3GPP TSG-RAN WG2 #115-e Tdoc DocNumber

Electronic meeting, 16th – 27th August 2021

Agenda Item: 8.13.2.1

Source: Ericsson

Title: [AT115e][851][SON/MDT] CHO and DAPS related RLF reports (Ericsson)

Document for: Discussion, Decision

# 1 Introduction

This paper addresses the following email discussion:

* [AT115e][851][SON/MDT] CHO and DAPS related RLF reports (Ericsson)

**Scope:** Focus on the following proposals: P1, 7,8 and 9.

 **Intended outcome**: Report with Agreements

 **Deadline**: 11:00 UTC, Wednesday August 25th

Companies are invited to provide their comments by the deadline, i.e. **11:00 UTC, Wednesday August 25th**

# 2 Discussion

## 2.1 “Time D” definition

RAN2 has agreed to include in the RLF-Report, associated to CHO, the following timer:

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| C | Time elapsed between the first CHO execution and the corresponding latest CHO configuration received for the selected target cell, i.e. timeSinceCHOReconfig. | Time of received CHO configuration | Time of CHO execution | Agreed in RAN2#112 |
| D | Time elapsed between CHO execution until the first HOF/RLF  | Time of executing the first CHO | Time of first HOF/RLF | Agreed in RAN2#113 |

Related to timer D, the following proposal with three different options has been discussed during the online session at RAN2#115-e:

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| --- |
| Proposal 1 Op1: For the Timer D, the TimeConnFailure is re-used with possible updates to indicate that it is started at CHO execution.Op2: Timer D is computed by the network using timer C and legacy timeConnFailure.Op3: Introduce a new Timer for Timer D “Time elapsed between CHO execution until the first HOF/RLF”. |

The above options imply the following:

**Option 1:** The “Time D” amounts to the timeConnFailure, which is supposed to start at CHO execution and stop when the HOF/RLF occurs.

**Option 2**: The timeConnFailure is supposed to start at reception of the CHO configuration and stop when the HOF/RLF occurs. The “Time D” is computed as the difference between timeConnFailure and “Time C”.

**Option 3:** A new timer (different from timeConnFailure) is used to represent the “Time D”. It starts at CHO execution and it stops when the HOF/RLF occurs.

Before selecting your preferences, Rapporteur invites companies to evaluate the following scenario already discussed during the online session and illustrated in the below Figure 1 for the various possible options:



Figure 1: Implications of the various options for the scenario discussed during the online session.

**Description of scenario in Figure 1:** The UE receives and ordinary HO command for HO from cell A to cell B. The UE moves in cell B and it receives a CHO configuration. However, before executing the CHO to cell C, the UE experiences an RLF, and as a consequence it logs the RLF-Report.

* Implications of Option 1/3 in the scenario in Figure 1: Both Option 1 and Option 3 assumes that the time D starts at CHO execution. Hence, when the UE experiences an RLF in cell B before the CHO execution, the timeConnFailure associated to the previous HO is still up and running. It will then represent the time elapsed since the HO command execution in cell A until the RLF in cell B. Once the RLF-Report is retrieved, the network can use this timeConnFailure as in legacy operations, i.e. to evaluate whether the HO from cell A to cell B was “too early” or if the cell B was “too late” with the HO.
* Implications of Option 2 in the scenario Figure 1: In Option 2, the timeConnFailure is started at reception of the CHO configuration. This implies that the previous timeConnFailure that was started at HO from cell A to cell B is overwritten. Hence, when the RLF occurs in cell B, the UE only includes the timeConnFailure started at CHO configuration. Once the RLF-Report is retrieved, the network may not know how to interpret the value of timeConnFailure and to properly use it for the “too early/too late” evaluation as it happens in legacy. For example, cell A, i.e. the previous PCell, does not know that the UE was configured with CHO at the time of RLF, hence it will think that the timeConnFailure represents the time since the HO from cell A to cell B, but in fact the UE had restarted the timeConnFailure and hence it would represent the time since the CHO configuration reception.
The above creates ambiguity in the interpretation of timeConnFailure, and consequently it may lead to erroneous HO classifications.

**Differences between Option 1 and Option 3:** Both Option 1 and Option 3 seem to behave similarly for the Scenario in Figure 1. However, related to standardization impact, if Option 3 is selected, RAN2 should discuss how to deal with the timeConnFailure if the CHO is executed. In legacy, when the RLF-Report is logged the UE shall include the timeConnFailure. However, If RAN2 selects option 3, it seems that the UE shall not include the timeConnFailure if the last HO was a CHO, and only this new Timer D should be included.

Rapporteur would like to ask companies which options are preferred.

* **Q1: Which option do you prefer to represent the Time D?**
	+ **Option 1:** The “Time D” amounts to the timeConnFailure, which is supposed to start at CHO execution and stop when the HOF/RLF occurs.
	+ **Option 2**: The timeConnFailure is supposed to start at reception of the CHO configuration and stop when the HOF/RLF occurs. The “Time D” amounts to the difference between timeConnFailure and “Time C”
	+ **Option 3:** A new timer (different from timeConnFailure) is used to represent the “Time D”. It starts at CHO execution and it stops when the HOF/RLF occurs.

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| **Company** | **Option 1/2/3** | **Comments** |
| **Qualcomm** | Option 2 | As the network has sent a new CHO configuration, therefore the RLF report should include the failure information corresponding to the new configuration (received in cell B). From the UE perspective, if UE has received a new configuration, then the reference point is set to the latest configuration. Setting the reference point to CHO execution is quite bad from the UE perspective, as UE has to remember all the timeline until RLF or new CHO execution happens (since the reception of CHO configuration in cell A). For example, if UE receives the new CHO configuration in cell B just after HO, but if CHO execution or RLF doesn’t happen for a very long duration. Then, UE has to remember about CHO execution in cell A until RLF. Therefore, we should avoid inter-mixing two failures and the reference point should be set as CHO configuration reception. The scenario argued seems a corner case. The argued scenario can be avoided by the network side, where the network can send the new CHO configuration after the expiration of the threshold set for detection of early handover failure, then the issue raised by Ericsson will not happen. I am not sure, why a network implementation wants to send a new CHO configuration just after a successful CHO. Isn’t it like encouraging ping-pong? |
| **OPPO** | Option 1 | The given scenario is definitely not a corner case. UE performing consecutive HOs is a possible usual case, especially during mobility in car along road or in train. Overwritting the TimeConnFailure is a serious problem we would like to avoid, since it will results in unsuccssuful optimization of HO from cell A to cell B in the given scenario. Comparing with option 1 and option 3, we would like to insist on using timeConnFailure IE. Introducing a new IE will bring additional complexity to the RRC spec. |
| **Apple** | Option 2 | Agree with QC, the scenario is a corner case. Furthermore, even if a network, for whatever reason, executed such a scenario, the network can learn rather quickly that it results in an issue and next time delay the CHO configuration.  |
| **Ericsson** | Option 1 | We do not understand why this can be a corner case. If we say that this is a corner case, then it is like saying that an RLF after a CHO configuration cannot occur. We do not quite understand why this cannot happen in a real network, e.g. the CHO parameters are not properly configured, and the UE experiences an RLF before executing the CHO.As mentioned above, when this happens, the HO evaluation in cell A (i.e. the previous PCell) is completely compromised, because cell A cannot be aware of whether the received timeConnFailure was started when the HO from cell A to cell B was triggered, or when the CHO configuration was received. We should avoid such ambiguity. |
| **Nokia** | Option 2 or 3 | We agree with QC comment on how UE behaves in the presented scenario. Reception of new RRC config with reconfigurationWithSync resets the point from which timeConnFailure is measured. In option 1, if CHO is configured but never triggered, none of the timers (C and D=timeConnFailure) will have a meaningful value so no useful information is offered to the network. WIth Option 2 or 3, even if CHO is never triggered (which means timers C and D are NULL/0/NaN), at least timeConnFailure will have a meaninful value which can aid the network in root cause analysis.  |
| **Sharp** | Option 1 | We tend to think the scenario is not a corner case. So option 1 and option 3 can both work well. For simplicity, option 1 is preferred. |
| **Lenovo** | Option 1 | We should not overwrite the TimeConnFailure to avoid incorrect MRO analysis for the case showed in Figure 1, thus option 2 is not suitable. For option 1 and option 3, obviously option 1 is better since option 3 has more spec impacts to introducea a new IE. |
| **Samsung** | Option 2 | We have assumed that the concerned scenario can happen while considering the normal HOs only, i.e. it’s just an old scenario, and we have not concerned. It seems unclear why it should be studied for CHO in this time.It is sufficient to implicitly derive the Timer D with the current timers as considering the scenarios RAN2 has agreed. |
| **CMCC** | Option 1 | We also don’t think the scenario proposed by Ericsson is corner case. We should avoid to bring confusion for network to analyse potential mobility problem. So option 2 is not good.As for option 1 and option 3, we prefer option 1 due to less spec impacts.  |
| **CATT** | Option 2 | We should discuss how to divide the two separate handover procedures first, i.e. whether the CHO configuration is configured or CHO execute can represent the second HO initial and should re-start the timeConnFailure timer.If the two handover procedures are separated by CHO execution, not CHO configuration, the network will judge whether the RLF is caused by first handover (i.e. too early handover or handover to wrong cell), if the two handover procedures are separated by CHO configuration, the network will judge whether the RLF is casused due to the new CHO configuration is not suitable (i.e. too late handover).We think how to divide the two separate handover procedures, it depends on how RAN3 define the too late handover, too early handover and handover to wrong cell which is under discussion.We slightly prefer to Option 2. |
| **LG** | Option 2 | Option 2 is desirable because it is straightforward and has less spec impact than Option 1/3. |
| **NEC** | Option 1 | We think the the secenario is a valid case that needs proper handling, and Option 1 is a better solution which can avoid the overwritting issue and has less specification impact. |
| **ZTE** | Option 1 or Option 3 | We also don’t think the scenario is a corner case. And based on the scenarios described, clearly the previous HO from cell A to cell B is improper and requires optimization. With option 2 the previous improper HO decision cannot be detected. To optimize the case CHO is configured but not used, an indication can be introduced, thus for this case, NW can know that an improper CHO configuration is configured. |
| **Huawei, HiSilicon** | Option 2 or Option 3 | Agree with QC overall. We could either derive timer D from the legacy timeConnFailure anad signalled timer C, or we could derive time C from timeConnFailure and timer D. |
| **vivo** | Option 2 | Share similar view with Samsung and LG. |

## 2.2 DAPS-related

The following proposals were discussed during the online session:

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| Proposal 7 For the case of RLF in source cell after DAPS fallback, the RLF report includes the legacy timeConnFailure, that represents in this case the time between DAPS HO execution and RLF in source cell after fallback.Proposal 8 For the case of RLF in source cell after DAPS fallback, include in the RLF report an indication that a “DAPS fallback” occurred before the RLF.Proposal 9 For the case of RLF in target cell after successful DAPS HO, the RLF-Report includes an handover type indicator indicating that the last handover before the RLF was a DAPS HO. |

### 2.2.1 On Proposal 7

Proposal 7 is on how to represent the time elapsed since the last HO execution and the RLF in source cell after the fallback. In the email discussion [1], the following options were discussed:

* **Option 1:** Introduce a new timer, e.g. timeSinceDAPSExecution, to represent the time elapsed between the HO execution and the RLF in the source after the fallback.
* **Option-2:** Reuse timeConnFailure to represent the time elapsed between the HO execution and the RLF in the source after the fallback.
* **Option-3**:

**We have already agreed on this:**

For the case of RLF in source cell while performing DAPS HO (i.e. before fallback), the follow time information is included in the RLF-Report:

a. timeConnSourceFailure: The time elapsed since DAPS HO execution until RLF occurs in source cell while performing DAPS HO ~~before the fallback~~

Note: here we can remove (before the fallback) and fallback indicator can be used to represent if the RLF at source has happened before or after fallback. timeConnSourceFailure is used together with fallback indication to represent RLF related timer for source in DAPS HO

We can reuse timeConnSourceFailure for the information related to RLF at source after DAPS HOF. A fallback indicator together with this timer value should be sufficient.

Furthermore, for proposal 8, the fallback indicator is basically an indicator to represent whether the RLF at source happened before or after the fallback.

Rapporteur’s note: if Option 1 is selected, RAN2 may need to discuss how to handle the existing timeConnFailure in the procedural text. Today, the timeConnFailure is included by the UE whenever there is an RLF. On the other hand, with Option 1, it seems that the UE should be prevented from including the timeConnFailure if there is an RLF in the source cell after the fallback. Otherwise both timeConnFailure and timeSinceDAPSExecution timers will be included which does not make sense.

* **Q2: Which of the above options do you prefer to represent in the RLF report the time since the last DAPS HO execution in case the RLF occurs in source cell after fallback?**

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| **Company** | **Option 1 / Option 2** | **Comments** |
| **Qualcomm** | Option 3 | Reuse already agreed on timer ***timeConnSourceFailure***with the fallback indicator to represent this timer. |
| **OPPO** | Option 3 | It is more clear to use timer ***timeConnSourceFailure*** with the fallback indicator to represent this timer, especially considering that timeConnSourceFailure has been agreed.  |
| **Apple** | Option 3 |  |
| **Ericsson** | Option 2 | Using timeConnSourceFailure or timeSinceDAPSExecution pose the problem of how to handle the timeConnFailure. By default, the timeConnFailure starts at the DAPS HO execution, and when the RLF occurs in the source cell it will be included in the RLF-Report automatically, by just reusing legacy specification.If we now want to avoid including the timeConnFailure, then we need to handle it in the procedural text. Not sure why we need to complicate the specification. It seems simpler to just reuse thet timeConnFailure. |
| **Nokia** | Option 3 | Option 3 is fine but we should discuss what timeConnFailure encodes in this scenario and possibly a new timer to measure time between HOF@Trg and RLF@Src  |
| **Sharp** | Option 3 with comments | Since timeConnSourceFailure has already been agreed by RAN2, it is better to reuse it also for this fallback case. But not sure whether the fallback indicator is really needed. We understand the NW can know the fallback from the structure of RLF-report for such successive failure case(first DAPS HOF then source falure) if single RLF-report with seperate IEs for 2 failures is used. Or the NW can know the fallback by comparing the length of timeConnFailure and timeConnSourceFailure as commented in the post114e[850] discussion. |
| **Lenovo** | Option 3 without explicit fallback indicator | timeConnSourceFailure can be used to indicate the time elapsed since DAPS HO execution until RLF occurs in source cell before or after fallback.But we think an explicit fallback indicator to show whether the RLF at source happened before or after fallback is not needed. Since for these two cases, timeConnFailure is also included in the RLF report to indicate the time elapsed since DAPS HO execution until handove failure, network can know whether the RLF at source happened before or after fallback based on timeConnFailure and timeConnSourceFailure, i.e. if timeConnFailure is longer than timeConnSourceFailure, it implicitly means source RLF happened before fallback; if timeConnFailure is shorter than timeConnSourceFailure, it means source RLF happened after fallback. |
| **Samsung** | Option 3 (but need to clarify whether to need a fallback indicator together) | It’s fine with the option 3, but we need to clarify whether to need a fallback indicator together with this timer. For instance, in the UE RLF Report, there are failedPCell and PreviousPcell. From the same failedPCell and PreviousPcell, the network can identify a failure in source. |
| **CMCC** | Option 3 | Agree with Qualcomm and OPPO. |
| **CATT** | Option 3 without fallback indication | Only reporting timeConnSourceFailure is sufficient to represent the RLF in source cell before and after fallback.The fallback indication metioned in Option 3 is not necessary as RLF in the source cell before or after the fallback can be deduced by timeConnFailure and timeConnSourceFailure. |
| **LG** | Option 3 | We can use the agreed timer, *timeConnSourceFailure*. By the way, instead of fallback indication, we think we can use both *timeConnFailure* and *timeConnSourceFailure,* theformer for the timer until target cell RLF and the latter for the timer until source cell RLF. Then, when RLF occurs at both source cell and target cell, the network can implicitly know whether the source cell RLF occurred before or after the fallback by comparing the two timers. |
| **NEC** | Option 3 without fallback indication | Reusing the already agreed timeConnSourceFailure timer is the better. And it seems that we don’t need one explicit fallback indication, and the network can be aware of it based on other RLF information. |
| **ZTE** | Option 3 with explicit fallback indication | Reuse timeSourceFailure is a clean solution without further clarification on the scenarios, and we can based on explicit fallback indication to know if fallback occurs to differentiate the scenario. |
| **Huawei,HiSilicon** | Option 2 or option 3 for Case 1: the UE detects RLF@src after successful fallbackoption 3 for Case 2: the UE detects RLF@src upon the fallback | First, we want to clarify the cases.Case 1: the UE detects RLF@src after successful fallbackOption a: We prefer to consider this case as a totally new case upon successful fallback. In this way, the UE has reports the HOF related info to the source node via FaiureInformation. Therefore, if the UE detects RLF@src after fallback, the UE records a new RLF report (and overwrites the previous one for the HOF@trg if exisiting). In this way, we can resue the timeConnFailure.Option b: If the UE continues the RLF report for the HOF@trg, we prefer option 3 timeConnSourceFailure. But to differ case 1 and case 2, it is better to indicate whether the fallback is successful (e.g., redefining the fallback indicator).Case 2: the UE detects RLF@src upon the fallbackIn this case, we prefer to use the option 3 timeConnSourceFailure. |
| **vivo** | Option 3 without explicit fallback indicator | Agree with Samsung. |

### 2.2.1 On Proposal 8/9

Proposal 8/9 are essentially discussing the same issue. Hence, they will be treated together.

In particular, Proposal 8 is about the need of a DAPS fallback indicator, in case there is an RLF in the source cell after the DAPS fallback.

Proposal 9 is about including in the RLF-Report a DAPS handover type indicator in case an RLF occurs in the target cell after the DAPS HO.

Rapporteur´s note: Irrespective of whether the RLF occurs in the source cell after DAPS fallback, or in the target cell after DAPS HO, the current RLF report does not allow the network to figure out that this RLF occurred after a DAPS HO.
In case of RLF in source cell after DAPS fallback, the network will see that the previousPCellID and the failedPCellID in the RLF-Report are the same, but these two cell IDs may be the same also in case of intra-cell HO.
Similarly, in case of RLF in target cell, the network cannot know that the last performed HO was a DAPS HO.
This information may be beneficial because the configuration of DAPS HO parameters may be different from the configuration of the ordinary HO parameters, hence DAPS HO indicator may be used to optimize the corresponding HO parameters.

* **Q3: Do you believe that it is beneficial to include in the RLF-Report an indicator indicating that the last executed HO before the RLF was a DAPS HO?**
	+ **Option 1:** Yes, both in case of RLF in the target cell after DAPS HO, and RLF in source cell after DAPS fallback
	+ **Option 2:** Yes, but only in case of RLF in the target cell after DAPS HO
	+ **Option 3:** Yes, but only in case of RLF in source cell after DAPS fallback
	+ **Option 4:** No

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| --- | --- | --- |
| **Company** | **Option 1/2/3/4** | **Comments** |
| **Qualcomm** | No (Option 4) | If we agree on option 3 for question 2, we don’t need an indicator existing fields should be sufficient. For example, if RLF at the source happens before the DAPS HOF or successful DAPS HO, we will set fallback indicator as False and timeConnSourceFailure, as the time since CHO execution until RLF. If DAPS HO also fails after RLF to the source, we will set timeConnFailure as the time since the execution of DAPS HO failure until RLF at target.For example, if we consider timeConnSourceFailure always captures the time value since the reception of DAPS config until RLF at source if UE has received DAPS config previously. Then, the presence of timeConnFailure itself will dictate if RLF at the target cell has happened after DAPS HO or not. Furthermore, the fallback indication is sufficient to represent if RLF has happened in the source cell after fallback or before.I believe that if we are creating a new timer, we should use that to the maximum extent and avoid introducing the new fields when it can be covey from existing or agreed on IEs. |
| **OPPO** | Option 2 | Agreeing on option 3 for Q2 only address the issue on proposal 8. |
| **Apple** | Option 4 | Agree with QC |
| **Ericsson** | Option 1 | We prefer to use the DAPS indicator whenever there is an RLF, no matter if that occurs in the target or in the source cell. That is to allow the network to know that the last HO was problematic. So that the network can optimize the DAPS HO parameters which may be different from the ordinary HO parameters.Related to RLF in source cell after DAPS fallback, obviously if timeConnSourceFailure is agreed in Q2, then it is not needed to include the DAPS indicator. However, as we mentioned in Q2, then there will be the problem of how to handle the timeConnFailure. Some updates to the existing procedural text is needed. It seems simpler to reuse the timeConnFailure, and just add a DAPS indcator when there is an RLF. |
| **Nokia** | Option 1 |  |
| **Sharp** | Option 2 | Regarding proposal 8, see our comments to Q2. |
| **Lenovo** | Option 2 | Only the case that RLF in the target cell after DAPS HO needs to be distinguished with the legacy case that RLF in the target cell after normal HO. For the case that RLF in source cell after DAPS fallback, information in the RLF report can implicitly indicates it is DAPS HO rather than normal HO, e.g. the timeConnSourceFailure IE. |
| **Samsung** | Option 2 | If the option 3 in Q2 is acceptable, the new timer, timeConnSourceFailure could be used to identify the case of RLF in source cell after DAPS fallback? |
| **CMCC** | Option 1 | Agree with Ericsson. |
| **CATT** | Option 4 | In our understanding, only option 2 need to be considered to include the DAPS HO indication, however, we don’t see the benefits to include this indication.  |
| **LG** | Option 4 | As Qualcomm commented, the presence of *timeConnSourceFailure* indicates the DAPS HO. |
| **NEC** | Option 4 | For RLF in source cell after DAPS fallback, as in Q2, the network can be aware of it by other RLF information, explicit indication is not needed. For RLF in the target cell after DAPS handover, we don’t see the need of including the indication so far. |
| **ZTE** | Option 4 | For option 2, the scenario is a too-early HO/to wrong HO, I wonder if different optimization shall be used if the previous HO is a DAPS HO.For option3, we agree with QC with explicit fallback indication this is no needed. |
| **Huawei,HiSilicon** | Option 1? | Including the DAPS HO type indicator for all cases will make it simpler. We are also open to discuss it until all the enhancements are stable and to check whether the implicit solution can work. |
| **vivo** | Option 4 | Agree with CATT and ZTE. |

# 3 Conclusion

**To be updated**

# References

1. R2-2108425, [Post114-e][850][SON MDT] Modeling of CHO and DAPS related RLF reports (Ericsson), RAN2#115-e