3GPP TSG-RAN WG3 Meeting #114e R3-215857

Online, 1 – 11 November 2021

Agenda Item: 10.2.6

Source: Lenovo, Motorola Mobility (moderator)

Title: Summary of Offline Discussion on Mobility Enhancement Optimization

Document for: Approval

# Introduction

**CB: # SONMDT8\_MobilityEnc**

**- Check company view on ambiguous CHO failure across two CHO configurations.**

**- Check company view on separate failure type detection for CHO in stage 2**

**- Check company view on UE context for CHO**

**- Separate failure type detection for CHO in stage 2?**

**- Check the user case that both a HO Success Report and an RLF report are generated for the same HO.**

**- Provide CRs, if agreeable.**

(Lenovo - moderator)

Summary of offline disc R3-215857

Phase I：Please provide your inputs before UTC time 16:00 Thursday 4th Nov.

Phase II：TBD.

# For the Chairman’s Notes

The following proposals can be agreed:

Propose the following:

R3-20xxxa, R3-20xxxc merged

R3-20xxxc rev [in xxxg] – agreed

R3-20xxxd rev [in xxxh] – agreed

R3-20xxxe rev [in xxxi] – agreed

R3-20xxxf rev [in xxxj] – endorsed

Propose to capture the following:

**Agreement text…**

**Agreement text…**

**WA: carefully crafted text…**

**Issue 1: no consensus**

**Issue 2: issue is acknowledged; need to further check the impact on xxx. May be possible to address with a pure st2 change. To be continued…**

# Discussion

## Enhancements for CHO

### Ambiguous CHO failure across two CHO configurations

In RAN3#113-e meeting, an ambiguous CHO failure case across two CHO configurations was issued in [1] as Figure 1 showed, but there is no consensus after the email discussion [2]. Here, we continue to discuss whether the use case on ambiguous CHO failure across two CHO configurations is valid.



* *For CHO2, it will be a too late handover failure type because CHO2 is configured but the CHO2 execution is not initiated prior to RLF;*
* *If UE reported timer, i.e. from CHO1 execution to RLF, is smaller than the configured threshold, it may be a too early or handover to wrong cell failure type*

**Figure 1 CHO failure across two CHO configurations**

In [3], it is proposed that no matter whether the UE only reports a timer related to the CHO2 or both a timer related to CHO2 and a timer related to CHO1, there is no ambiguous CHO failure based on network analysis. In [4], it is stated that the start time of UE report timer is start at CHO1 and end with complete of CHO1, then the timer is reset and start at CHO2 and end with the RLF occur. Thus, there is no ambiguous for CHO failure across two CHO configurations. [5] also think there is no ambiguous CHO failure.

[6] state that the two consecutive CHO procedures can be separated by CHO execution not CHO configuration, and it depends on how to define *timeConnFailure* IE, since RAN2 is discussing how to define *timeConnFailure* IE in RLF Report but no consensus yet, RAN3 may wait for RAN2 progress and then discuss how to solve ambiguous CHO failure type detection.

**Q1: Companies are invited to provide their views on whether the ambiguous CHO failure across two CHO configurations is valid.**

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| --- | --- |
| **Company** | **Comment** |
| Lenovo and Motorola Mobility | No, there is no ambiguity.For CHO2, based on RAN2 agreements, a timer that elapsed between the CHO execution and the corresponding latest CHO configuration received for the selected target cell, i.e. timeSinceCHOReconfig would be triggered when CHO2 configuration is received, since RLF occurs before CHO2 is executed, in this case, the timer timeSinceCHOReconfig for CHO2 in the RLF report from the UE is absent, thus the network can detect CHO2 is too late. |
| Nokia | The analysis in [3] seems correct. |
| CATT | In our opinion, currently the ambiguity exists in CHO failure type detection. So, we shall introduce a time requirement for detecting CHO too late failure type in current stage 2 text. As for what timer shall be selected to define CHO too late failure type, we may wait for RAN2. |
| Samsung | No, there is no ambiguity.We will the analysis in Huawei paper [3]. |
| Huawei | No.As we said in our paper, the CHO1 related timer should be reset upon receiving CHO2 cfg, though detailed timers depend on RAN2 definition. |
| ZTE | No, there is no ambiguity. We provide analysis in [4]. |
| Qualcomm | RAN2 is discussing this scenario and the definition of corresponding timers. There should be no ambiguity once RAN2 finalizes the definitions. |

### Failure type definition and detection

In [3] [4] [5] [7], four companies propose that separate failure type detection for CHO in stage 2 is not needed, since previously we agreed to reuse the legacy MRO definition with related updates for CHO, currently the captured stage 2 descriptions of MRO detection mechanism is simple and can work well for CHO.

[6] [8] propose to have separate failure type detection for CHO in stage 2 in order to make the detection clear.

**Q2: Companies are invited to provide their views on whether to have separate failure type detection for CHO in stage 2.**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | No | It is simple and sufficient to reuse the legacy MRO detection mechanism with necessary updates for CHO. We prefer to adopt the previously captured TS38.300.Additionally, separate description for CHO seems not necessary especially when the ambiguous CHO failure across two CHO configurations is invalid. |
| Nokia | Yes | The decision may be made later, but separate definitions may help clarity. |
| CATT | Yes | As far as we know, besides legacy *timeConnFailure,* many other timers shall be introduced by RAN2 in order to detect CHO failure type. MRO for CHO shall use more timer than legacy HO. For example, to handle the ambiguity in Q1, we may need to introduce two timers to detect CHO too late. It is more complex than legacy HO and it is hard to merge CHO and legacy HO.Moreover, there are more failure scenarios for CHO than legacy HO. So, we propose separate failure type detection for CHO in stage 2. |
| Samsung | Yes | The scenarios for CHO is more than legacy handover as captured in R3-214432. That’s why more information are needed for the detection e.g. the number of timers as CATT said.The detection mechanism should cover all the scenarios. E.g. the failure may be due to un-appropriate candidate cell list configuration instead of handover trigger setting. This should also be covered.In order to make the detection mechanism clear, it’s better to have separated description for CHO. |
| Huawei | No | We believe the updated definitions in stage 2 have covered the CHO failure cases. |
| ZTE | No | We prefer to update CHO cases based on current stage 2 description. |
| Qualcomm | No | Looking at R3-215538 which provides a draft TP to TS 38.300 with separate failure type definitions for CHO, there are a lot of duplicates with the existing failure types. So, reusing current definition and failure types make more sense.If we reuse the failure type definitions, we could perhaps make it more clear on the “UE reported timers” for CHO as there are at least 2 timers reported by UE for CHO. |

### CHO execution condition(s) and candidate cell list

In RAN3#110e meeting, it was agreed that the source node needs to know the candidate cell list and CHO execution condition(s), but how is FFS. UE-based solution and network-based solution are summarized as below.

**Option 1: UE-based solution. Include CHO execution condition(s) and candidate cell list in the RLF-report.**

**Option 2:** **Network-based solution.**

* **Option 2-1: Source node sends candidate cell list and CHO execution condition(s) to the target node after receiving Handover Success message, e.g. in a new introduced message, and then the target transmits the info back to the source node in HANDOVER REPORT message.**
* **Option 2-2: Derive candidate cell list and CHO execution condition(s) based on Mobility Information.**
* **Option 2-2-1: Source node transmits the mobility information to the target node when CHO is completed, i.e. in the SN STATUS TRANSFER message, and the target node sends the mobility information back to the source node via HANDOVER REPORT message.**
* **Option 2-2-2: Source nod transmits the mobility information to each candidate target node in the HO request message, and the target node sends the mobility information back to the source node via HANDOVER REPORT message.**
* **Option 2-3: Source node stores the CHO related configuration**

[6] support Option 1 since UE-based solution have been agreed by RAN2, it is not necessary for network to record CHO execution condition(s) and candidate cell list.

[8] support Option 2-1, they state that the receiving node may not understand Mobility Information for inter-vendor scenario, and Mobility Information is not easy to have it in standard way because handover trigger is implementation related.

[3] support Option 2-2-1, as well as support Option 2-3 for CHO to a wrong cell case.

[5] propose that network-based solution can be considered if UE-based solution is not sufficient. Option 2-2-2 is preferred compared with Option 2-1 and Option 2-2-1due to less spec impact.

**Q3: Companies are invited to provide their views on whether to have network-based solution to enable source node to get CHO execution condition(s) and candidate cell list.**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | consider NW-based solution if UE-based solution is not sufficient | RAN2#115e meeting confirmed to include latest radio measurement results of the candidate target cells and configured CHO execution condition(s) in the RLF report. If we agree UE-based solution is sufficient, Network-based solution may be not needed.  |
| Nokia | No at this moment | To our understanding, RAN2 still works on the solution, so we shall not spent time on it before it is confirmed the network-side solution is needed. We have a list of solutions ready, as presented above, if eventually needed. |
| CATT | No at this moment | UE based solution has been agreed in RAN2. For the argument that UE based solution is not sufficient for at most 8 candidate target cells can be included in the RLF report, as far as we know, it is 8 Frequencies each of which includes at most 8 cells as below in 38.331.MeasResultList2NR-r16 ::= SEQUENCE(SIZE (1..maxFreq)) OF MeasResult2NR-r16MeasResult2NR-r16 ::= SEQUENCE { ssbFrequency-r16 ARFCN-ValueNR OPTIONAL, refFreqCSI-RS-r16 ARFCN-ValueNR OPTIONAL, measResultList-r16 MeasResultListNR}MeasResultListNR ::= SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultNRmaxFreq INTEGER ::= 8 -- Max number of frequencies.maxCellReport INTEGER ::= 8So, we think UE based solution can provide enough information for candidate target cell.If we really find it is not enough,we could consider network based solution. |
| Samsung | Yes. | We think network based solutions are needed because of a couple of reasons:1. The network CANNOT get all the candidate cells in some scenarios.

E.g. The candidate cell list is configured inappropriate. Some good cells are not included in the candidate cell list but some bad cells are included. In this case, some cells in candidate list are not included in measurement result. Therefore, the network has no way to perform appropriate optimization. Actually, the candidate cell list is mainly useful for the network in case the candidate cell list is configured inappropriate.1. RAN2 leave the final decision to RAN3 as they indicated below. They will further revisit it.

Agreements in 113bis are confirmed as:1 Include in the RLF-report for CHO the following:a. Configured CHO execution condition(s) (A3 and/or A5 event configuration, TTT values)c. Latest radio measurement results of the candidate target cellsTry to reuse existing mechanism as much as possible.Agreement a. can be revisited if RAN3 has further progress on it. |
| Huawei | Conditional for 2-2-1 | Option 2-3 and 2-2-2 already exist and requires no change. We think adding 2-2-1 is beneficial for all cases, not only for CHO candidates. This would extend the existing principle and solutions to the CHO case. |
| ZTE | Yes | Compare with UE based solution, network based solution does not introduce extra Uu signalling load and better for future proof.It is possible, the maximum of CHO list may extended, then the specification of Uu interface need further update, while if 2-3 can be selected, nothing need to be change.  |
| Qualcomm | Yes for CHO execution conditions | RAN2 has agreed to only include an indicator whether the target cell is a candidate cell or not and NOT the configured CHO execution condition(s).Since the configured CHO execution condition(s) are bulky, it doesn’t make sense for UE to report it back to the RAN via RLF report, specially when we have network-based solutions identified.RAN3 should discuss whether they can support CHO execution condition(s) via network based solution and LS RAN2 to inform or wait for RAN2 to inform whether or not they can support CHO execution condition(s). |

**Q4: If network-based solution is needed, which option is preferred?**

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| --- | --- | --- |
| **Company** |  **Option 2-1/2-2/2-3** | **Comment** |
| Lenovo and Motorola Mobility | Option 2-2-2 | If UE-based solution can’t work well, Option 2-2-2 seems better which has less spec impact. |
| Nokia | 2-3; 2-2 | 2-3: If network-based support is needed, RAN3 may decide that keeping the UE context for a short while after a CHO is a requirement for supporting MRO with CHO in Rel.17.2-2: The use of the Mobility Info needs to be studied again, because previously 2-2-2 was considered infeasible. Perhaps the UE may report the most recent Mob Info in case of CHO failure? |
| CATT | 2-3 | **Option 2-3** can work but Source node do not know how long is enough to keep context. It depends on implementation. |
| Samsung | 2-1 | Option 2-1 is the best solution.Option 2-2-1 can be considered. The concern for this 2-2-1 is that: it’s RAN3 agreement that the last serving node will perform the root cause analysis and then sends Handover Report message to the node which triggered the last handover. For the failure of CHO, the failure reason could be inappropriate candidate list configuration or improper CHO execution condition configuration. The later one will bring too early, too late or wrong cell HO. Therefore, it’s better to let the serving node understand the candidate cell list and CHO execution conditions. As explained in our paper [8], Mobility information is defined as container because handover trigger is implementation related and it is not easy to have it in standard way. But candidate cell list and CHO execution condition(s) are different. They are already transmitted over the air interface.For Option 2-2-2, the Mobility Information transmitted in Handover Request may be not up to date as the source may has already updated the UE configuration.Option 2-3 is not reliable in implementation. That’s why we sent a LS to RAN2 in R3-212944 and said “it is not mandated that the source node stores the UE context”  |
| Huawei | 2-3, 2-2 | For the too late CHO and HOF after CHO execution, the source can realize the CHO is unsuccessful. It is reasonable for the source to store the related CHO configuration.For other case, upon receiving the HANDOVER SUCCESS message, the source can send the mobility info to the target node where the CHO has been successful. Whether the source node still stores the CHO configurations depends on the implementation.Note again that the only change that is needed is 2-2-1 since 2-3 and 2-2-2 is already possible by the specification. |
| ZTE | 2-3, 2-2-2, | For 2-3, although it is not mandated for a source node to save UE context after handover, but for CHO , the RAN node should be enhance to support the feature.  |
| Qualcomm | Any | We are not sure though Option 2-3 might be agreeble as we agreed in a previous meeting that the source node might not always have the UE context after CHO failure. Option 2-1 or Option 2-2 can be considered once we agree that we need a network-based solution for CHO execution condition(s). |

### FAILURE INDICATION and HANDOVER REPORT message

RAN3#113e agree to reuse FAILURE INDICATION message and HANDOVER REPORT message to transfer failure related information for CHO. Further discussions regarding Xn aspects are provided in [5] [6] [8].

In [5], it is proposed that “RRC Re-establishment” can be reused as the initiating condition in FAILURE INDICATION message for CHO, the existing Handover Report Type e.g. “HO too early” or “HO to wrong cell” can be reused in HANDOVER REPORT for CHO, and CHO Cell CGI can be included in the HANDVER REPORT message to represent the CHO candidate cell which is selected after CHO execution failure for CHO recovery. Additionally, the existing one UE RLF Report Container in XnAP FAILURE INDICATION message or HANDOVER REPORT message can be reused to transfer information related two successive failures in CHO.

In [6], it is proposed to enhance Failure Indication to include a new initiating condition for CHO recovery. Additionally, CHO recovery cell ID needs to be included in Failure Indication message if there is no RLF Report container in Failure Indication message.

In [8], it is proposed to add Handover Report value Too Early CHO Execution and CHO Execution to Wrong Cell in Handover Report message.

**Q5: Companies are invited to provide their views on FAILURE INDICATION message and HANDOVER REPORT message for CHO.**

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| **Company** | **Comment** |
| Lenovo and Motorola Mobility | For FAILURE INDICATION message, a new initiating condition for CHO is not needed, and the existing one UE RLF Report Container can be reused to transfer two successive failures. For HANDOVER REPORT message, do not introduce new Handover Report Type, CHO Cell CGI can be included to represent the CHO candidate cell for CHO recovery, and the existing one UE RLF Report Container can be reused to transfer two successive failures. |
| Nokia | We also think the existing messages can be reused. |
| CATT | FAILURE INDICATION message can be reused for CHO, but which IE in FAILURE INDICATION message can be reused needs discussion.For example, RRC Re-establishment IE is not proposed to be reused to record CHO recovery procedure for the following reason:1. There may be RRC Re-establishment procedures after CHO recovery. If reusing RRC Re-establishment IE for CHO recovery, there may be two RRC Reestablishment procedures in one CHO which may lead to ambiguity.
2. C-RNTI, ShortMAC-I and Failure cell PCI IE in Failure Indication message is mandatory present which cannot be reused by CHO recovery procedure and only Re-establishment cell CGI IE may be reused.

So, we proposed to include a new initiating condition for CHO recovery. |
| Samsung | RAN3 already agreed to reuse FAILURE INDICATION message and HANDOVER REPORT message to transfer failure related information for CHO.Reuse FAILURE INDICATION message and HANDOVER REPORT message to transfer failure related information for CHO.For HANDOVER REPORT message, new Handover Report Type is needed either in explicit way or implicit way. This can be discussed. |
| Huawei | No.All the above enhancements seem not necessary. |
| ZTE | We also think existing message can be reused. |
| Qualcomm | Same view as Lenovo |

## Enhancements for DAPS HO

### Failure scenarios

RAN3 #113-e meeting agreed that case 9, i.e. HOF@Target->report DAPS HO failure@src->RLF@src, will not be considered for failure cases in DAPS HO. However, [6] state that case 9 in RAN3 is exactly the scenario 1b agreed in RAN2 and RAN2 agreed to introduce a timer i.e. *timeConnSourceFailure* IE to detect RLF@src after fallback. [6] proposed to send an LS to RAN2 to coordinate available DAPS scenarios.

[7] think no further discussions on failure scenarios are needed, since the failure scenarios discussed in RAN3 are aligned with RAN2 and cover all possible failure cases for DAPS HO.

**Q6: Companies are invited to provide the views on whether** **to send an LS to RAN2 to align DAPS failure scenarios.**

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| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | Probably no | It seems that scenario 1b agreed in RAN2 is that the UE detects an RLF in source upon it wants to fallback, it is not exactly the case 9 in RAN3. We have discussed the failure scenarios for several meetings, considering TUs left for R17 SON/MDT, as the moderator, we suggest keeping the previous agreement that case 9 will not be considered for failure cases, and we can revisit if any issue is found due to not considering case 9. |
| Nokia | Probably no | It is unfortunate that RAN2 developpend their scenarios without using RAN3’s work. But at this stage, we don’t think they will abandon their agreements and scenarios, so the LS has no purpose. |
| CATT | Yes | Scenario 1b agreed in RAN2 is not aligned with RAN3 case 9 and RAN2 has also agreed to introduce a timer to detect this failure type. An LS is needed to coordinate available DAPS scenarios.

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| **RAN2** | **Description** |
| Scenario 1 (too late DAPS): 1b | * The UE executes the DAPS HO to the target but it fails
* The UE falls-back to the source cell
* The UE experiences an RLF after the fallback
 |

 |
| Samsung | Probably no | We agree with Lenovo to keep the previous agreement that case 9 will not be considered for failure cases. |
| Huawei | No | In our understanding, the timeConnSourceFailue was introduced corresponding case 6 in RAN3 that the UE detects HOF@trgt then fails to perform fall back.C:\Users\g00450637\AppData\Roaming\eSpace_Desktop\UserData\g00450637\imagefiles\EF80251F-FC16-4639-91D5-0096E1A12F87.png |
| ZTE | No | Similar view as Lenovo. |
| Qualcomm | No | Same view as Nokia. We can focus on stage-3 work in RAN3 and other topics. Also timeConnSourceFailure can be used for case 6 as well as highlighted by Huawei. |

### Success Report with RLF report

As issued in [9], for DAPS HO, there is a possibility that both HO Success Report and RLF Report are triggered, then a MRO issue needs to be considered, i.e. the source gNB may receive the SHR and the RLF report separately at different time, and it may make MRO analysis and optimization twice if it can’t understand the SHR and RLF report are related with the same HO. To solve this issue, potential solutions are provided in [9].

[10] analyzed this issue, considering RAN2 is discussing how to deal with the case in which the UE generates both an RLF report and a HO Success Report for the same HO in [11], [10] propose that RAN3 can wait for RAN2’s progress.

**Q7: Do companies agree to wait for RAN2 progress on how to handle the case when both a HO Success Report and an RLF report are generated for the same HO?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | Yes | In RAN2’s email discussion “[Post115-e][899][SON/MDT] Handover related SON aspects”, based on most companies’ responses, it is proposed that it is not a problem if both the SHR and RLF-Report are generated for the same HO, and it is not a problem if the network fetches them separately.We can wait for progress of RAN2#116e meeting. |
| Nokia | Yes |  |
| CATT | Prefer not | According to the email discussion in RAN2, it seems it is not acknowledged by all RAN2 guys that the necessity of the correlation. For MRO, the detection mechanism of failure root cause is implemented by network and discuss in RAN3.If there is requirement on the UE report, it should be raised by RAN3.So, we propose to discuss whether the case should be considered or not in RAN3. If RAN3 regard that correlation of the two reports is needed and would like to let RAN2 take the responsibility to make correlation, a LS is needed.From our point of view, for the case that both a HO Success Report and an RLF report are generated for the same HO, the network needs to be aware of that. Otherwise, the NG-RAN node may make optimization twice according to success report and RLF report separately which is not correct. |
| Samsung | Yes | If RAN2 decided to abandon SHR in case of RLF, then additional solution in RAN3 is not needed. |
| Huawei | Yes |  |
| ZTE | Yes |  |
| Qualcomm | Yes | RAN2 should discuss this. Also, we think that SHR should not be considered for MRO. The purpose of SHR is to detect lower layer problems before a successful HO and not to aid in MRO failure type detection (only RLF Report should be used for MRO) |

### Xn aspects

RAN3#113e meeting agreed to reuse FAILURE INDICATION message and HANDOVER REPORT message to transfer failure related information for DAPS HO.

In [10], it is proposed to reuse the existing one UE RLF Report Container in XnAP FAILURE INDICATION message and XnAP HANDOVER REPORT message to transfer the information related with the two successive failures happened in one DAPS HO procedures.

**Q8: Companies are invited to provide their views on Xn aspects of MRO for DAPS HO.**

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| --- | --- |
| **Company** | **Comment** |
| Lenovo and Motorola Mobility | Reusing the existing one UE RLF Report Container in the XnAP message has no RAN3 specification impact. |
| Nokia | Same as in Q5 – RAN3 shall try to reuse the existing messages. |
| Huawei | We can reuse the UE RLF Report container to support the delivery of the RLF report for the successive failures. |
| Qualcomm | OK to reuse |

# References

1. R3-213497, Discussion on MRO for CHO mobility enhance, CATT
2. R3-214325, Summary of Offline Discussion on Mobility Enhancement Optimization, Lenovo, Motorola Mobility
3. R3-214961, Mobility Enhancement Optimization, Huawei
4. R3-215753, Further consideratino on Mobility enhancement, ZTE
5. R3-215297, SON Enhancements for CHO, Lenovo, Motorola Mobility, ZTE
6. R3-215063, Discussion on MRO for mobility Enhancement, CATT
7. R3-215451, (TP for SON BL CR for TS 38.300) MRO for CHO and DAPS, Ericsson
8. R3-215537, Discussion on SON enhancements for CHO, Samsung
9. R3-213499, Discussion on MRO for DAPS mobility enhance, CATT
10. R3-215298, SON Enhancements for DAPS Handover, Lenovo, Motorola Mobility, ZTE
11. R2-2110889, [Post115-e][899][SON/MDT] Handover related SON aspects, Ericsson