3GPP TSG-RAN WG3 #112e R3-212668

Online, 17 May - 28 May 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: # 1212\_SONMDT\_MobEnh**

**- LS is noted**

**- Topics to discuss:**

**- Reply LS to RAN2 (i.e. to clarify whether the source cell will keep the UE context, at least until the RLF-report is received by the source cell)**

**- CHO:**

**- consider a Successful HO Report with RLF information as an equivalent of the RLF Report**

**- conclude that in case of a too late CHO, the source node may have the CHO information when it receives the RLF Report**

**- conclude that in case of a too early CHO, the node initiating the CHO may have the CHO information, but this will conflict with the benefits of the Mobility Information. If Mobility Information is used, it will not always have the CHO information when it receives the RLF Report.**

**- conclude that in case of a CHO to wrong cell, the node initiating the CHO may have the CHO information, but this will conflict with the benefits of the Mobility Information. If Mobility Information is used, it will not have the CHO information when it receives the RLF Report**

**- consider case 5 for too late CHO**

**- deprioritize case 3 and case 4 for too early CHO**

**- deprioritize case 6-10 for CHO to wrong cell**

**- For mixed HO/CHO, case 7, 8 and 9 can be considered and should be deprioritized**

**- XnAP FAILURE INDICATION and XnAP HANDOVER REPORT to transfer information related with the two successive failures**

**- failure information to be included in the RLF report**

**- to study the optimization of the number of prepared cells**

**- to study methods to optimize early and late data forwarding**

**- For CHO, the Too Late Handover, Too Early Handover and Handover to Wrong Cell means Too Late CHO Execution, Too Early CHO Execution and CHO Execution to Wrong Cell separately**

**- The source node sends candidate cell list to the target and the target transmits the info back to the source in Handover Report message**

**- The source node sends CHO execution condition(s) to the target and the target transmit the info back to the source in Handover Report message.**

**- The source node sends candidate cell list and CHO execution condition(s) to the target in SN status Transfer or a new message.**

**- Handover Report message includes candidate cell list and CHO execution condition(s).**

**- Add Handover Report value Too Early CHO Execution and CHO Execution to Wrong Cell in Handover Report message.**

**- DAPS**

**- consider case 9**

**- consider case 1,4.1,4.2,6 for too early DAPS**

**- consider case 4.3, 5 for DAPS to wrong cell**

**- consider/deprioritize case 3 and 8**

**- do not consider cases 9 and 10**

**- Case 11 should be considered for the successful DAPS HO not for the failure case**

**- For case 1 of DAPS HO, no enhancements are introduced for the legacy FailureInformation message**

**- consider the scenario that a successful HO followed by a DASP HO**

**- consider the case of a legacy HO execution though the UE should perform DAPS HO**

**- to include measurement result, DAPS indicator and Legacy timeConnFailure in HO Success Report for detecting case 2 failure type**

**- state of source link before UE successfully completes RACH procedure in DAPS handover can be reported for the Case 2/4/7**

**- failure cause for the source cell can be reported for the case that source link fails but DAPS handover to the target cell is successfully completed**

**- XnAP FAILURE INDICATION or XnAP HANDOVER REPORT message needs to be extended to include DAPS handover**

**- failure information to be included in the RLF report**

**- to consider the RAN2 agreed timer-related information**

**- to consider explicit indicator for DAPS HO failure, and RLF-cause in case of the failure in the source cell, discuss if more parameters are needed to capture all possible failure scenarios**

**- identify the failure events cause large interruption time during DAPS handover**

**- after success DAPS HO, the target gNB can report the time length between RLF@source and the success access to the target to the source gNB**

**- LS to RAN2**

**- Any other issue based on contributions submitted**

**- Start with summary of offline and see how far you go**

(Len - moderator)

Summary of offline disc [R3-212668](file:///C:\Users\yanle1\AppData\Local\Temp\7zO0E7C79DF\Inbox\R3-212668.zip)

# For the Chairman’s Notes

**Reply LS to RAN2:**

**From RAN3 point of view, the source gNB should be able to identify a neighbor cell is associated to a CHO candidate target cell.**

**How the source gNB identifies a neighbor cell is associated to a CHO candidate target cell needs further discussion in RAN3.**

RAN3 makes down selection of the following solutions in the future meetings:

* Option a: UE reports the candidate cell list and CHO execution condition(s) in RLF Report
* Option b: Source node sends candidate cell list and CHO execution condition(s) to the target node in SN status Transfer or a new message, and then the target transmits the info back to the source in Handover Report message
* Option c: the source gNB always keeps the information as a part of mobility information

**For CHO:**

* **For too early CHO, case 3 and case 4 will not be considered.**
* **For mixed HO/CHO to wrong cell, case 6-10 are deprioritized**
* **WA: Reuse FAILURE INDICATION message and HANDOVER REPORT message to transfer failure related information for CHO.**

**For DAPS HO:**

* **For failure cases in DAPS HO, case 10 will not be considered.**
* **For failure cases in DAPS HO, case 11 will not be considered as a failure case, but a case of successful HO**
* **The case of ‘a legacy HO is executed though the UE is configured with DAPS HO configuration’ will not be considered in the scope of MRO**

**LS to RAN2 about agreed failure cases for CHO and DAPS HO.**

# Enhancements for CHO

The agreement on MRO for CHO in RAN3#110e:

* For too late CHO, case 1, 2 and 3 will be considered, and case 4 and 6 will not be considered. FFS on case 5.
* For too early CHO, case 1 and 2 will be considered. FFS on case 3 and 4.
* For CHO to wrong cell, case 1-5 will be considered.
* Resource optimization for CHO is deprioritized.
* Data forwarding enhancements for CHO is deprioritized.
* Use cases for MRO of CHO handover:

- It is FFS whether the cases for mixed HO/CHO to wrong cell should be deprioritized.

## Failure scenarios and types

In RAN3#111e, it was agreed that:

*For too late CHO, case 1, 2 and 3 will be considered, and case 4 and 6 will not be considered. FFS on case 5.*

*For too early CHO, case 1 and 2 will be considered. FFS on case 3 and 4.*

*For CHO to wrong cell, case 1-5 will be considered.*

*It is FFS whether the cases for mixed HO/CHO to wrong cell should be deprioritized.*



**Figure 1 too late handover failure type**

As summarized in [1], case 5 for too late CHO is the case that:

Case 5: the UE receives CHO configuration; an RLF occurs in the cell before CHO execution; the UE attempts to CHO recovery to a CHO candidate cell and successes; the UE occurs an RLF in a short period after CHO recovery; the UE attempts to re-establish the radio link connection in a cell other than the source cell.

From moderator point of view, compared case 3 with case 5, the difference is the failure type after source RLF, i.e. CHO recovery failure (case 3) or RLF at CHO candidate cell after successful CHO recovery (case 5), since case 3 is agreed, case 5 should also be considered.

**Q1: Companies are invited to provide their view on whether to consider case 5 for too late CHO.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | Yes | Similar as case 3, case 5 should be considered. |
| CATT | No | For case 5, RLF occurs shortly after CHO recovery success. The cell in which UE perform CHO recovery is selected according to cell selection rule and should be the most suitable cell to camp on. But RLF still occurs in the cell which may be caused by other reasons and handover parameters optimization may not solve the problem. So, case 5 should not be considered in MRO. |
| Samsung | No | Scenario 5 is not MRO issue |
| Nokia | ? | It depends if the “other cell” is prepared (for CHO or a classic HO) or not. |
| Ericsson | Yes | If RLF happens shortly after CHO recovery then we need to consider these cases |
| Qualcomm | Yes; but should be SHR + RLF report | If RAN2 agrees to consider CHO recovery success scenario under successful HO report, then wouldn’t case 5 be handled by a successful HO report followed by a RLF report?  Case 5 still comes under “Too late handover” as the initial CHO execution didn’t happen before the 1st connection failure. MRO definition for too late CHO can still be “..*if CHO is configured but the CHO execution is not initiated for the UE prior to the connection failure*”. Whether CHO recovery succeeds/fails shouldn’t impact the definition in our understanding. |
| Huawei | Yes | This is another sub-case of case 3a and has been agreed as case 1c in RAN2. |
| ZTE |  | We think this scenario is not equal to case 1c in RAN2.  Case 1c in RAN2:  The UE received a CHO configuration from a source cell.  The RLF occurs in the source cell before CHO execution conditions for any of the candidate cells are fulfilled.  The UE selects for reestablishment one of the candidate CHO target, but the reestablishment in such cell fails.  The UE then performs a reestablishment in a non-candidate CHO target cell but it also fails, or it does not find a suitable cell  We think the case can be focus on RLF in the target. The RLF in the source can be covered by other case, e.g case 1,2.3.  Case 5: the UE receives CHO configuration; ~~an RLF occurs in the cell before CHO execution;~~ the UE attempts to CHO HO to a CHO candidate cell and successes; the UE occurs an RLF in a short period after CHO recovery; the UE attempts to re-establish the radio link connection in a cell other than the source cell. |

**Moderator Summary: No consensus**



**Figure 2 too early handover failure type**

As summarized in [1], case 3 and case 4 for too early CHO is the case that:

Case 3: the UE receives CHO configuration; an legacy handover is performed but fails; the UE attempts to re-establish the radio link connection in source cell.

Case 4: the UE receives CHO configuration; a legacy handover is performed and successes; an RLF occurs shortly after the successful legacy handover; the UE attempts to re-establish the radio link connection in the source cell.

From moderator point of view, in case 3 or case 4, legacy HO is performed rather than CHO which indicates that CHO execution is configured strictly or the configured CHO candidate cell list is not suitable, i.e. CHO is too late to be performed, it seems unsuitable to define them as too early CHO. Thus, case 3 or case 4 can be discussed later if time allows.

**Q2: Companies are invited to provide their view on whether to consider case 3 or case 4 for too early CHO.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | No | De-prioritize case 3 or case 4 for too early CHO. |
| CATT | No | Since CHO is only configured without execution while legacy handover is implemented and failed, it is the legacy handover to be optimized not CHO. |
| Samsung | Yes | The failure occurs due to un-proper HO parameter configuration. This should be optimized to avoid the failure and unnecessary configuration. |
| Nokia | No | Similar reason like CATT’s. |
| Ericsson | Yes at lower priority | Cases 3 and 4 are likely to be covered by the legacy MRO procedures, the only difference is that CHO was configured so UE would have had a better chances with CHO so in cases 3 and 4 it might be beneficial to get an indication that CHO was configured. |
| Qualcomm | Should be too late CHO. | BLCR for TS38.300 defines too late handover as *“…if CHO is configured but the CHO execution is not initiated for the UE prior to the connection failure*” 🡪 Case 3 and Case 4 hence should be considered under too late CHO if at all.  Whether to add an indication that CHO was configured or not in the RLF report for legacy HOF can be FFS. |
| Huawei | No | Both case 3 and case 4, the CHO is never executed and the procedures are totally the same as the legacy one. They have been covered by the scheme for too early legacy HO. No need to introduce repeated work. |
| ZTE | Too late CHO & legacy too early HO | Both case 3/4 are overlapping with legacy too early HO.  When HO start with CHO configuration, it means previous CHO configuration is in sub optimal situation and can be consider to improve.  The case can be merged as following and can be considered in too late CHO:  Case 3/4: the UE receives CHO configuration; an legacy handover is performed |

**Moderator Summary: For too early CHO, 4 companies think** **case 3 and case 4 should not be considered, 2 companies think case 3 and case 4 can be considered as too late CHO, 1 company thinks case 3 and case 4 can be considered, 1 company thinks case 3 and case 4 can be considered with lower priority. (6:2)**

**Proposal : For too early CHO, case 3 and case 4 will not be considered.**



**Figure 3 Potential scenarios for CHO to wrong cell**

It was agreed to consider case 1-5 in Figure 3 for CHO to wrong cell.



**Figure 4 mixed scenarios of legacy HO and CHO**

As summarized in [1], the FFSs scenarios for mixed HO/CHO to wrong cell in Figure 4 are as below:

Case 6: the UE receives CHO configuration; a legacy handover is performed but fails; the UE attempts to re-establish the radio link connection in a cell other than the source cell and the CHO candidate cells.

Case 7: the UE receives CHO configuration; a legacy handover is performed but fails; the UE successfully performs CHO recovery in a CHO candidate cell.

Case 8: the UE receives CHO configuration; a legacy handover is performed but fails; the UE attempts to CHO recovery to a CHO candidate cell but fails; the UE attempts to re-establish the radio link connection in a cell other than the source cell and the previously selected target cells.

Case 9: the UE receives CHO configuration; a legacy handover is performed but fails; the UE attempts to CHO recovery to a CHO candidate cell and successes; a RLF occurs shortly after CHO recovery; the UE attempts to re-establish the radio link connection in a cell other than the source cell and the previously selected target cells.

Case 10: the UE receives CHO configuration; a legacy handover is performed and successes;; a RLF occurs shortly after the successful legacy HO; the UE attempts to re-establish the radio link connection in a cell other than the source cell and the previously selected target cells.

From moderator point of view, in case 6-10, legacy HO is performed rather than CHO which indicates that CHO execution is configured strictly or the configured CHO candidate cell list is not suitable, i.e. CHO is too late to be performed, it seems unsuitable to define them as CHO to wrong cell. Thus, case 6-10 can be deprioritized.

**Q3: Companies are invited to provide their view on whether to deprioritize case 6-10.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | Yes | case 6-10 should be deprioritized. |
| CATT | Yes | They are common cases in real applications and RAN2 have discussed these cases at last RAN2 meeting. For example, the agreed RAN2 Scenario 3 (HO to wrong cell): 3c is same as mixed scenarios Case 7/9, the agreed RAN2 Scenario 3 (HO to wrong cell): 3f is same as mixed scenarios Case 8. |
| Samsung |  | RAN2 agreed to consider some mixed scenarios. It’s better to keep alignment between RAN2/RAN3. |
| Nokia | Yes | Cases 6-10 should not be addressed specifically – normally, RAN3 avoided addressing mixed scenarios for MRO. |
| Ericsson | Yes | Aforementioned cases are likely to be covered by the legacy MRO procedures, the only difference is that CHO was configured so UE would have had a better chances with CHO so in these cases it might be beneficial to get an indication that CHO was configured. |
| Qualcomm | Yes | Indicator whether CHO was configured in RLF report for legacy HOF can be FFS similar to Q2. |
| Huawei | Yes for case 7~9 | For case 6 and 10, as indicated in Q2, they have also been covered by legacy HO to wrong cell. No need to introduce repeated work.  For case 7, 8 and 9, it is OK to deprioritize them. |
| ZTE | Yes | Can be deprioritized |

**Moderator Summary: For mixed HO/CHO to wrong cell, 6 companies would like to deprioritize the case 6-10, 1 company supports to deprioritize the case 7-9 and exclude case 6/10, 1 company supports to keep alignment between RAN2/RAN3.**

**Proposal : For mixed HO/CHO to wrong cell, case 6-10 are deprioritized.**

In [2], it analyzed that

* For too Late CHO, cases 5 and 6 in Figure 1 are not considered in RAN2 offline discussion [3]
* For too early CHO, case 3-4 in Figure 2 are not aligned with RAN2 [3]
* For CHO to wrong cell, case 4-5 in Figure 3 are not aligned with RAN2 [3]

[2] suggested to align the RAN3 discussed failure cases with RAN2 failure cases in order to avoid confusion with parameters and definitions.

Additionally, as suggested in [4], to avoid duplicated WG work, we should inform RAN2 of the agreed use case in RAN3 on MRO for CHO.

**Q4: Companies are invited to provide their view on whether to send an LS to RAN2 to inform the already RAN3 agreed failure cases for alignment.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | Yes | If agreements for the failure cases can be achieved in this meeting, RAN3 could send an LS to RAN2 for alignment. |
| CATT | Prefer to align between RAN2 and RAN3 |  |
| Samsung | Not necessarily | Two reasons:   1. RAN2 is considering more scenarios than RAN3. 2. Company internal coordination is more efficient. |
| Nokia | Not critical | RAN2 could have aligned with us already before – they started the work later. So, we doubt an LS will change much, companies may steer the work in RAN2 so that it does not diverge from RAN3’s work. |
| Ericsson | Yes | We should be aligned with RAN2 and take back the lead on scenarios, taking into consideration the work done in RAN2. |
| Qualcomm | Maybe | If there is agreement, RAN3 can at least LS RAN2 the list of scenarios that can be deprioritized e.g. CHO and legacy mixed scenarios |
| Huawei | Yes | Besides the failure cases, we could also inform RAN2 of the agreed parameters in RAN3 (if any). |
| ZTE | Yes | Alignment with RAN2 benefit both group. |

**Moderator Summary: 6 companies would like to send an LS to RAN2 if** **there is agreement, 2 companies think the LS to RAN2 is not necessary.**

In [5], it is proposed to use dedicated description on the MRO detection for CHO in stage 2, i.e. CHO Execution Too Late, CHO Execution Too Early, CHO Execution to Wrong Cell.

**Q5: Companies are invited to provide their view on whether to describe the MRO detection for CHO separately from legacy handover/DAPS HO in stage 2.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | No | The failures in CHO, e.g. too late handover /too early handover/ handover to wrong cell can be covered by the existing handover failure types definitions with necessary updates, it is not necessary to describe the MRO detection for CHO separately. |
| CATT | Yes | In my opinion, it is suitable to describe the MRO detection for CHO separately because it is not clear to mix CHO MRO detection with legacy handover. |
| Samsung | Yes | The scenarios for CHO are more complex comparing with legacy handover. The detection mechanism should cover all scenarios. In order to make the detection clear and for readability, it’s better to have separate description for CHO. |
| Nokia |  | We may still wait until we have the list of supported scenarios fixed, but at this moment it may seem that the descriptions will be sufficiently different from the classic MRO to justify separate descriptions… |
| Ericsson | Yes | Due to the certain procedures in CHO (like CHO recovery), it has more scenarios therefore it is better to take it separately. |
| Qualcomm | Yes | Okay to have a separate description in stage-2 for CHO failure scenarios and its detection. Whether new Handover Report Types specific for CHO is needed in stage 3 can be discussed separately |
| Huawei | No | The enhanced definition can support the MRO cases for CHO. The separated definition will make the discussion complicated, e.g., whether to introduce explicit CHO failure type in the HO Report. |
| ZTE |  | Wait when scenario stable. |

**Moderator Summary: No consensus. To be continued.**

## UE context in the source cell

In RAN3#110e meeting, it was agreed that the source node needs to know the candidate cell list and CHO execution condition(s). It is FFS on how the source node knows this information.

In RAN2#113bis-e meeting, it was agreed that list of candidate cells IDs and CHO execution condition(s) can be included in the RLF report for CHO, but it is subjected to RAN3 for final decision. In the incoming LS [6], RAN2 asks RAN3 whether the source cell would keep the UE context at least until the RLF-report is received by the source cell. Majority companies support that the UE context is not always kept in the source node [4] [5] [7], e.g. the source node would release UE context upon handover is successful but an RLF occurs shortly after the successful handover. [8] think that in case of a too late CHO, the source node may have the CHO information when it receives the RLF Report; in case of a too early CHO or a CHO to wrong cell, the node initiating the CHO may have the CHO information, but this will conflict with the benefits of the Mobility Information, if Mobility Information is used, it will not always have the CHO information when it receives the RLF Report.

**Q6: Companies are invited to provide their view on whether source node may have the UE context when it receives the RLF Report.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | No | For the case that handover is successful but an RLF occurs shortly after the successful handover, the source node would release the UE context. |
| CATT | No | Legacy MRO method analysis is based on RLF Report while UE context has been removed and it seems no strong argument to change this principle. |
| Samsung |  | For HOF and RLF in too late HO, the source node has the UE context.  For RLF shortly after successful handover, it is depending on NG-RAN node implementation whether the source node has the UE context. But there is network based solution in this case.  So UE reporting is not needed. |
| Nokia | Yes – but do we want it to be mandatory? | Please note, RAN2 does not need full UE context, but only the information on the prepared CHO targets!  Technically, this information may be available at the node triggering the failed CHO.  However, in the past, RAN3 wanted to avoid mandating such implementation and designed the Mobility Information. It shall be discussed if this preference should be observed also for MRO with CHO. |
| Ericsson | No | The time the source node keeps the UE context is implementation dependent. The time between HO completion and the transfer of the RLF report to the source is implementation dependent.  Therefore, there is no guarantee that the source node will still have the UE context in memory when the RLF-report is received. |
| Qualcomm | Yes – network based solution can be used if we don’t want it to be mandatory | Agree with Samsung. Also Mobility Information can be used to get back CHO related information at source node if required |
| Huawei | Yes – but the answer should be clarified | UE context is one thing, and information required for MRO may be a different thing.  Support of MRO functionality is implementation specific. An MRO function may use whatever information available in the node. RLF report provides a way to identify the stored information. Therefore, a node that wants to support a certain functionality needs to make sure he can store this information.  A node may also choose to only store information for a certain time, and if reports are received outside this time only the information in the RLF report is used.  Also, the source node does not always have the context. In some cases, a node may choose to use mobility info instead. In that case, there is no context, but mobility info provide enough information.  We should not duplicate and send information from the UE that is available in the network. |
| ZTE | No | Due to depend on implementation, Source Node can not guarantee to have UE context when receive RLF report for CHO.  If necessary , mobility information can be used to provide information. |

**Moderator Summary: According to the feedback, it seems that all companies agree that the source gNB should be able to identify a neighbor cell is associated to a CHO candidate target cell. But there is no consensus on how the source gNB identifies the candidate target cell.**

After consensus is achieved on whether source node may have the UE context when it receives the RLF Report, a reply LS can be sent to RAN2.

If we agree that source node has no UE context when it receives the RLF Report, Then the issue is how the source node achieves CHO candidate cell list and CHO execution condition(s), via the RLF-Report from the UE [2] [4] as adopted by RAN2, or network based solution as mentioned in [5] that source node sends candidate cell list and CHO execution condition(s) to the target node in SN status Transfer or a new message and then the target transmits the info back to the source in Handover Report message.

**Q7: Companies are invited to provide their view on how the source node achieves CHO candidate cell list and CHO execution condition(s) if the answer for Q6 is “No”.**

* **Option a: UE reports the candidate cell list and CHO execution condition(s) in RLF Report;**
* **Option b: Source node sends candidate cell list and CHO execution condition(s) to the target node in SN status Transfer or a new message, and then the target transmits the info back to the source in Handover Report message.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option a or Option b** | **Comment** |
| Lenovo and Motorola Mobility | Option a. | Support Option a to align with RAN2 view. |
| CATT | Option a | We prefer Option a for the two reasons below:   1. Source node shall send candidate Cell list to every target nodes because there may be many target nodes for CHO and source cell do not know which would be the finally target cell. Each time candidate Cell list information is updated, source node shall send updated information to every target nodes. It is too complex for network to keep candidate cell list. 2. When CHO is executed, network cannot receive notification and may still modify the CHO candidate cell list to each target node which is not aligned with candidate cell list kept in UE. It will lead to wrong CHO candidate cell list kept in network. |
| Samsung | Option b | We have principle that for those information the network can get, network based solution should be used. Option b has less UE impact and reduce the load of Uu.  With Option 1 discussed by RAN2, the network cannot get all the candidate cells in some scenarios e.g. not all the candidate cells are included in the neighbour cell measurement results. In this case, the network may not perform appropriate optimisation.  To CATT: for the network based solution proposed in [5], the source just sends the latest candidate cell list to the target once when receiving Handover Success message. The source doesn’t need to send it to all the candidate target. |
| Nokia |  | Depends on the decision if RAN3 wants to mandate keeping UE context for MRO for CHO. |
| Ericsson | Option a | Aligned with RAN2 views and with legacy. |
| Qualcomm | Option b | Agree with Samsung. If NG-RAN can’t store the CHO related information till RLF report is received, solution proposed in [5] seems an optimal network based solution where source node can send the latest candidate cell list to target node after receiving Handover success and get it back in Handover Report.  RAN3 introduced Mobility Information in the past for similar scenarios, we don’t see any issue to reuse a similar mechanism rather impose requirement on UE to report it. |
| Huawei | Not needed | If this functionality is needed, the source node can store it. |
| ZTE | Option b | Prefer Network based solution in RAN3. |

**Moderator Summary: No consensus.**

## Timers in the RLF report

[4] [7] [9] proposed to report time related information for CHO.

1. a timer between CHO recovery success and RLF occur; [4]
2. the time UE have stayed in source cell; [4]
3. the time elapsed since the last HO initialization until connection failure which may occur after CHO configuration; [4]
4. the time between the first CHO execution and the corresponding latest CHO configuration for the selected target cell received at UE; [7]
5. reuse *timeConnFailure* to indicate the time elapsed since the last HO initialization, including CHO, until first connection failure; [9]
6. use new time IE, e.g., *timeBetwFailures*, to indicate the time elapsed since the first connection failure until the second one; [9]
7. reuse *timeSinceFailure* to indicate the time elapsed since the last connection failure; [9]
8. use new time IE, e.g., *timeCHOexeFailure*, to indicate the time elapsed since the CHO execution until the first connection failure; [9]

**Q8: Companies are invited to provide their view on which time information are needed.**

|  |  |  |
| --- | --- | --- |
| **Company** | **a-h** | **Comment** |
| Lenovo and Motorola Mobility | d | For a, in legacy RLF report, timer between HO success and RLF occurring shortly after the successful HO is not reported, similarly the timer between CHO recovery success and RLF occurring shortly after the successful CHO recovery seems not needed.  For b, not clear, time from receiving CHO configuration to RLF in source?  For c, there are two procedures including legacy HO and CHO, seems not needed to mix them.  For d, it was agreed to report the time between the CHO execution and the corresponding CHO configuration received at UE, since CHO configuration can be updated before CHO execution and it is the latest CHO execution condition determines the CHO execution, we further clarify that it is needed to report the time between the CHO execution and the corresponding latest CHO configuration received at UE.  For e/f/g, wait for RAN2 progress on how to signal the two consecutive failures.  For h, wait for RAN2 progress on whether to reuse the existing IE or define a new IE. |
| CATT | a, b, c | For a, it is used to detect agreed CHO to wrong cell case 4, but RAN2 did not discuss related timer, RAN3 may need to send LS to RAN2 to remind it.  For b and c, it is used to detect CHO too late handover, UE is required to stay a relatively long time in source cell after previous handover. Otherwise, it would be the previous handover needs optimization.  For d, it cannot be used to detect CHO too late handover. The time between the first CHO execution and the corresponding latest CHO configuration is not the time when UE have stay in source cell.  For e, it is similar with d.  For f,g,h, it may be decided by RAN2. |
| Samsung | None | Wait for RAN2 |
| Ericsson | None | RAN2 has discussed and agreed on the list of timers that are supposed to cover all possible failure scenarios |
| Qualcomm |  | Ok to wait for RAN2 |
| Huawei | e,f,g,h | e and g are the same as the legacy one.  h can be used to decide the CHO failure type by the receiving node.  In case of consecutive failures, e+h+f+g can be used to derive the moment when the source node sent the HO CMD and to know whether the related mobility parameters have been adjusted. |
| ZTE |  | Wait for RAN2 |

**Moderator Summary: Discussion on timer information** **to be reported for CHO is to be continued, and some timer information needs to wait for RAN2 agreements.**

## Other reported information

There are many proposals on UE reporting information for SON enhancements for CHO:

1. an explicit CHO failure indicator; [7]
2. *failedPCell* is used to indicate the cell where the first connection failure occurred in case of CHO; [9]
3. *reestablishmentCellId* indicates the cell where the UE performs the successful CHO recovery; [9]
4. use new cell information IE, e.g., *CHOCellId*, to indicate the selected CHO recovery cell after the first connection failure and before the second reestablishment; [9]

**Q9:** **Companies are invited to provide their view on which information are needed.**

|  |  |  |
| --- | --- | --- |
| **Company** | **a-d** | **Comment** |
| Lenovo and Motorola Mobility | a | For a, an explicit CHO failure indicator is needed to distinguish different handover types.  For b/c/d, agree to report the cell where the first connection failure occurred, the cell where the UE performs the successful CHO recovery and the selected CHO recovery cell after the first connection failure and before the second reestablishment, but how to represent these cells are dependent on RAN2 e.g. whether to reuse the existing IE or define a new IE. |
| CATT |  | How to record failure event in RLF report should be decided by RAN2. |
| Samsung |  | Wait for RAN2. |
| Ericsson | a-d (see comment) | Aforementioned parameters are discussed in RAN2 and some of them are already agreed or clarified (related to b,c,d) |
| Qualcomm |  | RAN2 should decide |
| Huawei | a-d | In case of consecutive two failures, it involves at most four cells.  It’s better reuse the legacy ones as many as possible. |
| ZTE |  | Wait for RAN2 |

**Moderator Summary: Discussion on other information to be reported for CHO is to be continued, and some information needs to wait for RAN2 agreements.**

## How to signal two consecutive failures

In RAN3#110e meeting, it agreed that if UE has experienced failure twice, UE reports information related with the two failures. [9] propose the solution for signaling two consecutive failures in CHO, but it seems a RAN2 issue and RAN2 is discussing how to signal since the last two meetings. Therefore, it is suggested to wait for RAN2 progress on how to signal two consecutive failures in CHO.

**Q10: Companies are invited to provide their view on whether to support that RAN3 waits for RAN2 progress on how to signal two consecutive failures in CHO.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | Yes |  |
| CATT |  | Wait for RAN2 |
| Samsung | Yes |  |
| Qualcomm | Yes |  |
| Huawei | Yes | RAN3 can focus on the information requiring UE to report and the root cause analysis based on the information. As for how to report this kind of information, we believe it is in RAN2’s scope. |
| ZTE | Yes |  |

**Moderator Summary: all companies (6 companies) agree that** **how the UE reports the two consecutive failures in CHO is a RAN2 topic.**

## Xn aspects

There are several proposals regarding Xn aspects, including:

* enhance Failure Indication to include CHO failure related information such as CHO recovery cell ID and RLF Report; [4]
* The XnAP FAILURE INDICATION message and XnAP HANDOVER REPORT message need to transfer information related with the two successive failures; [7]
* RAN3 should wait for the enhanced RLF report for CHO in RAN2 before studying the contents of the RLF INDICATION, HANDOVER REPORT, or UPLINK/DOWNLINK RAN CONFIGURATION TRANSFER message for the failure scenarios in CHO; [9]
* Add Handover Report value Too Early CHO Execution and CHO Execution to Wrong Cell in Handover Report message. [5]

**Q11: Companies are invited to provide their view on Xn aspects?**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Lenovo and Motorola Mobility | Wait for RAN2 progress on the RLF report for CHO before studying Xn aspects. |
| CATT | To transfer CHO recovery related information in Failure Indication message, a new initiating condition for CHO needs to be included. CHO recovery cell ID and RLF Report may be also included. |
| Samsung | 1. RLF INDICATION, HANDOVER REPORT message can be reused. 2. At least Handover Report value Too Early CHO Execution and CHO Execution to Wrong Cell in Handover Report message are needed |
| Ericsson | RLF Indication should be reused. We can make it a WA and revise it later if we see that this is not possible. New choices will probably be needed, but we need to wait for the full list of agreed scenarios first.  Same for HO Report. But conclusion may need to wait for the full list of scenarios due to the slightly more complex structure of this message (e.g. target/source cell IEs are mandatory. |
| Qualcomm | Okay to reuse Handover Report. Whether to define new Handover Report Type and other details of the message can be decided once scenario definitions are complete  Also, okay to reuse Failure Indication. RAN2 is inclining towards using a single RLF report to report consecutive CHO failures. How to add CHO recovery cell ID (either as a RAN3 IE or included within the UE RLF Report Container) can be decided post RAN2 decision. Not sure why we would need a new initiating condition as CATT proposed. |
| Huawei | Wait for progress in RAN2 |
| ZTE | Wait for RAN2 progress |

**Moderator Summary: most companies agree to reuse FAILURE INDICATION message and HANDOVER REPORT message to** **transfer failure related information in CHO. The contents in FAILURE INDICATION message and HANDOVER REPORT message are to be continued.**

**WA: Reuse FAILURE INDICATION message and HANDOVER REPORT message to transfer failure related information in CHO.**

# Enhancements for DAPS HO

In RAN3 #110 online meeting following agreements have been made:

Use cases for MRO of DAPS handover:

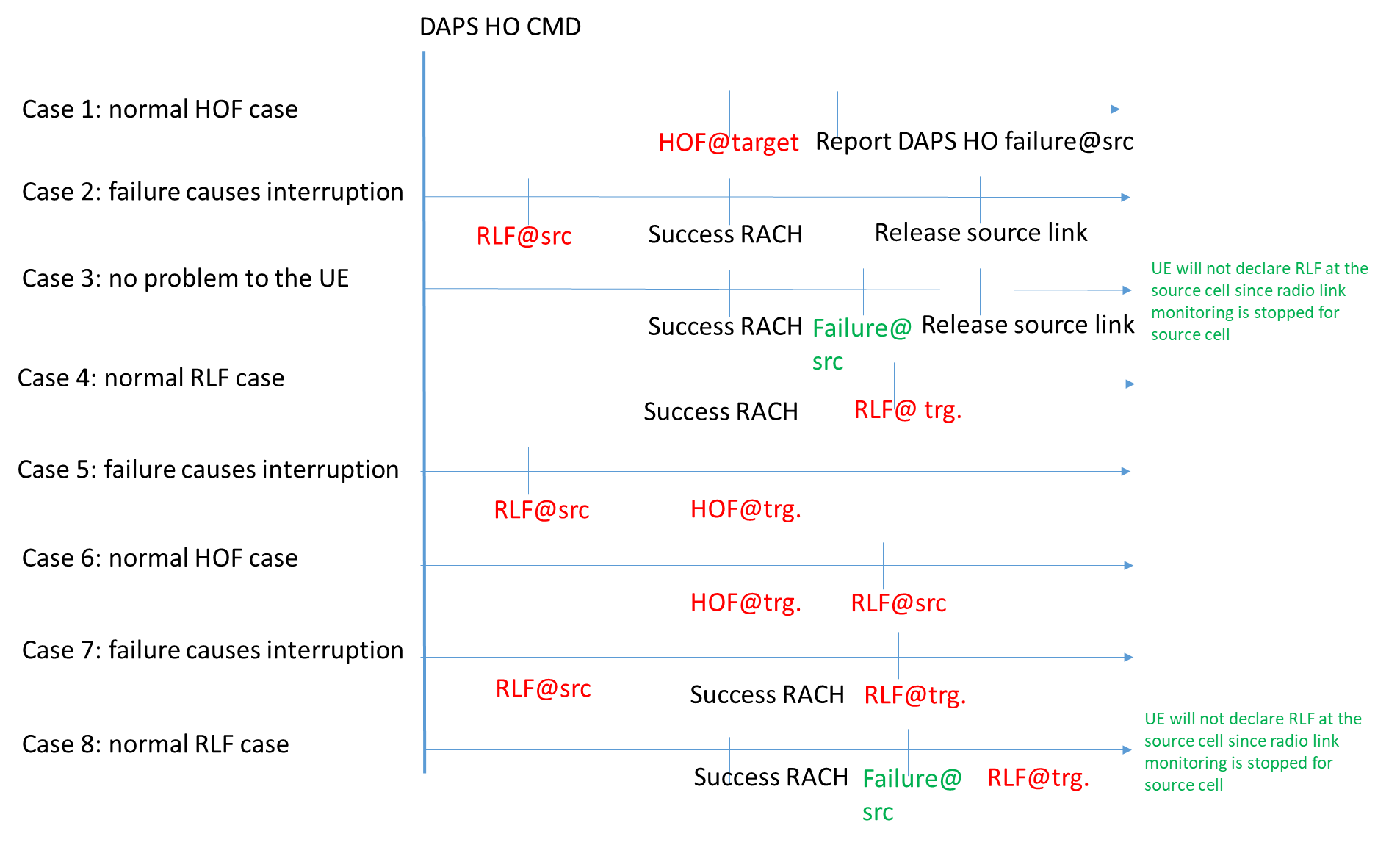
- It is FFS whether case 3 and case 8 should be deprioritized

- It is FFS whether case 9 and case 10, case 11 (successful DAPS HO without RLF@source) should be considered

## Failure scenarios and types

It was FFS whether case 3 and case 8 in Figure 5 should be deprioritized in last RAN3 meeting.

* Case 3: RLF@src after successful RACH
* Case 8: RLF@src after successful RACH and before RLF@trg



**Figure 5 - DAPS HO failure cases (RAN3)**

[9] and [10] propose that case 3 and case 8 should not be considered. The reason in [9] is that the UE will stop any RLF detection of the source cell after successful RACH with the target cell, and the reason in [10] is that case 3 and 8 can be regarded as normal failure case not causing any service interruption.

[11] state that the UE only stops RLM for the source cell after successful RACH, but RLC failure may happen because of HARQ/ARQ retransmission/ROHC feedback to the source gNB, then the UE may declare RLF@src after successful RACH, thus case 3 and case 8 should be considered.

[12] think the case that the UE declares a link failure in the source cell after successful RACH is because transmission of user data between the UE and the source cell to be exchanged is not completed, but this case is not related to MRO, thus case 3 and case 8 should be deprioritized.

To make further progress, first we should confirm whether RLC failure/RLF in source cell may happen after successful RACH because of (re)transmission between the UE and the source cell, if yes, then discuss whether to consider case 3 and case 8.

**Q12: Companies are invited to provide their view on whether RLC failure/RLF in source cell may happen after successful RACH because of (re)transmission between the UE and the source cell.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | Yes | Since HARQ/ARQ retransmission or ROHC feedback to the source gNB is kept after successful RACH, source RLF due to RLC failure may be declared. |
| CATT | Yes | RLC failure/RLF in source cell may happen after successful RACH. |
| Ericsson | Yes | Agree with CATT |
| Qualcomm | Yes | Same view as CATT |
| Huawei | No | This was clarified in RAN2#113bis-e meeting that UE will stop any failure detection after successful RACH.  The related part is extracted from R2-2104337/8 as below:  *In case of DAPS handover, the UE continues the detection of radio link failure at the source cell until the successful completion of the random access procedure to the target cell* |
| ZTE | No | *Agree with Huawei .* |

**Moderator Summary: 4 companies agree that RLC failure/RLF in source cell may happen after successful RACH. 2 companies are against.**

**Q13: Companies are invited to provide their view on whether to consider case 3 and case 8.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | Yes |  |
| CATT | Yes |  |
| Samsung | No | Case 3 and 8 will not cause any service interruption. Not typical cases which should be optimized |
| Ericsson | Yes (see comment) | For Case 8, the RLF report will be sent therefore state of the source link will likely be included (discussed in RAN2).  The only difference between Case 4 and 8 is that RLF happens in the source cell.  Case 3 can be covered by SHR |
| Qualcomm | Yes | State of source link can be used by NG-RAN to figure out if the DAPS HO should have been triggered earlier to avoid losing out on the packets being retransmitted at source NG-RAN (in case of failure@src) |
| LG | No | After successful RACH, the UE does not consider a link failure in the source cell. Also, case 3 and 8 are not related to MRO. |
| Huawei | No | As stated in Q12, case 3 and case 8 are invalid. |
| ZTE | No | Case 3 is not valid.  Case 8 is not a typical MRO case. |

**Moderator Summary: No consensus.**

Additionally, it was FFS whether case 9 and case 10, case 11 should be considered.

* Case 9: Mixed scenario of case 1 and case 6, i.e. HOF@Target->report DAPS HO failure@src->RLF@src;
* Case 10: RLF@src before/after successful RACH in a DASP HO procedure after a successful normal HO.
* Case 11: successful DAPS HO without RLF@source

[13] supports case 9 to align with RAN2 because RAN2#113bis-e has agreed to report time elapsed since DAPS HO execution until RLF occurs in source cell after fallback. [10] also supports that case 9 can be considered since it is related to the fallback case as mentioned in RAN2.

[9] [11] [12] don’t think case 9 should be considered. [9] [11] state that if the UE successfully reverts to the source cell, this mobility procedure ends, then if the UE detects RLF in source, this is another mobility procedure. [12] state that without reporting of DAPS HO failure to the source cell, the source cell can naturally know that DAPS HO is failed, and then the RLF occurs in the source cell.

**Q14: Companies are invited to provide the view on whether** **to consider case 9.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | No | As pointed out by CATT, RAN2 agreed to report time elapsed since DAPS HO execution until RLF occurs in source cell after fallback, but RAN2 did not agree case 9 explicitly when they discussed the failure cases. |
| CATT | Yes | RAN2 agreed the time elapsed since DAPS HO execution until RLF occurs in source cell after fallback. If the time is relatively short, it is still the DAPS problem and should be optimized. |
| Samsung | Yes | It is related to the fallback case as mentioned in RAN2. |
| Ericsson | Yes | Covered in RAN2 |
| Qualcomm | Yes | RAN2 agreed this |
| LG | No | Share view with Lenovo. |
| Huawei | No | If the UE successfully reverts to the source cell, this mobility procedure ends.  If the UE detects RLF in source, this is the starting of another mobility procedure and should be classified as a new too late HO. |
| ZTE | No | Share the view with lenovo. |

**Moderator Summary: No consensus.**

[13] supports case 10, in this case, whether it is DAPS handover failure can be decided based on the UE reported timer i.e. from receiving legacy handover command to RLF@src after DAPS HO command.

[12] supports partial case 10, e.g. the case that RLF@src before successful RACH in a DASP HO procedure after a successful normal HO, but not the case that the RLF@src after successful RACH in a DASP HO procedure after a successful normal HO.

[9] [11] don’t think case 10 should be considered for the reason that we should not mix DAPS handover procedure with the previous legacy successful HO procedure.

**Q 15: Companies are invited to provide the view on whether to consider case 10.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | No | Do not mix DAPS handover procedure with the previous legacy successful HO procedure. |
| CATT | Yes | For MRO analysis, legacy UE reported timer is used to detect whether the previous handover or current handover needs to be optimized. In other words, UE reported timer is used to define whether UE can keep stable in source cell.  For DAPS, we may also follow this rule and there is no difference between DAPS and legacy handover. RLF@src may also be caused by wrong target cell selection of previous handover instead of the DASP handover. |
| Samsung | No | The case 10 occurs when the DAPS HO is triggered shortly after the success normal HO. The previous handover has no problem. DAPS handover are covered by other scenarios. |
| Ericsson | No | Likely to be enough information in the RLF report to perform MRO |
| Qualcomm | No | Don’t see the reason to consider specifically whether a legacy HO preceded the RLF@src in a subsequent DAPS HO. RLF@src can happen due to any reason. |
| Huawei | No | Upon receiving the DAPS HO cmd, it starts a new mobility procedure and ends the legacy HO procedure.  We should not mix this new one with the previous legacy HO procedure. |
| ZTE | No | Can be covered by a normal HO and a DAPS HO. |

**Moderator Summary: 6 companies agree case 10 will not be considered. 1 company don’t.**

**Proposal: For failure cases in DAPS HO, case 10 will not be considered.**

[9] [11] support case 11 as successful DAPS HO case but not failure case, thus case 11 should be excluded from failure cases.

**Q 16: Companies are invited to provide the view on whether to exclude case 11 from failure cases.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | Yes | case 11 should be considered in the SHR. |
| Samsung | No | We didn’t see the further necessity for study since it is a successful case. |
| Ericsson | Yes | Should be covered by SHR |
| Qualcomm | Yes | SHR should cover this. |
| LG | Yes | This case can be covered by SHR. |
| Huawei | Yes | This is a successful DAPS HO without RLF in source cell, we prefer to study this case in the successful HO report agenda. |
| ZTE | Yes | Can be considered in SHR. |

**Moderator Summary: all (7) companies agree to consider case 11 as a successful case.**

**Proposal: case 11 will not be considered as a failure case, but a successful case.**

[14] provides the failure cases that were considered during the RAN2 offline discussion in Figure 6, and propose to discuss the failure cases that do not match RAN2 failure cases in order to align with the proposed RAN2 scenarios to avoid confusion with parameters and definitions.

RAN2#113bis-e meeting agrees to focus on the following DAPS scenarios:

a. Scenario 1 (too late DAPS): 1a, 1b

b. Scenario 2 (too early DAPS): 2a, 2b/2c

c. Scenario 3 (DAPS to wrong cell): 3a, 3b/3c

FFS whether to merge scenarios 2b/2c and 3b/3c.

The failure cases in RAN2 are as below:

Case 1a: the UE gets an RLF while configured with DAPS bearers, before receiving a HO command.

Case 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. [Moderator: Case 1b discussed in RAN2 is exactly the case 9 discussed in RAN3]

Case 2a: The UE executes the DAPS HO to the target but it fails; The UE falls-back to the source cell. [Moderator: Case 2a discussed in RAN2 is exactly the case 1 discussed in RAN3]

Case 2b: The UE executes the DAPS HO to the target, and it succeeds; The UE experiences an RLF in the target after the HO completion and before the daps configuration is released; The UE reestablishes to the source cell. [Moderator: It is FFS about whether to merge case 2b and case 2c in RAN2#113 bis-e meeting.]

Case 2c: The UE executes the DAPS HO to the target, and it succeeds; The UE experiences an RLF in the target after the HO completion and after the daps configuration is released; The UE reestablishes to the source cell. [Moderator: It is FFS about whether to merge case 2b and case 2c in RAN2#113 bis-e meeting.]

Case 3a: The UE executes the DAPS HO to the target but it fails; While doing HO, the UE also experiences an RLF in the source; The UE reestablishes in the a third cell different from source and target. [Moderator: case 6 discussed in RAN3 cover case 3a discussed in RAN2]

Case 3b: The UE executes the DAPS HO to the target, and it succeeds; The UE experiences an RLF in the target after the HO completion and before the daps configuration is released; The UE reestablishes to a third cell, different from source and target or it does not find any suitable cell [Moderator: It is FFS about whether to merge case 3b and case 3c in RAN2#113 bis-e meeting.]

Case 3c: The UE executes the DAPS HO to the target, and it succeeds; The UE experiences an RLF in the target after the HO completion and after the daps configuration is released; The UE reestablishes to a third cell, different from source and target or it does not find any suitable cell [Moderator: It is FFS about whether to merge case 3b and case 3c in RAN2#113 bis-e meeting.]



Figure 6 - DAPS HO failure cases (RAN2)

From moderator point of view, case 4 discussed in RAN3 does not restrict the reestablished cell is a source cell or a third cell, it can cover case 2b/2c/3b/3c in RAN2. RAN3 can only further discuss whether to consider case 1a that the UE gets an RLF while configured with DAPS bearers before receiving a HO command.

**Q 17: Companies are invited to provide the view on whether to exclude case 1a that the UE gets an RLF while configured with DAPS bearers before receiving a HO command.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | Yes | Case 1a is similar as too late handover case in legacy handover, no enhancement is needed for the RLF report. Thus, we do not need to consider case 1a. |
| CATT | Yes | Case 1a may be a legacy too late handover and should not be included in DAPS MRO failure type. |
| Samsung |  | The scenario is covered by two late handover. It’s already in the scope. |
| Ericsson | No | Case 1a is “Too Late DAPS HO”. This needs to be distinguished from Too Late HO, because the “lateness” is different. DAPS HO is supposed to be configured earlier than non DAPS HO (because source link should still be good enough) |
| Qualcomm | Yes | From TS38.331, daps-Config-r16 field is optionally present in DRB-ToAddMod, in case masterCellGroup includes ReconfigurationWithSync…  This means only a HO command can configure a DRB as DAPS bearer. Don’t see any other scenario where a UE can be configured with DAPS bearers but didn’t receive a DAPS HO command. |
| LG | Yes | Case 1a may be covered by a legacy too late handover. |
| Huawei | Yes | It is confusing how the UE is configured with DAPS bearers without a DAPS HO CMD? |
| ZTE | No | Share the view as Ericsson |

**Moderator Summary: No consensus.**

[12] proposed to consider the case of a legacy HO execution though the UE should perform DAPS HO, since it is possible that the UE may perceive that its capability for DAPS HO is exceeded or it may not have the transmitting data toward the source cell. In this case, the source cell cannot know why RRC connection with the UE is disconnected.

**Q 18: Companies are invited to provide the view on whether to consider the case of a legacy HO execution though the UE is configured with DAPS HO configuration.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | No | It seems like error implementation in the network side since it can know the UE capability before configuring DAPS handover. |
| CATT |  | Maybe ask RAN2 |
| Samsung |  | It’s not MRO issue |
| Ericsson | de-prioritize | It’s covered by legacy procedures |
| Qualcomm | No | Doesn’t seem to be MRO |
| LG | Yes | After transmitting a HO command configured with DAPS bearers to the UE, the source cell expects that the UE executes the DAPS HO to the target. By the way, if the UE executes a legacy HO to the target due to the radio condition with the source cell, this situation in the source cell side may be regarded as a failure of DAPS HO because a configuration for DAPS HO is wrong. |
| Huawei | Legacy HO | This is the wrong configuration not a mobility issue. Technically speaking, the source node can know whether the DAPS configuration exceeds the UE capability. |
| ZTE | No | Wrong configuration instead of MRO case. |

**Moderator Summary: for the case of a legacy HO execution though the UE is configured with DAPS HO configuration, 5 companies think it’s not MRO issue, one company think we need to ask RAN2, one company t****hink it should be deprioritized, and one company think it should be considered.**

**Proposal : The case of a legacy HO execution though the UE is configured with DAPS HO configuration will not be considered in the scope of MRO.**

[14] suggest to keep line with RAN2 to category cases into MRO failure type:

Too late DAPS:

Case 12: The UE gets an RLF while configured with DAPS bearers, before receiving a HO command. consider case 12 as too late DAPS.

Too early DAPS:

Case 1: The UE executes the DAPS HO to the target but it fails. The UE falls-back to the source cell.

Case 4.1: The UE executes the DAPS HO to the target, and it succeeds. The UE experiences an RLF in the target after the HO completion and before the DAPS configuration is released. The UE reestablishes to the source cell. [moderator: It is FFS about whether to merge case 4.1 and case 4.2 in RAN2#113 bis-e meeting. From RAN3 point of view, it seems no need to emphasize whether RLF@trg is before or after the daps configuration is released]

Case 4.2: The UE executes the DAPS HO to the target, and it succeeds. The UE experiences an RLF in the target after the HO completion and after the daps configuration is released. The UE reestablishes to the source cell. [moderator: It is FFS about whether to merge case 4.1 and case 4.2 in RAN2#113 bis-e meeting. From RAN3 point of view, it seems no need to emphasize whether RLF@trg is before or after the daps configuration is released]

DAPS to wrong cell:

Case 4.3: The UE executes the DAPS HO to the target, and it succeeds. The UE experiences an RLF in the target after the HO completion and before the daps configuration is released. The UE reestablishes to a third cell, different from source and target or it does not find any suitable cell. [moderator: It is FFS about whether to merge “The UE executes the DAPS HO to the target, and it succeeds. The UE experiences an RLF in the target after the HO completion and before the daps configuration is released, The UE reestablishes to a third cell, different from source and target or it does not find any suitable cell” and “The UE executes the DAPS HO to the target, and it succeeds. The UE experiences an RLF in the target after the HO completion and after the daps configuration is released, The UE reestablishes to a third cell, different from source and target or it does not find any suitable cell” in RAN2#113 bis-e meeting]

Case 5: The UE executes the DAPS HO to the target but it fails. While doing HO, the UE also experiences an RLF in the source. The UE reestablishes in the a third cell different from source

**Q 19:** **Companies are invited to provide their view on the above category.**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Lenovo and Motorola Mobility | Postpone until failure cases in DAPS HO are clear. |
| Samsung | Discuss this later |
| Ericsson | Matters above will not have a huge impact on failure cases and MRO, moreover, most of the scenarios will be covered by the RLF report for DAPS HO |
| Qualcomm | Ok to discuss this later. |
| LG | Discuss this later. |
| Huawei | Discuss this later |
| ZTE | Better to do so in order to have better alignment with other group |

**Moderator Summary: To be continued since no consensus.**

## Whether to enhance report for Case 1

For case 1 in Figure 5, the UE falls back to the source link if the source link is still available when T304 expires. Currently, the UE would report the *FailureInformation* message including the DAPS-failure indication to source gNB. In [9], it is proposed that no enhancements on the *FailureInformation* message is needed. Since it is a RAN2 issue and RAN2 is discussing, it is suggested to wait for RAN2 progress.

**Q20:** **Companies are invited to provide their view on whether to agree that we wait for RAN2 progress on whether to enhance the *FailureInformation* message for case 1.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | Yes |  |
| CATT |  | wait for RAN2 |
| Samsung |  | wait for RAN2 |
| Ericsson | No | FailureInformation is a critical message so it should not be extended |
| Qualcomm |  | Should be RAN2 decision |
| LG |  | Wait for RAN2 progress |
| Huawei | No | The legacy FailureInformation message can provide enough information for source node to identify the issue and perform optimization.  No enhancement is needed for the legacy FailureInformation message. |
| ZTE |  | Wait for RAN2 |

**Moderator Summary: 6 companies agree to wait for RAN2 agreements on whether to enhance the FailureInformation message for case 1. 2 companies agree that FailureInformation should not be extended**

## Timers in the RLF report

[9] [10] [15] proposed to report some time related information for DAPS HO.

1. *timeConnFailure* is used to indicate the time elapsed since the last HO initialization, including DAPS HO, until first connection failure; [9]
2. use new time IE, e.g., *timeBetwFailures*, to indicate the time elapsed since the first connection failure until the second one; [9]
3. *timeSinceFailure* is defined to indicate the time elapsed since the last connection failure; [9]
4. use new time IE, e.g., *timeFailureDAPSHO*, to indicate the time elapsed since the first connection failure until the successful RACH with the target DAPS HO cell; [9]
5. report the time length between RLF@source and the success access to the target [10]
6. consider RAN2 agreed timers, e.g. time elapsed since DAPS HO execution until RLF occurs in source cell before fallback, time elapsed since DAPS HO execution until RLF occurs in source cell after fallback, elapsed time between the execution of DAPS and RLF in target cell [15]

**Q21: Companies are invited to provide their view on which time information are needed?**

|  |  |  |
| --- | --- | --- |
| **Company** | **a, b, c, d, e, f** | **Comment** |
| Lenovo and Motorola Mobility | e | For a/b/c, wait for RAN2 progress on how to signal the two consecutive failures.  For d, agree to indicate the time elapsed since the first connection failure until the successful RACH with the target DAPS HO cell, but how to represent it is dependent on RAN2 e.g. whether to reuse the existing IE or define a new IE.  For f, agree the time elapsed since DAPS HO execution until RLF occurs in source cell before fallback, and the elapsed time between the execution of DAPS and RLF in target cell as agreed in RAN2. |
| CATT | a~f | For a, it has been discussed in RAN2.  For b ~f, they are all useful but how to record them is up to RAN2. |
| Samsung | e | This timer is useful to detect service interruption and therefore make some optimization. |
| Nokia | e | Since RAN2 started their discussion, and they use own scenarios, we could leave it up to RAN2. |
| Ericsson | None | Timers listed above are partially agreed or discussed by RAN2, we suggest to wait for agreements. |
| Qualcomm |  | Okay to wait for RAN2 |
| LG |  | Wait for RAN2 progress |
| Huawei | a,b,c,d/e | a: this is a common definition and can work well for all cases, e.g., indicated in bullet f. This info doesn’t differ where and when the first connection failure occurs.  b+c: by introducing time info b, the source can get the time info when it sent the DAPS HO by c+b+a.  d/e: We think d and e means the same thing to indicate the interruption time. It’s better merge them into one option.  f: it splits the time info a into different sub-cases and introduce corresponding time info. In our opinion, this kind of split is not needed. |
| zte |  | Wait for RAN2 |

**Moderator Summary: 5 companies agree to report the time length between RLF@source and the success access to the target, 4 companies suggest to wait for RAN2 agreements on the listed timer information. No consensus**

## Other reported information

There are many proposals on UE reporting information for SON enhancements for DAPS handover:

1. measurement result, DAPS indicator and Legacy timeConnFailure in HO Success Report for detecting case 2 failure type; [13]
2. the state of source link after successful RACH; [11]
3. the failure cause for the source cell for the case that source link fails but DAPS handover to the target cell is successfully completed; [11]
4. failedPCell is to indicate the target cell in case of consecutive connection failures; [9]
5. *reestablishmentCellId* can indicate the successful DAPS HO cell; [9]
6. new HO type IE, e.g., DAPS HO; =>This has been agreed in RAN3#110-e meeting and re-agreed in RAN2#113bis-e meeting; [9]
7. failure order indicator, e.g., *consecutivetwofailuresoder*, to indicate whether the failure between the UE and the source cell occurs before the one between the UE and the target cell; [9]
8. RAN2 agreed parameters e.g. explicit indicator for DAPS HO failure, and RLF-cause in case of the failure in the source cell, also discuss if more parameters are needed to capture all possible failure scenarios; [15]
9. user plane related parameters; [15]

**Q22: Companies are invited to provide their view on which information are needed?**

|  |  |  |
| --- | --- | --- |
| **Company** | **i, ii,…** | **Comment** |
| Lenovo and Motorola Mobility | ii, iii, viii | For i, RLF report is reported for case 2, rather than HO Success Report.  For iv/v/vi/vii, wait for RAN2.  For viii, agree to report explicit indicator for DAPS HO failure, and RLF-cause in case of the failure in the source cell as agreed in RAN2. |
| CATT | ⅰ ~ ⅸ | For ⅰ, HO Success Report is used to recording the failure information for case 2 which may be a too late DAPS handover. The related parameters to detect too late DAPS handover failure type shall be included in HO Success Report.  Actually, we may need all these information, but how to record them is up to RAN2. |
| Samsung |  | Wait for RAN2. |
| Nokia |  | Since RAN2 started their discussion, and they use own scenarios, we could leave it up to RAN2. |
| Ericsson | None | Information listed above are partially agreed or discussed by RAN2, we suggest to wait for agreements. |
| Qualcomm |  | Okay to wait for RAN2 |
| LG |  | Wait for RAN2 progress |
| Huawei |  | Wait for RAN2 progress |
| ZTE |  | Wait for RAN2 |

**Moderator Summary: most companies suggest to wait for RAN2 agreements on the listed information.**

## How to signal two consecutive failures

Similar as the signalling issue for CHO discussed in section 3.5, we suggest to wait for RAN2 progress on how to signal two consecutive failures in DAPS HO.

**Q23: Companies are invited to provide their view on whether to support that RAN3 waits for RAN2 progress on how to signal two consecutive failures in DAPS HO.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comment** |
| Lenovo and Motorola Mobility | Yes |  |
| CATT |  | wait for RAN2 |
| Samsung |  | Wait for RAN2. |
| Nokia |  | Now, this is already RAN2’s topic… |
| Ericsson | Yes | As separate IEs in the RLF report (discussed in RAN2) |
| Qualcomm |  | RAN2 topic |
| LG |  | Wait for RAN2 progress |
| Huawei |  | Wait for RAN2 progress |
| zte |  | Wait for RAN2 |

**Moderator Summary: all companies (9 companies) agree that how the UE reports the two consecutive failures in DAPS HO is a RAN2 topic.**

## Xn aspects

There are several proposals regarding Xn aspects, including:

* XnAP FAILURE INDICATION or XnAP HANDOVER REPORT message needs to be extended to include DAPS handover, e.g. DAPS handover without RRC Reestablishment [11].
* RAN3 should wait for the enhanced RLF report for DAPS HO in RAN2 before studying the contents of the RLF INDICATION, HANDOVER REPORT, or UPLINK/DOWNLINK RAN CONFIGURATION TRANSFER message for the failure scenarios in DAPS HO; [9]
* the target gNB can report the time length between RLF@source and the success access to the target to the source gNB if DAPS HO is success. [10]

**Q24: Companies are invited to provide their view on Xn aspects?**

|  |  |
| --- | --- |
| **Company** | **Comment** |
| Lenovo and Motorola Mobility | Wait for RAN2 progress on the RLF report for DAPS HO before studying Xn aspects. |
| CATT | Agree to wait for the enhanced RLF report for DAPS HO in RAN2. |
| Nokia | Indeed, we shall first see what will be the content of the RLF Report. |
| Ericsson | RLF Indication should be reused. We can make it a WA and revise it later if we see that this is not possible. New choices will probably be needed, but we need to wait for the full list of agreed scenarios first.  Same for HO Report. But conclusion may need to wait for the full list of scenarios due to the slightly more complex structure of this message (e.g. target/source cell IEs are mandatory. |
| Qualcomm | Okay to reuse Failure Indication and Handover Report. Details post RAN2 decision |
| LG | Wait for the enhanced RLF report for DAPS HO in RAN2. |
| Huawei | Wait for RAN2 progress |
| ZTE | Wait for RAN2 |

**Moderator Summary: most companies (6 companies) agree to wait for RAN2 agreements to** **see the contents in the RLF Report. 2 companies agree to reuse FAILURE INDICATION message and HANDOVER REPORT message to transfer failure related information in DAPS HO.**

**Proposal 20: Wait for RAN2 agreements on the contents in the RLF Report** **for DAPS HO, and discussion on Xn aspects is to be continued.**

# other enhancements for CHO

[2] stated that CHO mechanism leverages significant amount of network resources to provide robust mobility. The reservation of resources in the target would lead to an overload of the network, which is clearly undesirable. Therefore, it proposed to investigate methods to optimize the number of prepared cells.

Also, since early data forwarding will increase overhead on backhaul and memory usage in candidate cells, [2] proposed to study how to optimize early data forwarding.

Since the above issues were discussed in last meeting RAN3 meeting and achieved the agreements that resource optimization and data forwarding enhancements for CHO are deprioritized, we suggest to postpone to discuss optimizations for number of CHO candidate cells and early data forwarding until the enhanced RLF report for CHO is stable.

**Q25:** **Companies are invited to provide their view on whether to postpone discussion on optimizations for number of CHO candidate cells and early data forwarding until the enhanced RLF report for CHO is stable.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comment** |
| Lenovo and Motorola Mobility | Yes |  |
| CATT | Agree to postpone discussion |  |
| Samsung | Yes |  |
| Nokia | ? | The same seems to be proposed in 10.2.1.3. Decision should be synchronized.  In general, companies are always free to bring contributions. Therefore, once a particular solution is proposed, we could decide if it is relevant or not. |
| Ericsson | No | CHO is a very resource-demanding feature therefore these optimizations are very important.  This is the right time for RAN3 to start discussing this topic, or at least open for contributions at next meeting (i.e. agreement to study) because it is likely that scenarios will be finalized at this meeting, and the rest of the discussion will be for RAN2. Therefore, RAN3 will have plenty of time to spend on RAN3 issues, such as new scenarios. |
| Qualcomm |  | Similar view as Nokia |
| Huawei | Yes | This is already downprioritized |
| zte | Yes |  |

**Moderator Summary: 3 companies agree to continue to discuss resource optimization and data forwarding enhancements for CHO, 5 companies agree to postpone the discussion. Keep the previous agreements that resource optimization and data forwarding enhancements for CHO are deprioritized, and the discussion can be continued.**

**Proposal 21: Resource optimization and data forwarding enhancements for CHO are deprioritized, and the discussion can be continued.**

# References

1. R3-211227, Way forward on Scenarios for SON enhancements for CHO and DAPS HO, Lenovo, Motorola Mobility
2. R3-212254, Mobility Robustness Optimization for Conditional Handover, Ericsson
3. R2-2103945, [Post113-e][851][NR17 SON/MDT] HO related SON changes, Ericsson
4. R3-211848, Discussion on MRO for CHO mobility enhance, CATT
5. R3-212404, Discussion on SON enhancements for CHO, Samsung
6. R2-2102149, LS on UE context keeping in the source cell, Ericsson
7. R3-212158, SON Enhancements for CHO, Lenovo, Motorola Mobility, ZTE
8. R3-211561, CHO information in the UE context, Nokia, Nokia Shanghai Bell
9. R3-212212, (TP for SON BLCR for 38.300) Mobility Enhancement Optimization, Huawei
10. R3-212590, Discussion on MRO for DAPS, Samsung
11. R3-212160, SON Enhancements for DAPS Handover, Lenovo, Motorola Mobility, ZTE
12. R3-212398, Discussion on use cases for MRO of DAPS HO, LG
13. R3-211850, Discussion on MRO for DAPS mobility enhance, CATT
14. R3-212145, Scenarios of Mobility Enhancement Optimizatio, ZTE
15. R3-212253, (TP for SON BL CR for TS 38.300) DAPS handover SON aspects, Ericsson