocessing,2 values for different scenarios, suggest focusing only on the typical scenarios and classifying the scenarios into limited groups.**  **Proposal 12: Categorize all the scenarios into at most four groups depending on if L2/L3 reconfiguration or L1 reconfiguration is needed:**   |  |  |  |  | | --- | --- | --- | --- | |  | **L2/L3 reconfigu**  **ration** | **L1 reconfigu**  **ration** | **Typical scenario** | | **Group**  **#1** | **Y** | **Y** | * **intra-DU or Inter-DU, intra-frequency or inter-frequency cell switch with L1 and L2/L3 reconfiguration** | | **Group**  **#2** | **N** | **Y** | * **intra-DU or Inter-DU, intra-frequency or inter-frequency cell switch without L2/L3 reconfiguration but with L1 reconfiguration:**   + **including switch to active SCell without L2/L3 reconfiguration** | | **Group**  **#3** | **N** | **N** | * **intra-frequency cell switch without L1/L2/L3 reconfiguration, maybe intra-DU or inter-DU** | | **Group**  **#4** | **Y** | **N** | * **intra-frequency cell switch with L2/L3 reconfiguration, maybe intra-DU or inter-DU** |   **Proposal 14: In cell switch delay requirements, the baseline is:**   * **TΔ=1 Tfirst-RS,** **Tmargin = 2ms**   + **FFS: whether TΔ and Tmargin can be omitted under certain conditions.**   **Proposal 15: When TCI state is indicated together with cell switch command, only define cell switch delay requirements for known TCI state case and not define requirements for unknown TCI state case.**  **Proposal 16: Only consider known cell case for RACH-less cell switch, i.e. Tsearch=0.**  **Proposal 17: For RACH-based cell switch of PCell/PSCell:**   * **Tsearch=0 when target cell is known or target cell is an active scell,** * **FR1: If the target cell is an unknown intra-frequency cell of the source cell and the target cell Es/Iot≥-2 dB, then Tsearch = Trs ms. If the target cell is an unknown inter-frequency cell of the source cell and the target cell Es/Iot≥-2 dB, then Tsearch = 3\* Trs ms.** * **FR2-1: If the target cell is an unknown intra-frequency cell of the source cell and the target cell Es/Iot≥-2 dB, then Tsearch = 8\* Trs ms. If the target cell is an unknown inter-frequency cell of the source cell and the target cell Es/Iot≥-2 dB, then Tsearch = 8\*3\* Trs ms.**   **Proposal 18: For PCell/PSCell switch delay, extra TCI state switching time is not needed.**  **Proposal 19: Regarding L1/L2 inter-cell mobility execution time, wait for RAN2 progress.**  **Proposal 20: Wait for RAN2 progress and then further discuss how to make sure cell switch command arrive too early after candidate cells configuration.** |
| R4-2301055 | ZTE | ***Proposal 1. Define cell switch delay requirements at least for the two scenarios:***   * ***PCell change without SCell change*** * ***PSCell change without SCell change***   ***Proposal 2. UE performs the first DL/UL reception/transmission on the indicated beam of the target cell for RACH-lsee case.***  ***Proposal 3. For RACH-less case***  ***Tdelay = Tcmd + Tprocessing + Tsearch + T∆ + Tmargin + TIU***  ***where, TIU is the uncertainty in the first DL/UL reception/transmission on the indicated beam.***  ***Proposal 4. For intra-DU scenario, UE processing time could been reduced.***  ***Proposal 5. FFS to add TCI state switching time in cell switch delay.*** |
| R4-2301660 | OPPO | **Proposal 1: Support to not define cell switch delay requirements for the case “PCell change with PSCell change” in this release.**  **Proposal 2:**   * **For RACH-less case (if supported), the timeline for L1/L2-based inter-cell mobility is defined as the time from UE receives the cell switch command to UE performs the first DL/UL reception/transmission on the indicated beam of the target cell.** * **For RACH-based case (if supported), the timeline for L1/L2-based inter-cell mobility is defined as the time UE receives the cell switch command to UE starts transmission of the new uplink PRACH channel to the target cell.**   **Proposal 3: DL1/L2\_mobility = Tcmd + Tinterrupt, where Tinterruption includes all the other components in L1/L2 inter-cell mobility delay except L1/L2 command processing delay (Tcmd).**  **Proposal 4: Consider known TCI state only and extra TCI state switching delay is not needed.**  **Proposal 5: L1/L2 based inter-cell mobility delay should consider at least the following components**   * **Tcmd : L1/L2 command processing delay, e.g. MAC/DCI decoding time** * **Tprocessing : UE processing time including MAC/RLC reset (when configured), RF retuning and baseband retuning** * **Cell search time: if the target/candidate cell is assumed to be known or current SCell, Tsearch = 0** * **TΔ : fine timing tracking time** * **Tmargin: SSB or CSI-RS post-processing** * **TIU: Interruption uncertainty in acquiring the first available PRACH occasion in the new cell or the first DL/UL reception/transmission on the indicated beam** |
| R4-2301706 | vivo | **Proposal 1 In R18, RAN4 discuss the RRM requirements for the following scenarios of cell switch:**  **Scenario 1: PCell switch without SCell switch**  **Scenario 2: PSCell switch without SCell switch**  **Scenario 3: PCell switch with SCell switch**  **Scenario 4: PSCell switch with SCell switch**  **Proposal 2 For PCell change without SCell change, and for PSCell change without SCell change, the SCell may be**   * **not configured in both the source and target cell group, or** * **not activated in both the source and target cell group, or** * **configured and activated, but not changed in both the source/target cell group.**   **Proposal 3 RAN4 should prioritize the discussion on RRM requirements for the following subset of scenarios**   * **Scenario 1a: PCell switch, and the target PCell is current deactivated SCell.** * **Scenario 2a: PSCell switch, and the target PSCell is current deactivated SCell.** * **Scenario 3a: PCell switch with SCell switch, the target PCell is current activated SCell, and current PCell becomes activated SCell.** * **Scenario 4a: PSCell switch with SCell switch, the target PSCell is current activated SCell, and current PSCell becomes activated SCell.**   **Proposal 4 RAN4 works for a general form of delay requirements for all the agreed scenarios, and leave the value of some delay components as scenario-dependent.**  **Proposal 5 Specify LTM delay requirements based on the Figure 2-1, while considering 2 types of scenarios for potential test cases design:**   * **Scenario Type A: UE performs synchronization, TCI state switching, CSI reporting and RACH after cell switch command is received. In this scenario, for the concern period in the testing, the starting point of cell switch is the time UE receives cell switch command, and the end point is the time when UE transmitting PRACH to the target cell.** * **Scenario Type B: UE performs synchronization, TCI state switching, CSI reporting and RACH before cell switch command is received, e.g. switch between SpCell and SCell, or switch between ICBM serving cell and the cell with additional PCI. In this scenario, for the concern period in the testing, the starting point of cell switch is the time UE receives cell switch command, and the end point is the time when UE performs the first DL/UL reception/transmission on the indicated beam of the target cell.** |
| R4-2301827 | Huawei | **Proposal 1: Specify cell switch requirements for the following scenarios:**  **- Target Pcell/SCell is not current SCell/PCell, and**  **- Target Pcell/SCell is current SCell/PCell.**  **Proposal 2: Cell switch delay can be specified as:**   * **For RACH-less case, it is defined as the time UE receives the cell switch command to UE performs the first DL/UL reception/transmission on the indicated beam of the target cell (depends on RAN1/RAN2 conclusion).** * **For RACH-based case, it is defined as the time UE receives the cell switch command to UE starts transmission of the new uplink PRACH channel to the target cell.**   **Observation 1：The processing time of cell switch command (MAC CE) would be decreased compared with RRC procedure delay.**  **Observation 2: Tprocessing has rooms to be reduced.**  **Observation 3: If DL coarse synchronization is performed before cell switch, Tsearch is zero.**  **Observation 4: If SSB based fine synchronization is performed before cell switch, Tdelta is zero.**  **Observation 5: If SSB based fine synchronization is performed before cell switch, TCI state switch delay may not be needed.**  **Observation 6: For RACH-based cell switch, Tiu can be reused. For RACH-less based cell switch, Tiu is zero.**  **Proposal 3: There is almost no interruption during cell switch procedure when target Pcell/SCell is current SCell/PCell.** |
| R4-2302244 | Nokia, Nokia Shanghai Bell | *Observation 1: Minimising LTM switch delay will help UE and network to minimise buffering (UL and DL)*  *Proposal 1: Lowest delay scenario for LTM should be based on beam switch delay*  *Proposal 2: LTM is very different from legacy L3 HO. MAC / RLC reset, BB retuning and RF retuning scenarios for LTM are captured in TLTM-processing instead of Tprocessing2*  *Proposal 3: TLTM-processing is 0ms depending in some conditions (no extra processing needed).*  *Proposal 4: Tsearch = 0 when the cell is known. LTM target cell is always assumed to be known prior to LTM Cell switch command, at least in Rel-18.*  *Proposal 5: UE performs pre-processing of LTM cell switch target cell prior to LTM switch command.*  *Proposal 6: RAN4 to discuss if UE can perform RRC pre-processing immediately when RRC configuration arrives*  *Proposal 7: When the RRC configuration is not changed, TRRC = 0ms*  *Proposal 8: RRC processing delay after the LTM cell switch command is 0 when there are no configuration changes.* |
| R4-2302245 | Nokia, Nokia Shanghai Bell | **Proposal 1: Like in LTE Rel-14, the network can indicate to the UE whether the TA of the target cell is the same as source cell. When TA is known, the TIU = 0ms**  **Proposal 2: FFS if any other RACH-less approaches need to be supported based on RAN1 & RAN2 agreements.** |
| R4-2302660 | Ericsson | 1. RAN4 to agree to specify HO and SCell change requirements for following case    1. LTM HO    2. LTM HO with SCell change    3. LTM HO with direct SCell activation 2. RAN4 to define LTM HO with SCell change and LTM HO with direct SCell activation after defining the requirements of LTM HO. 3. If UE need to perform RACH after receiving cell switch command, delay requirement for the LTM HO is Tcmd + Tprocessing,2 + Tsearch + T∆ + Tmargin+ TIU. Where the individual components are for FFS. 4. If UE need not perform RACH after receiving cell switch command, delay requirement for the LTM HO is Tcmd + Tprocessing,2. Where the Tcmd and Tprocessing,2 are FFS. 5. RAN4 to study interruption requirements due to PRACH transmission 6. RAN4 to discuss the DL synchronization requirements and the number of cells for which DL pre-synchronization can be maintained at the UE. |
|  |  |  |

## Open issues summary

### Sub-topic 3-1 General and Principles

*RAN2 has agreed to support the following scenarios in LTM (L1/L2 triggered mobility).*

|  |
| --- |
| *RAN2 LS R2-2211061*   * L1L2 based mobility supports the following CA scenarios:   PCell change without SCell change  PCell change with SCell change   * Support NR-DC scenario in L1L2 based mobility, at least for the PSCell change without MN involvement case, i.e. intra-SN. |

**Issue 3-1-1: Whether define cell switch delay requirements for the case “PCell change with PSCell change”**

|  |
| --- |
| *From WID*  *Note 3: The procedure of L1/L2 based inter-cell mobility are applicable to the following scenarios:*   * + - *Standalone, CA and NR-DC case with serving cell change within one CG*     - *…… （omitted）* |

*“without MN involvement” refers to that cell switch command for SCG is sent from SN without coordination with MN. It is possible that PCell is also switched as no coordination between MN and SN.*

* Proposals
  + Option 1 (Apple, Intel, CATT, MTK, OPPO): Only define requirements for serving cell change within one CG, e.g., not define cell switch delay requirements for the case “PCell change with PSCell change”.
  + Option 2 (CMCC): Define cell switch delay requirements for NR-DC scenario PSCell change without MN involvement.
* Recommended WF
  + Recommend agree on Option 1.

**Issue 3-1-2:** **Define cell switch delay requirements for SpCell change without SCell change**

*There is another proposal from vivo considering whether SCell is configured/activated or not. It is not clear to moderator the impact on the delay requirements and not captured. If there is potential impact on the delay requirements, please clarify further.*

* Proposals
  + Option 1 (Apple, CATT, MTK, Intel, CMCC, ZTE, vivo, Huawei, Ericsson): Define cell switch delay requirements for:
    - PCell change without SCell change
    - PSCell change without SCell change
* Recommended WF
  + Recommend agree on Option 1.

**Issue 3-1-3: Whether to define cell switch delay requirements for SpCell change with SCell change**

*Some company has mentioned the scenario “SpCell change with direct SCell activation”, in moderator’s understanding, “SpCell change with direct SCell activation” means “SpCell change with SCell change” plus SCell activation. RAN2 haven’t agreed to support “SpCell change with SCell activation” yet. They also haven’t concluded whether SCell is activated or deactivated after “SpCell change with SCell change”. If SCell is deactivated after “SpCell change with SCell change”, RAN4 don’t need to discuss this issue. Moderator thinks it is still not mature to discuss this issue.*

|  |
| --- |
| *RAN2#119bis*   * FFS if it should be possible to perform SCell activation/deactivation (amongst SCells associated with the candidate configuration) simultaneously with L1 L2 mobility trigger MAC CE (if so, FFS how this is determined). |

* Proposals
  + Option 1 (CATT, MTK): The requirements of SpCell change without SCell change are applicable to PCell/PSCell for SpCell change with SCell change. FFS: define delay requirements for SCell change at PCell/PSCell change.
    - MTK: If time permits, define cell switch delay requirements for SCell change at PCell change and focus on single non-PUCCH SCell.
  + Option 2 (Apple, Intel): FFS whether to define cell switch delay requirements for the following scenarios:
    - PCell change with SCell change
    - Role change between PCell and SCell in the same CG.
  + Option 3 (Huawei, CMCC, vivo, Ericsson): Specify cell switch requirements for the following scenarios:
    - Target Pcell/SCell is not current SCell/PCell, and
    - Target Pcell/SCell is current SCell/PCell.
* Recommended WF
  + Wait for RAN2 progress.

**Issue 3-1-4: Principles to follow and factors to consider when specify cell switch delay requirements**

*These proposals are not mutually exclusive. In moderator’s view, we can follow proposal 1 in general, and it is important to be clear about whether and how different factors would impact any components of cell switch delay. Moderator suggests:*

*RAN4 works for a general form of cell switch delay requirements and leave the value of some delay components as scenario-dependent, e.g.*

* *FR1 to FR1, FR1 to FR2, FR2 to FR1, FR2 to FR2*
* *With pre-sync and without pre-sync cases*
* *When one of SCells is promoted to PCell, whether the SCell is for DL-only or both DL/UL*
* *intra- and inter-frequency cell switch*
* *FFS*

*Companies are encouraged to analyse the impact on the components of cell switch delay of each factor.*

* Proposals
  + Proposal 1 (Apple, vivo): RAN4 works for a general form of delay requirements for all the agreed scenarios, and leave the value of some delay components as scenario-dependent.
  + Proposal 2 (Intel): Re-use legacy L3 HO requirement structure. The requirement is classified based on FR, i.e. FR1 to FR1, FR1 to FR2, FR2 to FR1, FR2 to FR2. During each scenario, intra-f and inter-f are further differentiated.
  + Proposal 3 (Intel): Need to consider pre-sync and without pre-sync cases.
  + Proposal 4 (QC): When one of SCells is promoted to PCell upon LTM-based handover, RAN4 to discuss whether and how to differently define LTM based handover delay and interruption requirements depending on whether the SCell is for DL-only or both DL/UL. It is also up to decisions from other working groups.
  + Proposal 5 (Nokia): RAN4 specifies cell switch delay requirements for intra- and inter-frequency cases separately
  + Proposal 6 (CMCC):
    - If the starting point of cell switch delay for PCell/PSCell is that UE receives cell switch command, no need to differentiate intra- and inter-frequency, similar like existing HO delay requirements.
    - If the starting point of LTM delay requirements is the time when UE receives the RRC LTM configuration, it is necessary to different intra-frequency and inter-frequency case for cell switch delay requirements since measurement delay is covered by cell switch delay and the measurement delay requirements are different for intra- and inter-frequency case.
* Recommended WF
  + RAN4 works for a general form of cell switch delay requirements and leave the value of some delay components as scenario-dependent, e.g.
    - FR1 to FR1, FR1 to FR2, FR2 to FR1, FR2 to FR2
    - With pre-sync and without pre-sync cases
    - When one of SCells is promoted to PCell, whether the SCell is for DL-only or both DL/UL
    - intra- and inter-frequency cell switch
    - FFS
  + Companies are encouraged to analyse the impact on the components of cell switch delay of each factor.

**Issue 3-1-5: LTM delay requirements**

* Proposals
  + Option 1 (CATT, MTK): Suggested not to define the LTM delay requirement.
* Recommended WF
  + Not define the LTM delay requirement which starts from UE receives RRC configuration on candidate cell(s).

### Sub-topic 3-2 Timeline of cell swith delay for Pcell/PSCell

*Background: RAN2 had a discussion on the time chart of L1/L2 inter-cell mobility (R2-2209256). As pointed out by some companies, the terminology “interruption” used in RAN2’s assumption as in Figure 1 and RAN2’s LS R2-2209257 is different from conventional definition in RAN4.*

**Timeline

Description automatically generated with low confidence**

*Figure 1. Components of mobility latency for L1/L2-based inter-cell mobility (from RAN2)*

**Issue 3-2-1: Starting point of cell switch delay for PCell/PSCell**

* Proposals
  + Option 1 (Apple, CTC, Intel, CATT, CMCC, xiaomi, MTK, OPPO, Huawei): UE receives cell switch command.
* Recommended WF
  + Recommend agree on Option 1.

**Issue 3-2-2: Ending point of RACH-based cell switch delay for PCell/PSCell**

* Proposals
  + Option 1 (Apple, CTC, Intel, CATT, CMCC, xiaomi, MTK, OPPO, Huawei): For RACH-based cell switch, cell switch delay for PCell/PSCell ends at UE transmitting PRACH to the target cell.
* Recommended WF
  + Recommend agree on Option 1.

**Issue 3-2-3: Ending point of RACH-less cell switch delay for PCell/PSCell**

*It is not clear to moderator whether “the first DL/UL reception/transmission” in Option 2 is “DL reception and UL transmission” or “DL reception or UL transmission”.*

* Proposals
  + Option 1 (Apple, MTK): UE performs the first UL transmission on the indicated beam of the target cell.
  + Option 2 (CTC, CMCC, ZTE, OPPO, Huawei): UE performs the first DL/UL reception/transmission on the indicated beam of the target cell.
  + Option 3 (xiaomi): UE starts to transmit **a new PUSCH on the target cell**.
* Recommended WF
  + Need more discussion.

**Issue 3-2-4: Procedure of cell switch**

* Proposals
  + Option 1 (MTK): Further discuss whether UE can perform T/F fine tracking (TΔ) if needed at first and then L1/L2/L3 processing (Tprocessing,2) to reduce the interruption time during cell switch.
* Recommended WF
  + Need more discussion.

### Sub-topic 3-3 Detail of cell swith delay requirements for Pcell/PSCell

*For information:*

**Timeline

Description automatically generated with low confidence**

*Figure 2 Time chart of L1/L2 inter-cell mobility in R2-2209256*

*Table in R2-2209256*

|  |  |
| --- | --- |
| Components | Meaning |
| Tcmd | Time for processing L1/L2-command (HARQ and parsing) |
| Tprocessing,2 | Time for UE processing. This may include L2/3 reconfiguration, RF retuning, baseband retuning, security update if needed, etc. |
| Tsearch | Time required to search the target cell |
| TΔ | Time for fine tracking and acquiring full timing information |
| Tmargin | Time for SSB or CSI-RS post-processing |
| TIU | interruption uncertainty in acquiring the first available PRACH occasion in the new cell |

**Issue 3-3-1: RACH-based Cell switch delay for Pcell/PSCell**

* Proposals
  + Option 1 (Apple, CTC, CMCC, xiaomi, OPPO, [Ericsson]): Tdelay = Tcmd + Tprocessing + Tsearch + T∆ + Tmargin + TIU, where TIU is the uncertainty in acquiring the first available PRACH occasion in the new cell.
* Recommended WF
  + Recommend agree on that the baseline Tdelay = Tcmd + Tprocessing + Tsearch + T∆ + Tmargin + TIU, where TIU is the uncertainty in acquiring the first available PRACH occasion in the new cell.
    - FFS: the exact value of each component. Some components can be 0 in certain cases, if agreed.
    - FFS: add other component(s).

**Issue 3-3-2: RACH-less Cell switch delay for Pcell/PSCell**

* Proposals
  + Option 1 (Apple, Xiaomi): Tdelay = Tcmd + Tprocessing + Tsearch + T∆ + Tmargin + TIU,

where TIU is the uncertainty in acquiring the first PUSCH transmission occasion or SR on PUCCH.

* + Option 3 (CTC, ZTE, OPPO): Tdelay = Tcmd + Tprocessing + Tsearch + T∆ + Tmargin + TIU,

where TIU is the uncertainty in the first DL/UL reception/transmission on the indicated beam

* + Option 4 (Ericsson): Tdelay = Tcmd + Tprocessing
* Recommended WF
  + Recommend agree on that the baseline Tdelay = Tcmd + Tprocessing + Tsearch + T∆ + Tmargin + [TIU or],
    - FFS: the ending point
    - FFS: the exact value of each component. Some components can be 0 in certain cases, if agreed.
    - FFS: add other component(s).

**Issue 3-3-3: Processing time: Tprocessing**

* Proposals
  + Option 1 (CTC, Huawei, CMCC, ZTE, Nokia): The time for UE processing could be reduced if some procedures have been done before UE receive the cell switch command or for some scenarios.
    - Option 1a (CMCC): Tprocessing = 0 for the case that DL synchronization for candidate cell(s) is performed before cell switch command
    - Option 1b (ZTE): For intra-DU scenario, UE processing time could be reduced.
    - Option 1c (Nokia): LTM is very different from legacy L3 HO. MAC / RLC reset, BB retuning and RF retuning scenarios for LTM are captured in TLTM-processing instead of Tprocessing2. TLTM-processing is 0ms depending in some conditions (no extra processing needed).
  + Option 2 (Apple): Reuse execution time defined in CHO as the processing time in LTM cell switch delay requirements.
  + Option 3 (QC): RAN4 to not assume UE can always finish a processing of RRC configurations for LTM cells before LTM handover command reception, e.g. the processing and loading the configuration before the LTM handover command reception can be limited to measurement related configurations of the LTM cells. And RAN4 to not assume the processing and loading the measurement configuration of the LTM cell before LTM handover command reception means the entire downlink configuration of the LTM target cell is processed and loaded.
  + Option 4 (MTK):
    - To avoid defining too much Tprocessing,2 values for different scenarios, suggest focusing only on the typical scenarios and classifying the scenarios into limited groups.
    - Categorize all the scenarios into at most four groups depending on if L2/L3 reconfiguration or L1 reconfiguration is needed:

|  |  |  |  |
| --- | --- | --- | --- |
|  | L2/L3 reconfiguration | L1 reconfiguration | Typical scenario |
| Group#1 | Y | Y | * intra-DU or Inter-DU, intra-frequency or inter-frequency cell switch with L1 and L2/L3 reconfiguration |
| Group#2 | N | Y | * intra-DU or Inter-DU, intra-frequency or inter-frequency cell switch without L2/L3 reconfiguration but with L1 reconfiguration:   + including switch to active SCell without L2/L3 reconfiguration |
| Group#3 | N | N | * intra-frequency cell switch without L1/L2/L3 reconfiguration, maybe intra-DU or inter-DU |
| Group#4 | Y | N | * intra-frequency cell switch with L2/L3 reconfiguration, maybe intra-DU or inter-DU |

* + - Tprocessing,2=20ms for intra-FR cell switch and Tprocessing,2=40ms for inter-FR cell switch when software processing for L2/L3 reconfiguration and L1 reconfiguration is needed. FFS: the value for other groups.
* Recommended WF
  + Need more discussion.

**Issue 3-3-4: T/F fine tracking: TΔ and Tmargin**

* Proposals
  + Option 1 (Apple, MTK, Xiaomi): The baseline is: TΔ=1 Tfirst-RS, Tmargin = 2ms
    - FFS: whether TΔ and Tmargin can be 0 under certain conditions.
  + Option 2 (CMCC, Huawei): TΔ = 0 for the case that DL synchronization for candidate cell(s) is performed before cell switch command
* Recommended WF
  + Need more discussion.

**Issue 3-3-5: Cell search for RACH-based cell switch: Tsearch**

* Proposals
  + Option 1 (Apple, Nokia, Xiaomi): Tsearch=0 when target cell is known
    - Nokia: Target cell is always assumed to be known prior to LTM Cell switch command, at least in Rel-18.
  + Option 2 (CTC, OPPO, [Huawei], MTK): Tsearch equals to 0 when target cell is known or target cell is current active Scell
    - MTK: For unknown cell:
      * FR1: If the target cell is an unknown intra-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = Trs ms. If the target cell is an unknown inter-frequency cell of the source cell and the target cell Es/Iot≥-2 dB, then Tsearch = 3\* Trs ms.
      * FR2-1: If the target cell is an unknown intra-frequency cell of the source cell and the target cell Es/Iot≥-2 dB, then Tsearch = 8\* Trs ms. If the target cell is an unknown inter-frequency cell and the target cell Es/Iot≥-2 dB, then Tsearch = 8\*3\* Trs ms.
  + Option 3 (CMCC): Tsearch equals to 0 when target cell is known or DL synchronization for candidate cell(s) is performed before cell switch command.
* Recommended WF
  + Recommend agree on:
    - For RACH-based cell switch, Tsearch equals to 0 when target cell is known or target cell is current active Scell
      * FFS: whether to define requirements for unknown cell.

**Issue 3-3-6: Cell search for RACH-less cell switch: Tsearch**

* Proposals
  + Option 1 (Apple, CMCC, Xiaomi): If the target cell is known, then Tsearch=0 ms.
  + Option 2 (CTC, [Huawei]): Tsearch equals to 0 when target cell is known or target cell is current active Scell
  + Option 3 (MTK, OPPO, Nokia): Tsearch = 0 and only consider known cell case for RACH-less cell switch
* Recommended WF
  + Recommend agree on:
    - For RACH-less cell switch, Tsearch equals to 0 when target cell is known or target cell is current active Scell.

**Issue 3-3-7:** **TCI state switching time**

* Proposals
  + Option 1 (Intel, MTK, OPPO): no need to add TCI state switching time in cell switch delay.
  + Option 3 (ZTE, Xiaomi): FFS to add TCI state switching time in cell switch delay.
* Recommended WF
  + Need more discussion.

**Issue 3-3-8: Whether to define PCell/PSCell switch delay requirements for unknown TCI state case**

* Proposals
  + Option 1(Intel, MTK, OPPO): Only define cell switch requirement for known TCI state case in LTM.
* Recommended WF
  + Only define cell switch requirement for known TCI state case in LTM.

**Issue 3-3-9:** **Execution time**

* Proposals
  + Option1 (CATT, MTK): wait for RAN2 progress.
    - If the time of UE decoding RRC pre-configuration (Tprocessing, 1) is before the cell switch command, then the extra execution time is not required.
  + Option 2 (Nokia?):
    - UE performs pre-processing of LTM cell switch target cell prior to LTM switch command.
    - RAN4 to discuss if UE can perform RRC pre-processing immediately when RRC configuration arrives
    - When the RRC configuration is not changed, TRRC = 0ms
    - RRC processing delay after the LTM cell switch command is 0 when there are no configuration changes.
* Recommended WF
  + Need more discussion.

**Issue 3-3-10: PL-RS measurement**

* Proposals
  + Option 1 (Intel): If UL TCI state switch is included in cell switch command, possible extra delay is expected due to non-maintained PL-RS. Further discuss whether to consider non maintained PL-RS case.
* Recommended WF
  + Need more discussion.

**Issue 3-3-11: Tinterruption**

* Proposals
  + Proposal 1 (Apple, CTC, CMCC, OPPO): The components of L1/L2 cell switch interruption Tinterruption are the components of L1/L2 inter-cell mobility delay except Tcmd
  + Proposal 2 (Nokia): LTM cell switch interruption time should be minimized, and upper limit should be agreed not to exceed the existing L3 HO interruption time. The target should be to be as close to a beam switch delay as possible.
  + Proposal 3 (Huawei): There is almost no interruption during cell switch procedure when target Pcell/SCell is current SCell/PCell.
* Recommended WF
  + Need more discussion.

### Sub-topic 3-4 Known conditions

**Issue 3-4-1: known cell conditions**

* Proposals
  + Option 1 (CTC, MTK): use the conditions for L3 HO with a bit modification:

|  |
| --- |
| The target cell is known if it has been meeting the following conditions:  - During the last 5 seconds before the reception of the ~~handover~~ cell switch command:  - the UE has sent a valid L1 [or L3] measurement report for the target cell and  - One of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in clause 9.3,  - One of the SSBs measured from the target cell also remains detectable during the ~~handover~~ cell switch delay according to the cell identification conditions specified in clause 9.3.  otherwise it is unknown. |

* Recommended WF
  + Recommend agree on: Use the following known cell condition as a baseline:
    - The target cell is known if it has been meeting the following conditions:
      * During the last 5 seconds before the reception of the cell switch command:
      * the UE has sent a valid L1 or [L3] measurement report for the target cell and
      * One of the SSBs measured from the NR target cell being configured remains detectable according to the cell identification conditions specified in clause 9.3,
      * One of the SSBs measured from the target cell also remains detectable during the cell switch delay according to the cell identification conditions specified in clause 9.3.
    - otherwise it is unknown.

**Issue 3-4-2: known TCI state conditions**

* Proposals
  + Option 1 (MTK): use legacy known TCI state conditions with a bit modification:

|  |
| --- |
| The TCI state is known if the following conditions are met:  - During the period from the last transmission of the RS resource used for the L1-RSRP measurement reporting for the target TCI state to the completion of ~~active TCI state~~cell switch, where the RS resource for L1-RSRP measurement is the RS in target TCI state or QCLed to the target TCI state  - ~~TCI state~~cell switch command is received within 1280 ms upon the last transmission of the RS resource for beam reporting or measurement  - The UE has sent at least 1 L1-RSRP report for the target TCI state before the ~~TCI state~~cell switch command  - The TCI state remains detectable during the ~~TCI state~~cell switching period  - The SSB associated with the TCI state remain detectable during the ~~TCI~~cell switching period  - SNR of the TCI state ≥ -3dB  Otherwise, the TCI state is unknown. |

* Recommended WF
  + Recommend agree on: Use the following known TCI state condition as a baseline:
    - The TCI state is known if the following conditions are met:
      * During the period from the last transmission of the RS resource used for the L1-RSRP measurement reporting for the target TCI state to the completion of cell switch, where the RS resource for L1-RSRP measurement is the RS in target TCI state or QCLed to the target TCI state
        + Cell switch command is received within 1280 ms upon the last transmission of the RS resource for beam reporting or measurement
        + The UE has sent at least 1 L1-RSRP report for the target TCI state before the cell switch command
        + The TCI state remains detectable during the cell switching period
        + The SSB associated with the TCI state remain detectable during the cell witching period

SNR of the TCI state ≥ -3dB

* + - Otherwise, the TCI state is unknown.

### Sub-topic 3-5 Others

**Issue 3-5-1: Potential test cases design:**

*This should be discussed in Performance part.*

* Proposals
  + Option 1 (vivo): Specify LTM delay requirements based on the Figure 2-1, while considering 2 types of scenarios for potential test cases design:
    - Scenario Type A: UE performs synchronization, TCI state switching, CSI reporting and RACH after cell switch command is received. In this scenario, for the concern period in the testing, the starting point of cell switch is the time UE receives cell switch command, and the end point is the time when UE transmitting PRACH to the target cell.
    - Scenario Type B: UE performs synchronization, TCI state switching, CSI reporting and RACH before cell switch command is received, e.g. switch between SpCell and SCell, or switch between ICBM serving cell and the cell with additional PCI. In this scenario, for the concern period in the testing, the starting point of cell switch is the time UE receives cell switch command, and the end point is the time when UE performs the first DL/UL reception/transmission on the indicated beam of the target cell
* Recommended WF
  + No more discussion in Core part.