3GPP TSG-RAN WG3 Meeting #127bis R3-252298

Wuhan, CN, April 7–11, 2025

Agenda Item: 10.2

Source: Lenovo (moderator)

Title: SoD of MRO for LTM

Document for: Approval

# For the Chairman’s Notes

Propose to capture the following:

BFR shortly after successful LTM cell switch to the wrong beam

**RAN3 support network-based solution for the case of BFR shortly after a successful LTM cell switch**

**The target DU identifies the BFR happened in UE shortly after successful LTM cell switch caused due to wrong beam.**

**In case that the source DU selects a wrong beam among candidate beam list, the source DU is responsible for MRO optimization**

**In case that the target DU provides a wrong candidate beam list, the target DU is responsible for MRO optimization**

**Target DU needs to send the recovered beam information to CU and CU forwards it to source DU.**

**Open issues:**

**Whether the case of BFR shortly after a successful LTM cell switch is considered as a new near failure case?**

**FFS on the details of the recovered beam information.**

**When target DU sends the recovered beam information to CU, immediately or later?**

**Whether CU needs to send the old beam information to source DU or source DU can keep the UE context?**

**FFS if/how the solution for case 1 could also be used for the case of LTM cell switch failure due to wrong beam (case 2)**

LTM failure due to outdated TA

**MRO will cover the scenario that RACH-less LTM fails including outdate TA and UE performs RACH based LTM.**

**RAN3 will not consider the case of LTM cell switch failure due to outdated TA calculated by UE.**

**For PDCCH order triggered early TA acquisition, RAN3 consider the case of RACH-less LTM fails due to outdate TA and UE performs RACH-based LTM failure recovery to the same cell or RRC re-establishment to the same cell (FFS).**

**FFS: whether LTM failure due to outdated TA is defined as a new failure case or it can covered by existing failure case.**

**[For online discussion]: whether UE based solution or network based solution is used for LTM failure due to outdated TA.**

Network based or UE based solution for TA acquisition type

**[For online discussion]:**

**Will TA acquisition type always be available in the CU? or is there a need for the DU to store and retrieve (partial) UE Context?**

**Network based or UE based solution for TA acquisition type?**

UHI and ping-pong issue

**[For online discussion]:**

**RAN3 to discuss which option to be agreed for UHI and ping-pong issue:**

* **Option 1: CU sends the UHI to DU upon successful LTM cell switch/UHI is updated, e.g. via the CU-DU CELL SWITCH NOTIFICATION message.**
* **Option 2: CU sends the UHI to DU when LTM ping-pong is detected, e.g. via the ACCESS AND MOBILITY INDICATION message.**
* **Option 3: CU sends an indication to DU that LTM ping-pong has occurred, e.g. via the CU-DU CELL SWITCH NOTIFICATION message.**
* **Option 4: CU filters the LTM related UHI, and sends to DU via UE Context Setup Request, UE Context Modification Request or CU-DU CELL SWITCH NOTIFICATION.**
* **Option 5: No need to send UHI from CU to DU.**

Proposed TPs

Stage 2 TP for LTM failure due to outdated TA:

R3-25xxxx is revision of R3-252192 (ZTE)

# Discussion

## LS from RAN2

RAN2 have discussed the issues as below and sent an LS to RAN3 [1]:

* BFR shortly after successful LTM cell switch to the wrong beam (“near failure”), and
* LTM cell switch failure due to wrong beam

On the former issue, RAN2 have acknowledged the issue but agreed not to define a UE-based solution. RAN2 respectfully asks RAN3 to consider defining a network-based solution for this. Furthermore, RAN2 asks RAN3 to see if/how the solution (if specified) could also be used for the latter issue.

### Case 1: BFR shortly after successful LTM cell switch to the wrong beam (“near failure”)

Based on the LS from RAN2, Case 1 is acknowledged, and RAN3 is asked to consider a network-based solution.

**RAN3 consider the case of BFR shortly after a successful LTM cell switch as a new near failure case? Any stage 2 TP to capture the new case (e.g. TS 38.300, TS 38.401)?**

**RAN3 support network-based solution for the case of BFR shortly after a successful LTM cell switch**

Further, we should discuss network-based solution:

**Which node identifies the BFR shortly after successful LTM cell switch caused due to wrong beam? (e.g. CU? or source DU? or target DU?)**

**The target DU identifies the BFR happened in UE shortly after successful LTM cell switch caused due to wrong beam**

**Which node performs corresponding MRO optimization? (e.g. source DU ?)**

**If the source DU selects a wrong beam among candidate beam list, Source DU performs corresponding MRO optimization**

**In case target DU provides a wrong candidate beam list, then the target DU is responsible for MRO optimization**

When above issues can have consensus, the details as following can be further discussed:

**Whether/what information is sent from target DU to CU? e.g. beam/TCI state where failure happened? beam/TCI state for BFR?** **new failure type (e.g. LTM to wrong beam/TCI state)? an (implicit) beam-failure-after-cell-switch indication? percentage of BFR shortly after successful LTM cell switch? UE F1AP ID? C-RNTI?**

**Target DU needs to send recovered beam information (details FFS) to CU and CU forwards it to source DU.**

**When target DU sends the information to CU, immediately or later?**

**CU sends the old beam information to source DU or source DU can keep the UE context?**

**FFS if/how the solution for case 1 could also be used for the case of LTM cell switch failure due to wrong beam (case 2)**

**UE associated message (e.g. UL RRC MESSAGE TRANSFER) or non-UE associated (e.g. DU-CU ACCESS AND MOBILITY INDICATION) message to send information from target DU to CU?**

**Whether/what information is sent from source DU to CU? e.g.** **TCI state which is activated/deactivated via the Candidate Cell TCI States Activation/Deactivation MAC CE? UE F1AP ID? C-RNTI?**

**UE associated message (e.g. DU-CU Cell Switch Notification) or non-UE associated message (e.g. DU-CU ACCESS AND MOBILITY INDICATION) to send information from source DU to CU?**

**Whether/what information is sent from CU to source DU? e.g. beam/TCI state where failure happened? beam/TCI state for BFR? new failure type (e.g. LTM to wrong beam/TCI state)? an (implicit) beam-failure-after-cell-switch indication? UE F1AP ID? C-RNTI? Cell ID?**

**UE associated message (e.g. UE CONTEXT RELEASE COMMAND) or non-UE associated message (e.g. ACCESS AND MOBILITY INDICATION) to send information from CU to source DU?**

### Case 2: LTM cell switch failure due to wrong beam

Case 2 is not acknowledged by RAN2 yet. RAN2 asks RAN3 to see if/how the solution (if specified for Case 1) could also be used for Case 2.

**RAN3 consider the case that: LTM cell switch failure due to wrong beam as a new failure case? Any stage 2 TP to capture the new failure case (e.g. TS 38.300, TS 38.401)?**

If we can have consensus on Case 2 and above network-based solution for Case 1, we further discuss whether network-based solution can also be used for Case 2.

**FRAN3 support network-based solution for the case of LTM cell switch failure due to wrong beam?**

**FFS:RAN3 can support network-based solution for the case of LTM cell switch failure due to wrong beam**

**Reuse the solution for case 1.**

We need to consider RLF report correlation and UE may re-establish to another DU.

Then, we further check the details of network-based solution for Case 2…

## LTM failure due to outdated TA

FFS left in RAN3#126 meeting:

**MRO will cover the scenario that RACH-less LTM fails including outdate TA and UE performs RACH based LTM.**

### UE based TA measurement

For UE based TA measurement, if UE calculated TA value is outdated, since how to calculate TA value is up to UE implementation, this case is out of MRO scope.

**For LTM cell switch failure due to outdated TA calculated by UE, RAN3 would not consider it for MRO**

### PDCCH order triggered early TA acquisition

For PDCCH order triggered early TA acquisition, source DU is in charge of checking the TA validity (e.g., based on a timer in source DU), there is a possibility that the TA validity timer is to be expired when sending the early TA value to the UE. RACH-less LTM may fail due to the outdated TA, when RACH-less LTM cell switch failure occurs, the UE may recover or re-establish the radio link connection to same target cell/beam via RA-based access, the TA used in RA-based access is different from the TA indicated in the LTM Cell Switch Command MAC CE.

**For PDCCH order triggered early TA acquisition, RAN3 consider the case of** **RACH-less LTM fails due to outdate TA and UE performs RACH-based LTM failure recovery to the same cell or RRC re-establishment to the same cell (FFS).**

**Update stage 2 to cover above case.**

**FFS include it in existing text to cover the case or define a new failure case.**

 **Discuss UE based or enwo**

**? Any stage 2 TP to capture the new failure case (e.g. TS 38.300, TS 38.401)?**

If above failure case due to outdated TA can be acknowledged, we further discuss the solutions.

**Which node identifies LTM cell switch failure due to outdate TA? (e.g. CU? or source DU?)**

**Which node performs corresponding MRO optimization? (e.g. source DU?)**

When above issues can have consensus, the details as following can be further discussed:

**Whether/what enhancement is needed for RLF report from UE? e.g. TA value used for failed LTM cell switch? TA value for LTM failure recovery or RRC re-establishment? TA difference between TA in LTM Cell Switch Command MAC CE and TA for recovery/re-establishment cell? an indication of whether the TA used in RACH-less LTM cell switch is provided by the source DU?**

**Whether/what information is sent from target DU to CU? e.g. TA value for LTM failure recovery or RRC re-establishment?**

**UE associated message (e.g. ACCESS SUCCESS) or non-UE associated (e.g. DU-CU ACCESS AND MOBILITY INDICATION) message to send information from target DU to CU?**

**Whether/what information is sent from source DU to CU? e.g.** **TA value configured for RACH-less LTM cell switch? timer duration for checking the TA validity? elapsed or remaining duration of the timer when sending the LTM Cell Switch Command MAC CE?**

**UE associated message (e.g. DU-CU Cell Switch Notification) or non-UE associated message (e.g. DU-CU ACCESS AND MOBILITY INDICATION) to send information from source DU to CU?**

**Whether/what information is sent from CU to source DU? e.g. TA value configured for RACH-less LTM cell switch? TA value for LTM failure recovery or RRC re-establishment? new failure type (e.g. outdated TA, or invalid TA)?**

**UE associated message (e.g. UE CONTEXT RELEASE COMMAND) or non-UE associated message (e.g. ACCESS AND MOBILITY INDICATION) to send information from CU to source DU?**

## UHI and ping-pong issue

RAN3#126 meeting agreed that:

**CU can adjust the candidate Cell list for LTM based on UHI.**

**DU should be able to resolve LTM ping-pong based on information over F1.**

Until now, RAN3 have no consensus on whether/how to forward UHI from CU to DU. There are several options on table.

**RAN3 to discuss which option to be agreed:**

* **Option 1: CU sends the UHI to DU upon successful LTM cell switch/UHI is updated, e.g. via the CU-DU CELL SWITCH NOTIFICATION message.**
* **Option 2: CU sends the UHI to DU when LTM ping-pong is detected, e.g. via the ACCESS AND MOBILITY INDICATION message.**
* **Option 3: CU sends an indication to DU that LTM ping-pong has occurred, e.g. via the CU-DU CELL SWITCH NOTIFICATION message.**
* **Option 4: CU filters the LTM related UHI, and sends to DU via UE Context Setup Request, UE Context Modification Request or CU-DU CELL SWITCH NOTIFICATION.**
* **Option 5: No need to send UHI from CU to DU.**

Another issue is **whether to indicate HO type (e.g. L3 HO or LTM) in UHI**, we can further discuss it if offline/online time allows.

## C-RNTI IE in ACCESS AND MOBILITY INDICATION

It was agreed to add source C-RNTI in ACCESS AND MOBILITY INDICATION message for UE context identification in case of RLF happened in too early LTM or LTM to wrong cell, and the FFS issue is which spec to capture the condition of the source cell C-RNTI, in e.g. TS38.473 or TS38.401.

**Specify the condition of the optional C-RNTI IE in ACCESS AND MOBILITY INDICATION message in TS38.473 or TS38.401? Any TP to be agreed?**

Another raised issue is **whether to add target C-RNTI in the ACCESS AND MOBILITY INDICATION message**, but it relates with the issue of **whether CU needs to forward RLF report to target DU e.g. when RA information exists in RLF report for HOF case**. We can further discuss if time allows.

## Network based or UE based solution for TA acquisition type

RAN2#127bis meeting agreed that unless RAN3 defines a NW-based solution, the UE logs and reports whether and how the UE got the TA value used for a failed LTM switch (gNB indicated or UE determined).

RAN3#127 meeting discussed it but didn’t have consensus, two FFSs as below were left. We should continue the discussion.

**Will TA acquisition type always be available in the CU? or is there a need for the DU to store and retrieve (partial) UE Context?**

**Network based or UE based solution for TA acquisition type?**

**Network based solution**

## SHR enhancements for LTM

### SHR triggers and info in SHR

Some papers discuss SHR triggers and new information to be included in SHR.

**Any new trigger condition for SHR is needed? e.g. a threshold related to number of RLC retransmissions of the first UL transmission in RLC AM for RACH less LTM? BFR shortly after successful LTM cell switch?**

**An indicator of LTM cell switch to distinguish from L3 handover is introduced to SHR report?**

### SHR forwarding mechanism in F1

SHR forwarding mechanism in F1 is also discussed in some papers.

**If the trigger of SHR is T310/T312, which is source cell configured timers, the CU may forward the SHR to the source DU?**

**If the trigger of SHR is T304, which is target cell configured timer, the CU may forward the SHR to the target DU?**

## RRC re-establishment/LTM failure recovery without RLF report

Some papers discuss RRC re-establishment/LTM failure recovery without RLF report for MRO, as well as the enhancements in F1 interface, e.g. CU forwards e.g. source cell information, source C-RNTI, target cell information, reestablishment/recovery cell information, failure type, etc. to source DU.

**RAN3 support RRC re-establishment without RLF report for LTM MRO?**

**RAN3 support LTM failure recovery without RLF report for LTM MRO?**

# Conclusion, Recommendations [if needed]

If needed.

# References

1. R2-2501378, LS on SON for LTM, Apple