**3GPP TSG-RAN WG3 Meeting #125 R3-244727**

**Maastricht, NL, Aug 19 - Aug 23, 2024**

**Agenda item: 10.2**

**Source: CMCC (moderator)**

**Title: Summary of SONMDT for LTM**

Document for: Approval

# Introduction

*RAN3#123bis:*

*Work on scenarios of near failure LTM.*

*Work on scenarios for the differentiation of too early LTM, too late LTM and LTM to wrong cell.*

*RAN3#124:*

*MRO for LTM:*

*RAN3 to prioritize MCG LTM over SCG LTM.*

*RAN3 takes RAN2#125-bis agreement on MRO for LTM scenarios as baseline for further study.*

*For failures due to wrong selection of candidate LTM cell, CU is in charge of root cause analysis and performs optimization.*

*For failures due to inappropriate cell switch triggering (e.g. wrong cell selection at cell switch, wrong cell switch timing, …) source DU performs optimization.*

*For failures due to inappropriate cell switch triggering (e.g. wrong cell selection at cell switch, wrong cell switch timing, …) FFS if CU or DU performs root cause analysis.*

*For stage-2, FFS if existing problem definitions (Connection failure due to intra-system mobility) can be reused or if a new chapter needs to be created.*

# For the Chairman’s Notes

*Reuse the existing connection failure definition of too late handover, too early handover, handover to wrong cell for LTM failure case. Add a sentence for LTM handover. FFS to enhance failure scenario.*

*Take the existing detection mechanism descriptions as baseline.*

*For failures due to inappropriate cell switch triggering, CU performs root cause analysis and forwards the RLF report to the DU responsible for the failure.*

*CU needs to forward the RLF related information to DU using existing Access and Mobility Indication procedure, FFS for additional information needed.*

# Agreements from RAN2#127

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| * Only the field description associated to the timeConnFailure IE needs to be updated accordingly. Otherwise, we don’t expect any further specification impact for timeConnFailure and reconnectCellId is foreseen, TBC.
* introduce a new field in RLF report to indicate the LTM recovery cell id.
* RAN2 include the specific access type in the RLF report, i.e. whether it is RA-based or RA-less cell switch. FFS details, e.g. if explicit or implicitly signalled.
* We do not include in the RLF report, the time since the last reception of PDCCH order towards the target cell till reception of cell switch command.
* RA-based access will not be a new triggering condition for the SHR report.
* HO interruption time will not be a new triggering condition for the SHR report
* Reuse the existing approach of using timeUntilReconnection in RLF-report also for LTM failure scenarios.
* We will not define and log timeSinceLTM-Reconfig (like timeSinceCHO-Reconfig) within RLF-report and SHR in LTM failure and near failure cases.
* We will not log interruption time in SON reports (e.g. SHR) for LTM.
* We aim to log some info to deduce the ltmCandidate (similar like choCandidate) in SHR to indicate whether a neighbour cell is an LTM candidate cell or not, TBD if explicit/implicit.
* Log L3 measurements for serving cell, target cell and other LTM candidate cells in RLF report, upon RLF or mobility failure. RAN2 assumes this is already possible with existing spec.
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# Discussion

## The stage2 description for LTM

In last RAN3 meeting, RAN3 make the following agreement on LTM scenarios.

**RAN3 takes RAN2#125-bis agreement on MRO for LTM scenarios as baseline for further study.**

RAN2#125bis made the following agreements on MRO for LTM:

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| * For LTM MRO, RAN2 considers the following three connection failure cases:

- Too late LTM- Too early LTM- LTM to wrong cell* For too late LTM, the following sub-cases are considered but we may down prioritize later (not limiting):

- Case 1a: the UE detects RLF in source cell after receiving LTM candidate configurations and performs reestablishment procedure.- Case 1b: the UE detects RLF in source cell after receiving LTM candidate configurations, selects an LTM candidate cell, detects HOF with the selected LTM cell.- Case 1c: the UE detects RLF in source cell after receiving LTM candidate configurations, and successfully completes LTM execution with the selected LTM candidate cell.* For too early LTM, the following sub-cases are considered but we may down prioritize later (not limiting):

- Case 2a: the UE detects HOF/RLF in the LTM target cell and performs reestablishment procedure with the source cell.- Case 2b: the UE detects HOF/RLF in the LTM target cell, selects the source cell which is also an LTM candidate cell, detects HOF with the source cell, and performs reestablishment procedure.- Case 2c: the UE detects HOF/RLF in the LTM target cell, and successfully completes LTM execution with the selected source cell which is also an LTM candidate cell.* LTM to wrong cell, the following sub-cases are considered but we may down prioritize later (not limiting):

- Case 3a: the UE detects HOF/RLF in the LTM target cell and performs reestablishment procedure with the source cell.- Case 3b: the UE detects HOF/RLF in the LTM target cell, selects an LTM candidate cell which is different from the source or target one, detects HOF with the selected LTM candidate cell, and performs reestablishment procedure.- Case 3c: the UE detects HOF/RLF in the LTM target cell, and successfully completes LTM execution with the selected LTM candidate cell which is different from the source or target one. |

RAN2#126 meeting has agreed to correct the definition of the above case 3a as below:

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| * We correct the definition of scenario 3a as follows: Case 3a: the UE detects HOF/RLF in the LTM target cell and performs reestablishment procedure in a cell other than the source cell and the target cell.
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Based on existing descriptions on LTM failure cases provided by RAN2, some companies propose to reuse existing description in CHO or various modifications to correct or amend the descriptions of LTM or send an LS to RAN2 to clarify the UE behavior. To analysis, we will discuss the description for these three scenarios separately.

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| * For too late LTM, the following sub-cases are considered but we may down prioritize later (not limiting):

- Case 1a: the UE detects RLF in source cell after receiving LTM candidate configurations and performs reestablishment procedure.- Case 1b: the UE detects RLF in source cell after receiving LTM candidate configurations, selects an LTM candidate cell, detects HOF with the selected LTM cell.- Case 1c: the UE detects RLF in source cell after receiving LTM candidate configurations, and successfully completes LTM execution with the selected LTM candidate cell. |

In [1][2][4][6][9][12][13], it is proposed that the existing connection failure definition of too late handover can be reused for LTM failure case.

In [3], it is proposed to capture the following description:

*- Too Late LTM cell switch: an RLF occurs after the UE was configured with at least one LTM configuration; the UE attempts LTM recovery or to re-establish the radio link connection in a candidate cell different from the last serving cell.*

*Editor's note: In the above definition it is FFS if the failed LTM recovery should be considered as a too late LTM switch.*

In [8], it is proposed to capture the following description:

*- Too Late MCG LTM: UE receives configuration for a LTM procedure, while an RLF occurs after the UE has stayed for a long period of time in the serving cell; the UE attempts to re-establish the radio link connection in a different cell.*

In [10], it is proposed to capture the agreements from RAN2 to define the LTM failure scenarios.

In [13], it is proposed that the description should be clear where cell attempt to recovery should be the cell that other than the source cell.

**Q1: How to capture the too late LTM scenario?**

**Moderator summary:**

Reuse the existing connection failure definition of too late handover for LTM failure case.

Add a sentence for LTM handover.

In [13], it is proposed that one more user case needs to be captured:

*The UE detects RLF in source cell after receiving LTM candidate configurations, selects an LTM candidate cell, detects HOF with the selected LTM cell, and the UE performs reestablishment procedure in a cell other than the source cell.*

**Q2: Do companies agree to introduce above scenario?**

**Moderator summary:**

FFS to enhance above failure scenario in BLCR.

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| * For too early LTM, the following sub-cases are considered but we may down prioritize later (not limiting):

- Case 2a: the UE detects HOF/RLF in the LTM target cell and performs reestablishment procedure with the source cell.- Case 2b: the UE detects HOF/RLF in the LTM target cell, selects the source cell which is also an LTM candidate cell, detects HOF with the source cell, and performs reestablishment procedure.- Case 2c: the UE detects HOF/RLF in the LTM target cell, and successfully completes LTM execution with the selected source cell which is also an LTM candidate cell. |

In[1][2][4][6][9][12][13], it is proposed that the existing connection failure definition of too early handover can be reused for LTM failure case.

In [3], it is proposed to capture the following description:

*- Too Early LTM cell switch: an RLF occurs shortly after a successful LTM cell switch from a source cell to a target cell or a LTM cell switch failure occurs during the LTM cell switch procedure; the UE attempts LTM recovery or to re-establish the radio link connection in the source cell.*

In [8], it is proposed to capture the following description:

*- Too Early MCG LTM: a radio link failure occurs shortly after a successful LTM cell switch from a source cell to a target cell, or a failure occurs during the LTM cell switch execution; the UE attempts to re-establish the radio link connection in the source cell.*

In [10], it is proposed to capture the agreements from RAN2 to define the LTM failure scenarios.

**Q3: How to capture the too early LTM scenario?**

**Moderator summary:**

Reuse the existing connection failure definition of too early handover for LTM failure case.

Add a sentence for LTM handover.

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| * LTM to wrong cell, the following sub-cases are considered but we may down prioritize later (not limiting):

- Case 3a: the UE detects HOF/RLF in the LTM target cell and performs reestablishment procedure in a cell other than the source cell and the target cell.- Case 3b: the UE detects HOF/RLF in the LTM target cell, selects an LTM candidate cell which is different from the source or target one, detects HOF with the selected LTM candidate cell, and performs reestablishment procedure.- Case 3c: the UE detects HOF/RLF in the LTM target cell, and successfully completes LTM execution with the selected LTM candidate cell which is different from the source or target one. |

In [1][2][4][6][9][12][13], it is proposed that the existing connection failure definition of LTM to wrong cell can be reused for LTM failure case.

In [3], it is proposed to capture the following description:

- *LTM cell switch to Wrong Cell: an RLF occurs shortly after a successful LTM cell switch from a source cell to a target cell or a LTM cell switch failure occurs during the LTM cell switch procedure; the UE attempts LTM recovery or to re-establish the radio link connection in a cell other than the source cell or the target cell.*

In [6], it is proposed to add the wrong candidate target cell selection case. The definition can be: an RLF occurs shortly after a successful handover from a source cell or a handover failure occurs during the handover procedure; the UE attempts to re-establish the radio link connection in a cell other than the source cell, the target cell and the candidate LTM cells.

In [8], it is proposed to capture the following description:

* *MCG LTM to wrong cell: a radio link failure occurs shortly after a successful LTM cell switch from a source cell to a target cell, or a failure occurs during the LTM cell switch execution; the UE attempts to re-establish the radio link connection in a cell other than the source cell and the target cell.*

In [10], it is proposed to capture the agreements from RAN2 to define the LTM failure scenarios.

**Q4: How to capture the LTM to wrong cell scenario?**

**Moderator summary:**

Reuse the existing connection failure definition of handover to wrong cell for LTM failure case.

Add a sentence for LTM handover.

In [6], it is proposed to add the wrong candidate target cell selection case. The definition can be:

*An RLF occurs shortly after a successful handover from a source cell or a handover failure occurs during the handover procedure; the UE attempts to re-establish the radio link connection in a cell other than the source cell, the target cell and the candidate LTM cells.*

**Q5: Do companies agree to introduce above scenario?**

**Moderator summary:**

Move to the F1 impact discussion.

Besides the failure case description, the detection mechanism for LTM in Stage2 also should be considered. Companies are invited to express the views on reusing existing detection mechanism descriptions (Connection failure due to intra-system mobility) or creating new ones.

**Q6: How to capture the detection mechanism for LTM?**

**Moderator summary:**

Take the existing detection mechanism descriptions as baseline.

## F1 impact

In last meeting, there is an FFS shown as follows:

**For failures due to inappropriate cell switch triggering (e.g. wrong cell selection at cell switch, wrong cell switch timing, …) FFS if CU or DU performs root cause analysis.**

It is still undecided which node performs root cause analysis for failures due to inappropriate cell switch triggering. From the contributions, we summarize the following options:

1. CU identifies the failure type and the cell where failure originated and forwards the RLF report to the source DU, DU performs root cause analysis. [2][3][4][6][7][9][10][11][12]

2. CU performs root cause analysis. [8]

3. If the suitable Cell after failure is one of the candidate target LTM Cells provided by the gNB-CU, but not one of the candidate Cells accepted by the gNB-DU, gNB-DU do the final root cause analysis; else it is gNB-CU do the final root cause analysis. [13]

4. Ask RAN2 whether RRC can analysis L1 measurement and then decide. [1]

**Q7: Which node performs root cause analysis due to inappropriate cell switch triggering?**

**Moderator summary:**

Root cause analysis: failure type

For failures due to inappropriate cell switch triggering, CU performs root cause analysis and forwards the RLF report to the DU responsible for the failure.

Whatever CU or DU performs root cause analysis, majority of companies support that CU needs to forward the RLF related information to DU. The existing Access and Mobility Indication procedure can be reused.

**Q8: Do companies agree CU needs to forward the RLF related information to DU using existing Access and Mobility Indication procedure?**

**Moderator summary:**

CU needs to forward the RLF related information to DU using existing Access and Mobility Indication procedure, FFS for additional information needed.

## RACH-less HO and RACH-based HO

In last meeting, we agree to discuss enhancements related to the information of RACH-less access and RACH-based access for LTM. Currently UE includes RACH information (ra-InformationCommon) in RLF Report if connectionFailureType is HOF and the failed handover is an intra-RAT handover. Some companies think it is beneficial to indicate the RACH based or RACH less LTM execution in the RLF report and SHR report.

In [1][3][8], it is proposed to report RACH-less indication in RLF Report for optimization.

In [2], extending the RLF report for LTM indicates the RACH-based or RACH-less LTM execution.

**Q9: Do companies agree to introduce a RACH-less indication or an indication indicating the RACH-based or RACH-less in RLF report?**

**Moderator summary:**

In [3], it is proposed to include an indication of fallback from RACH-less LTM to RACH-based LTM (e.g. TA validity timer has expired or that UE failed to autonomously calculate TA) inside *RA-InformationCommon* to enable logging it in the RA-report and the SHR;

**Q10: Do companies agree to introduce a RACH-less indication in the RA-report and the SHR?**

**Moderator summary:**

## Near failure case for LTM

Companies provide various LTM specific trigger condition(s) for SHR.

1. The legacy timer trigger conditions, i.e., T310, T312, T304; [2][3][12]
2. RACH fallback information, i.e., LTM cell switch is not performed or performed but not successful. [2][3][4][8][11][13]
3. HO interruption time [4]
4. Failed and successfully recovery beam of target PCell, TCI state configuration of the target PCell, L1 measurement in SHR report. [13]
5. Number of RLC retransmissions of the first UL transmission in RLC AM. [2]
6. TA validation time related triggering condition [6][8]

**Q11: Which LTM specific trigger condition(s) for SHR can be adopted?**

**Moderator summary:**

## Ping-Pong Issue

In LTM, UE may perform frequent and repeated handover within candidate cell list. Some companies propose that Ping-Pong issue during LTM triggered frequent and repeated handover needs consideration. Thus, the UHI enhancement for LTM is introduced to identify the intra-gNB ping-pong issue. [1][4][9]

**Q12: Do companies agree to identify Ping-Pong issue during LTM triggered frequent and repeated handover?**

**Moderator summary:**

**Q13: If Q12 is agreed, do companies agree to enhance UHI to identify the ping-pong issue?**

**Moderator summary:**

# Conclusion, Recommendations [if needed]

If needed

# References

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| 1 | [R3-244264](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125%5CDocs%5CR3-244264.zip) | Discussion on MRO for mobility (CATT) |
| 2 | [R3-244335](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125%5CDocs%5CR3-244335.zip) | MRO Enhancements for LTM and CHO with Candidate SCG(s) (Nokia) |
| 3 | [R3-244433](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125%5CDocs%5CR3-244433.zip) | MRO enhancements for LTM and CHO with candidate SCGs (Ericsson) |
| 4 | [R3-244278](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125%5CDocs%5CR3-244278.zip) | (TP for SON BLCR for 38.300, 38.401, 38.473, 37.340) MRO enhancement for R18 mobility mechanisms (Huawei) |
| 5 | [R3-244160](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125%5CDocs%5CR3-244160.zip) | MRO for LTM (NEC) |
| 6 | [R3-244207](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125%5CDocs%5CR3-244207.zip) | Discussion on MRO for LTM (Samsung) |
| 7 | [R3-244256](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125%5CDocs%5CR3-244256.zip) | Discussion on MRO enhancements for LTM (China Telecom) |
| 8 | [R3-244306](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125%5CDocs%5CR3-244306.zip) | Discussion on MRO for LTM (Lenovo) |
| 9 | [R3-244430](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125%5CDocs%5CR3-244430.zip) | MRO enhancements for R18 mobility mechanisms (Qualcomm Incorporated) |
| 10 | [R3-244533](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125%5CDocs%5CR3-244533.zip) | Discussion on MRO Enhancements (China Unicom) |
| 11 | [R3-244536](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125%5CDocs%5CR3-244536.zip) | Discussion on MRO issues related to LTM (LG Electronics Inc.) |
| 12 | [R3-244604](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125%5CDocs%5CR3-244604.zip) | Discussion on MRO enhancements for LTM (CMCC) |
| 13 | [R3-244615](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_125%5CDocs%5CR3-244615.zip) | (TP for TS 38.300 TS37.340)Discussion on MRO (ZTE Corporation) |