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

Electronic meeting, August 16th – August 27th 2021

Agenda Item: 8.13.2.1

Source: Ericsson

Title: [Post114-e][850][SON/MDT] Modeling of CHO and DAPS related RLF reports (Ericsson)

Document for: Discussion, Decision

# 1 Introduction

This document captures the outcome of this email discussion:

* [Post114-e][850][SON/MDT] Modeling of CHO and DAPS related RLF reports (Ericsson)

Scope：

- Model for storing (one variable or…) and/or reporting of Rel-17 report entries

- Enhancing FailureInfromation message vs using RLF report in certain scenarios (e.g., dual failure scenarios)

- Current Rel-16 version (after Jun Plenary) can be used as a baseline to start discussing the ASN.1 changes required for different options.

-Open issues figured out at this meeting

Intended outcome: Email discussion report

Deadline: Long

Companies inputs to this email discussion are appreciated by the 2nd August 2021 (EOB).

# 2 Discussion

The objective of this email discussion is to address open issues related to CHO and DAPS.

## 2.1 CHO

Related to CHO, the following agreements were reached in the last RAN2#114-e meeting:

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| **Agreements on CHO from RAN2#114-e:**   * To represent Timer C, i.e. the “Time elapsed between the first CHO execution and the corresponding latest CHO configuration received for the selected target cell” introduce a new timer, e.g. timeSinceCHOReconfig * To represent the measurement results of the candidate target cells: Reuse the measResultNeighCells in the RLF-Report, and include an indication (depending RAN3 conclusion) on whether a measured neighbour cell was configured as a CHO candidate or not. * RAN2 to progress the following method to derive Timer D, i.e. the time elapsed between CHO execution until the first HOF/RLF: The TimeConnFailure is re-used with possible updates to indicate that it is started at CHO execution. Introduce a new timer is not excluded. * For CHO, the reestablishmentCellID in the RLF-Report is used to represent the CellID in which the UE attempted the second reestablishment after failure of the CHO recovery failure following an HOF/RLF. * For CHO, the reestablishmentCellID is also used to represent in the RLF-report the cellID of the cell in which the UE attempted the (first) reestablishment if such cell is a non-CHO candidate cell. * RAN2 to include in the RLF report the following parameters for CHO failure cases:   1. failedPCellId is reused to indicate the cell where the first connection failure is detected in case of CHO   2. previousPCellId to include the source cell identity if the first failure is a HOF or CHOF   3. C-RNTI   4. rlf-cause if the first failure is RLF   5. noSuitableCellFound * For scenarios that two connection failures happened, the connection failure corresponds to the first failure. Separate IEs will be used for the two failures * For CHO, it is confirmed that a new CHOCellID is introduced in the RLF-Report to represent the CHO candidate cell selected after the first connection failure and before the reestablishment. |

Related to open issues on CHO, the following was captured as FFS:

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| **Open issues on CHO from RAN2#114-e:**   * FFS:Use separate IEs within the existing RLF-report to represent the second failure, and the first failure can be represented by reusing as much as possible existing IEs. |

Given the above, Rapporteur would like to mainly focus on the following open issues:

* Consolidate Timer D definitions
* Signalling model for CHO failures

### 2.1.1 Open issues on CHO parameters

The Timer D was defined in the email discussion [1], and it should represent the “Time elapsed between CHO execution until the first HOF/RLF”. As reported in the above list of agreements, in RAN2#114-e it was agreed that

* “The TimeConnFailure is re-used with possible updates to indicate that it is started at CHO execution. Introduce a new timer is not excluded”.

Hence, Rapporteur would like to ask if RAN2 can confirm that Timer D is represented by the legacy TimeConnFailure with updates to indicate that is started at CHO execution.

* **Q1: For the timer D, can RAN2 confirm that to represent the Timer D, the legacy TimeConnFailure can be used with clarifications to indicate that the TimeConnFailure is started at CHO execution?**

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| **Company** | **Yes/No** | **Comments** |
| **Qualcomm** | No | As pointed out by Nokia in the RAN2#114e-meeting, in the scenario when CHO is not executed because execution condition for none of the candidate cell met, timeConnFailure should also be reused to represent the time until connection failure since the reception of RRCReconfiguration.  Therefore, we want to keep the legacy definition of timeConnFailure. Timer D can be computed by the network using timer C and legacy timeConnFailure. |
| **Samsung** | No | We need not update the current definition of *TimeConnFailure*.  In RAN2#114e, RAN2 made the following agreement:  *To represent Timer C, i.e. the “Time elapsed between the first CHO execution and the corresponding latest CHO configuration received for the selected target cell” introduce a new timer, e.g. timeSinceCHOReconfig.*  Thus, the timer D can be easily derived from the new timer C (i.e. ti*meSinceCHOReconfig*) and the current timer, *TimeConnFailure*.  The suggested update would result in just confusion. |
| **OPPO** | Yes | What the network really care should be the CHO execution related information. Indeed, the UE could receive the RRCReconfiguration (including CHO execution condition) either later or sooner, but for optimization of the CHO performance, to know UE reception of the RRCReconfiguration timing information is not usuful. It is streightforward and simple for the network to juedge whether or not the CHO problem should be a too early, too late, or HO to wrong cell problem by simply checking a dedicated IE but not to derive it from other IEs. |
| **Huawei, HiSilicon** | No | We think timer D can be derived from timer C and the legacy timer timeConnFailure. |
| **CATT** | No | We prefer to keep the current definition of *TimeConnFailure*. The timer D can be derived from the timer C and the legacy *TimeConnFailure*. |
| **Ericsson** | Yes | Agree with Oppo analysis. If timeConnFailure is started at CHO configuration, that time is basically useless, because in case of RLF is of no interest for the network to know the time between CHO config and RLF in target. Additionally, the UE would need to start and run two timers in parallel, i.e. timer C and the timeConnFailure.  Instead, what the network wants to know is the time between CHO execution and RLF in target, and it seems much clearer and simpler (we believe also from the UE perspective) to just clarify in the specification that timeConnFailure is started at CHO execution. |
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Summary: To be added later

Related to parameters, Rapporteur would like to ask companies if there is any further timer, or radio-related parameter, or other types of parameters from the list of parameters discussed in [2] that you deem essential to consider in the RLF-Report for CHO.

* **Q2: Is there any further timer-, radio, or other other type of parameters that you deem essential to include in the RLF-Report for CHO? Please use the notation adopted in the corresponding tables in [2].**

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| **Company** | **No / Options (timer A,B,C,D, radio measurement A, B, C, etc.)** | **Comments** |
| **Qualcomm** | No |  |
| **Samsung** | None |  |
| **Huawei, HiSilicon** | Yes | In section 2.2.2, time between successive failures was discussed. For CHO, we think successive failures may also happen, e.g. CHO failure and CHO recovery failure. In this case, we suggest to discuss the time between successive CHO failures. |
| **CATT** | No |  |
| **Ericsson** | Time between fullfilment of triggering conditions | In case the UE is configured with both A3 and A5 event for CHO, it is interesting for the the network can determine whether both events should be configured or only one of them. For example, if the time elapsed is too long, there might be the risk that the UE experiences an RLF before triggering the HO, on the other hand it the time elapsed is sufficiently short, two event conditions may make the HO more robust. |
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Summary: To be added later

### 2.1.2 Signalling mechanisms

When performing a CHO, the UE may experience an handover failure that may be followed by a second handover attempt to a second CHO cell which in turn may succeed or fail. How to represent such multiple failures was discussed several times during the last RAN2 meetings, and these are the options currently on the table [1]:

* 1. Option-1: Use separate IEs within the existing RLF-report to represent the second failure, and the first failure can be represented by reusing as much as possible existing IEs
  2. Option-2: In case UE experiences multiple report triggers/ events, the UE stores multiple reports that the network can retrieve

In the email discussion [1], majority of companies were supporting Option 1, however it was not possible to reach agreement in RAN2#114. The overall ASN.1 impact and additionally procedural text impact of Option 1 and Option 2 are represented in the Annex. Rapporteur invites companies to have a look at the Annex to evaluate the two alternatives, and comment on that (if needed).

* **Q3: Which option do you prefer for the signalling model of the CHO RLF-Report?**

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| **Company** | **Option 1/2** | **Comments** |
| **Qualcomm** | Option 1 | This avoids duplication of the contents. |
| **Samsung** | Option 2  (but, not agree the ASN.1 example in Annex) | We really hope to have a tidy structure of ASN.1.  Main point is that if we don’t have an entry per failure, we will have to add several fields for 2nd failure as shown below, even though most of these fields are actually same as in existing RLF report.  This approach of the separate IEs is not simple, and not suitable also for future proof, e.g. should add more IEs if there is 3rd failure below in further enhancement:  RLF-Report-v17xy  secondFailureInfo                           SQUENCE {                                  field1                                                     Field1                                  field 2                                                    Field2                                  ..  }  thirdFailureInfo                                SQUENCE {                                  field1                                                     Field1                                  field 2                                                    Field2                                  ..  }  }  For simplicity and extensibility, we would like to have the multiple entries of failure report.  Since most of these fields of the 2nd failure are actually same as in existing RLF report, having multiple entries can avoid we have to introduce a lot of new ASN.1. The 2nd failure may include some fields that will not be relevant for existing ASN.1, but they can be omitted (as optional). Also, the overlapped fields can be omitted.  On the other hand, we have not assumed that ASN.1 example in Annex is best, i.e. we could introduce further simple and extensible structure, the form of a list (the SEQUENCE OF construct in ASN.1). Thus we have suggested the following structure:  UEInformationResponse-r17-IEs ::=    SEQUENCE {      rlf-ReportListExt-r17                       RLF-ReportListExt-r17                      OPTIONAL  }  RLF-ReportListExt-r17 ::= SEQUENCE (SIZE (1.. maxRLF-ReportExt-r17)) OF RLF-Report-r16 |
| **Huawei, HiSilicon** | FFS | There are pros/cons for both options.  For option 2, currently there are some mandatory IEs inside R16 RLF report. If following option 2, the mandatory IEs have to be used for 2nd RLF report, and this may need double checking.  Generally, we see some benefits for option 2, as it is more future-proof, e.g. if 2nd RLF report needs new IEs to be added, or a 3rd RLF report is introduced. |
| **CATT** | Option 2 | We tend to agree with Samsung that Option 2 is better choice.  First of all Opiton 2 has the that seems simpler and extensible. With the two failures in two reports separately, we cmay need to further check the duplicated contents for the two. But it seems that most fields in RLF report is optional present and most of the mandatory fields are different for two failures. Furthermore, it seems no need to request the two failure reports separately as the two failures are successive failures. |
| **Ericsson** | Option 1 | Our main concern with Option 2 is that many of the information in the two consecutive RLF report will be very similar, e.g. the measurement results of the last serving cell and neighbouring cells, as well as the location infomation, since likely the two failures will occur very close in time. Moreover, it will be difficult/not possible for the UE to include some of the parameters in the second RLF report. For example, at the time of second failure there is no serving cell, and no measurement configuration. Hence providing neighbour cell measurements may not be meaningful/possible. Additionally, some of the timers in the RLF-Report will need to be duplicated, e.g., the timeConnFailure would need to be stopped at the first failure and then immediately restarted so that it can be included again in the second RLF report in case a second failure occurs.  In order to avoid all the above, it should be captured in the specification that some of the parameters included in the first RLF report should not be included in the second RLF Report. Capturing these exceptions would complicate the specification, and doing the analysis of which parameters shall be included in the second RLF report and which not, would cost time.  We are also not sure about the ASN.1 structure proposed by Samsung, i.e. does that imply that a Rel.17 UE would always use the RLF-ReportListExt-r17 to include both the first and second RLF report? If yes, then that structure might not be fully backward compatible. If the network that fetches the RLF report is a Rel.16 node, it will not be able to even read the content of the first RLF Report. This implies that only Rel.17 network nodes would be able to fetch the legacy Rel.16 RLF Report. This is obviously not acceptable. That is the reason why we believe that if Option 2 is agreed, we should go for the design proposed in the Annex, i.e. create a new variable container for the second RLF report and stored it separately from the legacy RLF container, so that the Rel.16 first RLF report is not affected. Again, this seems to us an unnecessary complication. |
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Summary: To be added later

### 2.1.3 CHO for LTE

One aspect that has been missed in the past is regarding the CHO related RLF report enhancements associated to LTE. The CHO is configurable in LTE as well and the same set of RLF report contents as agreed for NR could be applicable for LTE. Based on this, Rapporteur would like to check if all companies are fine with including CHO related RLF report enhancements to LTE.

* **Q4: Whether companies are fine to apply the agreements related to NR CHO RLF report to LTE?**

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| **Company** | **Yes/No** | **Comments** |
| **Qualcomm** | May be not | We should focus on NR CHO RLF report. |
| **Samsung** | Yes | Possible, but we assume that the first priority is NR. |
| **OPPO** | No | Prefer focusing on NR CHO RLF report. |
| **Huawei, HiSilicon** | Yes | We are open for applying similar enhancements for CHO for LTE, and it could be lower priority compared with CHO for NR. |
| **CATT** | Yes | Agree we could get NR done first. |
| **Ericsson** | Yes | Since CHO is supported also in LTE, and there is no difference protocol-wise between CHO in LTE and in NR, we believe that the same agreements reached for NR can be applied also to LTE.  It is ok however to keep focusing on NR at this stage. |
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Summary: To be added later

## 2.2 DAPS

Related to DAPS, the following agreements were reached in the last RAN2#114-e meeting:

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| **Agreements on DAPS from RAN2#114-e:**   * For DAPS, the timeSinceFailure represents “the time elapsed since the last connection failure” (irrespective of whether that is in source or target). * For DAPS, the failedPCell and reestablishmentCellID in the RLF-report are reused as in legacy * For DAPS, scenarios 2b/2c and 3b/3c are merged |

Related to open issues on DAPS, the following was captured as FFS:

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| **Open issues on DAPS from RAN2#114-e:**   * RAN2 to keep discussing the need to include in the RLF report the “The elapsed time between first failure in source (or target) and second failure in target (or source) while performing the DAPS HO”. * For DAPS, RAN2 to further discuss the need of the following information in the RLF-Report   1. DAPS handover type indication in RLF-report in case that DAPS HO is successfully performed but subsequent RLF occurs in target   2. 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   3. Indicator to determine whether the HoF happened before or after the RLF at the source   4. The state of source link after successful RACH should be included in the RLF-Report * FFS: For DAPS, the timeConnFailure in the RLF-report represents “The elapsed time between the execution of DAPS and HOF or RLF in target cell”. * FFS: For DAPS, “The time elapsed since DAPS HO execution until RLF occurs in source cell before fallback”, is represented by a new timer in the RLF-Report, e.g. timeConnSourceFailure. * FFS: For DAPS, “The time elapsed since DAPS HO execution until RLF occurs in source cell after fallback”, is represented by the legacy timeConnFailure and by a “DAPS fallback” indication. |

Given the above, Rapporteur would like to mainly focus on the following open issues:

* Contents of RLF report related
  1. Timer related
     1. *timeBetweenTwoFailure*: Whether the following definition of a new timer associated to a DAPS HO is agreeable - time between successive failure (failure in source (or target) and second failure in target (or source)) in DAPS HO
     2. *timeConnFailure*: Whether the following definitions of timeConnFailure associated to a DAPS HO is agreeable (under different scenarios associated to DAPS):
        + The elapsed time between the execution of DAPS and HOF or RLF in target cell
        + The time elapsed since DAPS HO execution until RLF occurs in source cell after fallback
     3. *timeConnSourceFailure*: Whether the following definition of a new timer associated to a DAPS HO is agreeable - The time elapsed since DAPS HO execution until RLF occurs in source cell before fallback
  2. Other measurements
     1. Chronological sequence of the failure i.e., indication of whether the source failure occured first or the target failure occurred first when the UE experiences successive failures
     2. State of the source link after succeeding in perform RA to the target cell of the DAPS HO when the UE experiences failure in the target before receiving DAPS source release message.
     3. Handover type indicator i.e., indication that the handover failure is associated to the DAPS HO.
* Signalling model for failure related reporting in DAPS failures

### 2.2.1 Scenario of DAPS HOF or RLF in target cell after DAPS HO

First of all, Rapporteur would like to ask if RAN2 can confirm the following definition for timeConnFailure associated to the scenario of DAPS HOF or RLF in target cell (after DAPS HO).

* “The elapsed time between the execution of DAPS and HOF or RLF in target cell”
* **Q5: Is the above definition of timeConnFailure acceptable to represent in the RLF report the scenario of DAPS HOF or RLF in target cell (after DAPS HO)?**

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| **Company** | **Yes/No** | **Comments** |
| **Qualcomm** | Yes |  |
| **Samsung** | Yes (but preferable to keep the wording of current definition) | For the indicated scenario, the existing definition of timeConnFailure is ok and clear i.e. since the reception of the last RRCReconfiguration message to the failure. To say “the execution of DAPS” is not that clear (seems mix DAPS with CHO). |
| **OPPO** | Yes |  |
| **Huawei, HiSilicon** | No | We think timeConnFailure is defined as:   * The elapsed time between execution of DAPS and HOF or RLF in either source cell or target cell   If the first failure happens in the target cell, our suggested definition is the same as Q5. |
| **CATT** | Yes |  |
| **Ericsson** | Yes | The legacy timeConnFailure can be reused for DAPS, as it is in the legacy |
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### 2.2.2 Scenario of RLF in source while performing DAPS HO

Related to the scenario of RLF in source cell while performing DAPS HO (i.e. before fallback), Rapporteur would like to ask which of the following new timer values should be included in the RLF report associated to the DAPS HO.

1. *timeConnSourceFailure:* The time elapsed since DAPS HO execution until RLF occurs in source cell before fallback
2. *timeBetweenTwoFailure:* time between successive failure (failure in source (or target) and second failure in target (or source)) in DAPS HO

* **Q6: Which of the above new timer values should be included by the UE in the RLF report to represent the scenario of RLF in source cell while performing DAPS HO (i.e. before fallback)?**

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| **Company** | ***timeBetweenTwoFailure* / *timeConnSourceFailure* / *Both*** | **Comments** |
| **Qualcomm** | *timeConnSourceFailure* | However, we want to chaane the definition as: “The time elapsed since DAPS HO execution until RLF occurs in source cell”. We can use the flag to indicate if RLF at source happened before or after fallback. |
| **Samsung** | timeBetweenTwoFailure  (but, need to clarify whether to implicitly indicate it) | For DAPS HO optimization, we have assumed that it is useful to identify the interruption time happening even though DAPS HO has been configured.  If the interruption time is not ignored, it means the goal of the DAPS HO is not achieved, and the DAPS HO parameters may need to be updated.  Similar as CHO, if two RLF Report entries are defined, timeBetweenTwoFailure can be deduced from the two timeConnFailure, i.e. no new explicit timer is needed.  On the other hand, the time between the source failure and DAPS HO success may be also required. It can be reported with the Successful HO Report. |
| **OPPO** | *timeConnSourceFailure* | Agree with Qualcomm that *timeConnSourceFailure* IE is only to be used for indicating the time since DAPS HO execution until RLF occurs in source cell. A flag could be used to indicate whether or not fallback has been experienced when RLF occurs in source cell. |
| **Huawei, HiSilicon** | timeBetweenTwoFailure | Related to Q5, we think the legacy timeConnFailure with timeBetweenTwoFailure is sufficient. |
| **CATT** | *timeConnSourceFailure* | In our view *timeConnSourceFailure* is more suitable. If the legacy timeConnFailure is reused for failure in target cell, a new timer should be introduced to indicate the time failure in source cell. We prefer to use two new timers to represent the time elapsed since DAPS HO execution until RLF in source cell before and after fallback, respectively, for the sake of clarity. |
| **Ericsson** | *timeConnSourceFailure* | We agree to use the *timeConnSourceFailure,* since we do not see what benefit it brings to the network to know the time difference between successive failure.  However, we are not sure on the benefit of the Qualcomm proposal. Note that as per legacy behaviour, the legacy *timeConnFailure* will be anyhow included when there is an RLF, no matter if that occurs in the target or in the source after the DAPS fallback. Hence, if now we want to use the *timeConnSourceFailure* for the case of RLF in source cell after fallback, we would need to clarify in the specification that the legacy *timeConnFailure* **shall not** be included in the RLF report if the failure happens after fallback.  This seems an unnecessary complication in the procedural text. It seems more straightforward to assume that the new *timeConnSourceFailure* is just used during the DAPS HO, and the legacy *timeConnFailure* is used for the ordinary RLFs after the DAPS HO (i.e. no changes needed to the standard procedures related to the *timeConnFailure*). |
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Summary: To be added later

### 2.2.3 Scenario of RLF in source after DAPS fallback

Related to the scenario of RLF in source cell after fallback, Rapporteur would like to ask RAN2 how to cover it in the RLF report. In [1], two possible options were discussed:

* Option 1: Introduce a new timer, e.g. timeSinceFallback, representing the time elapsed between the HO execution (or the fallback) and the RLF in the source.
* Option-2: Reuse timeConnFailure (i.e. the time between DAPS HO execution and RLF) and introduce a “DAPS fallback” indication
* **Q7: Which of the above options do you prefer to represent in the RLF report the scenario of RLF in source cell after fallback?**

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| **Company** | **Option 1 / Option 2** | **Comments** |
| **Qualcomm** | Option 2 | However, instead of using timeConnFailure, we would prefer to use *timeConnSourceFailure, if for Q6 timeConnSourceFailure is agreed.* |
| **Samsung** | Option 2 (but need to clarify the new indication) | It is agreeable to reuse the current timer (i.e. option 2), but need to clarify if the new indication is required.  For instance, in the UE RLF Report, there are failedPCell and PreviousPcell. From the same failedPCell and PreviousPcell, the network can know failure in source without the UE context. |
| **OPPO** |  | The timer used for 2.2.2 and 2.2.3 should be the same, with a flag indicating whether or not the fallback has been experienced. TimeConnFailure is not proper since it would represent the time since DPAS execution until the 1st RLF/HOF, i.e., RLF at the target cell in such ‘after DAPS fallback scenario’. |
| **Huawei, HiSilicon** | Option 3 (New) | The definition of TimeConnFailure is the same as our answer to Q5, so the legacy IE can be reused.  For the “DAPS fallback” indication, we do not think it is needed as the network can deduce fallback based on RLF report 1 and RLF report 2. |
| **CATT** | Option 1 | Please see our comments to Q6. |
| **Ericsson** | Option 2 | Introducing a separate timer as an option 1 seems unnecessary, since timeConnFailure can be resued for this purpose. Additionally, as explained in our reply to Q6, as per legacy behaviour, the legacy *timeConnFailure* will be anyhow included when there is an RLF, no matter if that occurs in the target or in the source after the DAPS fallback.  Hence, without any modification to existing procedure, this time can be reused when an RLF occurs in the source after the fallback. Only a flag, i.e. “DAPS fallback” indication, should be added to the RLF report to inform the network that this RLF occurred after the DAPS fallback, so that the network does not do the mistake to categorize this HO as “too early” HO. |
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Summary: To be added later

### 2.2.4 Other DAPS parameters

Rapporteur would like to ask if the following measurements can be included in the RLF report associated to the failed DAPS HO.

1. Chronological sequence of the failure i.e., indication of whether the source failure occured first or the target failure occurred first when the UE experiences successive failures
2. State of the source link after succeeding in performing RA to the target cell of the DAPS HO when the UE experiences failure in the target before receiving DAPS source release message.
3. Handover type indicator in case of RLF in target cell after successful HO i.e., indication that the last handover before the RLF was a DAPS HO.
4. Indicator to determine whether the HOF happened before or after the RLF at the source

* **Q8: Which of the above measurements do you want to include in the RLF report associated to a failed DAPS HO?**

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| **Company** | ***i, ii, iii, none*** | **Comments** |
| **Qualcomm** | iii (I believe it is already agreed) | Others are not needed. This can be determined by other fields discussed in the above questions. |
| **Samsung** | Agree that all is useful, but need to check whether to implicitly indicate them | On i), it is useful but it can be implicitly derived with the timeConnFailure and the failedPCell, if separate RLF Report entry is applied for each failure.  On ii), it is useful but it can be estimated with the measurement results included in the RLF report.  On iii), we have assumed a network-based solution for network to identify it upon the handover failure, e.g. the source may identity it based on UE context and retrieved RLF Report, or ther target may inform the source of it upon handover failure. |
| **OPPO** | i,iii | We think both of i and iii are useful  Chronological sequence could be derived by checking the flag indicating whether or not the fallback has been experienced shown in the above section. |
| **Huawei, HiSilicon** | iii | On i), we think it depends on solutions for CHO related RLF report (e.g. listed in section 5 Annex).  On ii), TS 38.300 has the following definition for DAPS HO:  *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.*  For ii), the UE does not perform detection of RLF after succeeding in perfoming RA to the target cell, so ii) can not be got by the UE.  For iii), it was discussed in previous RAN2 meetings, and there was some support. We support introducing it. |
| **CATT** | iii | We think that i and ii can be deduced by timer information.  For iii, explicit DAPS handover type indication seems needed. |
| **Ericsson** | iii (maybe) | Parameter “iii” might be beneficial to have. However, if the DAPS fallback indicator is introduced from Q7, then having this indicator for a normal RLF after successful DAPS HO might not be strictly necessary. |
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Summary: To be added later

### 2.2.5 Signalling mechanisms

When performing a DAPS HO, the UE may experience a handover failure at the target cell and/or a RLF at the source cell. One could look into the single failure scenarios and dual failure scenarios separately as they might have different impacts on what message could be used for the failure related information reporting.

**Single Failure while performing DAPS HO:**

1. SF-1: Failure at the target cell (HOF) and successfully performing fallback

Currently the UE sends the FailureInformation but with no detailed information compared to an RLF report.

1. SF-2: Failure at the source cell (RLF) while completing DAPS HO to target cell

**Dual failure while performing DAPS HO:**

1. DF-1: Failure at the source (RLF) while performing access to DAPS target cell and failing to access the target (HOF)
2. DF-2: Failure at the target cell (HOF) and failing to perform fallback (RLF at source)

For the scenario SF-1 above, one could adopt one of the following options.

* Option-1: The detailed handover failure related information (similar to the contents of RLF report) are included in the FailureInformation message.
* Option-2: The detailed handover failure related information are included in the RLF-Report and this RLF report can be fetched like any other RLF report.

Based on the above.

* **Q9: Which option do you prefer for the failure related information reporting from the UE when the UE declares HOF while performing DAPS and successfully performs fallback to the source (i.e. scenario SF-1)?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1/2** | **Comments** |
| **Ericsson** | Option-2 | We do not want to increase the size of the mandatory message like FailureInformation as additional information included would increase the size significantly. |
| **Qualcomm** | Option-1 | In rel-16 UE behaviour, UE generates failureInforamtion upon T304 expiry and if the HO is DAPS HO to indicated HoF failure. We should keep the same UE behaviour and upon T304 expiry if HO is DAPS HO, we should use failureInformation to indicate HoF.  Furthermore, in my understanding, using the additional information provided in the failureInformation can be used by source cell to have a better target cell selection in next RRCReconfiguration upon fallback. Instead of blind selection of the target cell in the next RRCReconfiguration, the source cell can use additional information provided in the failureInformation. Therefore, our preference is to introduce additional information in the failureInformation itself. |
| **Samsung** | Option 1 | We have not assumed that the full RLF Report content should be included into FailureInformation. Since the source keeps alive, we may need a partial information, e.g. RA-related info during DAPS HO. |
| **OPPO** | Option 1 | Additional information provided in failureInformation message could help source cell filter out the improper target cell. |
| **Huawei, HiSilicon** | Option 1 | We share similar views as Qualcomm. |
| **CATT** | Option 1 | Agree with the points raised by QC and Samsung. |
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Summary: To be added later

For the scenario SF-2, DF-1 and DF-2 above, Rapporteur would like to ask if it is acceptable to use the RLF report to log the failure related measurements in these scenarios.

* **Q10: Is it acceptable to use the RLF report to log the failure related measurements for SF-2, DF-1 and DF-2 scenarios mentioned above?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments (if no, please mention what other procedure do you prefer)** |
| **Ericsson** | Yes |  |
| **Qualcomm** | Yes for DF-1 and DF-2 | I believe SF-2 is agreed to be considered in the SHR report. |
| **Samsung** | Yes  (but, SF-2 should be treated in Successful HO report?) | For dual failures, we would like to have separate RLF report entry as mentioned in 2.1.2. |
| **OPPO** | Yes |  |
| **Huawei, HiSilicon** | Yes | RAN2 has agreed to include SF-2 in SHR, so no need to log it again in RLF report. |
| **CATT** | Yes for DF-1 and DF-2 | For SF-2, the scenario has been discussed in SHR and agreed that “Successful HO completion, but RLF in source during DAPS HO” is part of the SHR.”. |
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Summary: To be added later

# 3 Conclusion

Based on the discussion in the previous sections we propose the following:

To be added later:

# 4 References

1. R2-2106690, [Offline 801][SON/MDT] Handover related SON aspects (Ericsson), Ericsson, RAN2#114
2. R2-2103945, [Post113-e][851][NR17 SON/MDT]  HO related SON changes (Ericsson), Ericsson, RAN2#113

# 5 Annex – Specification changes associated to RLF reports (16.4.1 version)

## 2.1 CHO related RLF report changes

### 2.1.1 Option-1: Single RLF report with entries related to both failures

/\*start of first changes\*/

– *UEInformationResponse*

The *UEInformationResponse* message is used by the UE to transfer information requested by the network.

Signalling radio bearer: SRB1 or SRB2 (when logged measurement information is included)

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to network

***UEInformationResponse message***

-- ASN1START

-- TAG-UEINFORMATIONRESPONSE-START

UEInformationResponse-r16 ::= SEQUENCE {

rrc-TransactionIdentifier RRC-TransactionIdentifier,

criticalExtensions CHOICE {

ueInformationResponse-r16 UEInformationResponse-r16-IEs,

criticalExtensionsFuture SEQUENCE {}

}

}

UEInformationResponse-r16-IEs ::= SEQUENCE {

measResultIdleEUTRA-r16 MeasResultIdleEUTRA-r16 OPTIONAL,

measResultIdleNR-r16 MeasResultIdleNR-r16 OPTIONAL,

logMeasReport-r16 LogMeasReport-r16 OPTIONAL,

connEstFailReport-r16 ConnEstFailReport-r16 OPTIONAL,

ra-ReportList-r16 RA-ReportList-r16 OPTIONAL,

rlf-Report-r16 RLF-Report-r16 OPTIONAL,

mobilityHistoryReport-r16 MobilityHistoryReport-r16 OPTIONAL,

lateNonCriticalExtension OCTET STRING OPTIONAL,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

/\*some parts skipped\*/

RLF-Report-r16 ::= CHOICE {

nr-RLF-Report-r16 SEQUENCE {

measResultLastServCell-r16 MeasResultRLFNR-r16,

measResultNeighCells-r16 SEQUENCE {

measResultListNR-r16 MeasResultList2NR-r16 OPTIONAL,

measResultListEUTRA-r16 MeasResultList2EUTRA-r16 OPTIONAL

} OPTIONAL,

c-RNTI-r16 RNTI-Value,

previousPCellId-r16 CHOICE {

nrPreviousCell-r16 CGI-Info-Logging-r16,

eutraPreviousCell-r16 CGI-InfoEUTRALogging

} OPTIONAL,

failedPCellId-r16 CHOICE {

nrFailedPCellId-r16 CHOICE {

cellGlobalId-r16 CGI-Info-Logging-r16,

pci-arfcn-r16 SEQUENCE {

physCellId-r16 PhysCellId,

carrierFreq-r16 ARFCN-ValueNR

}

},

eutraFailedPCellId-r16 CHOICE {

cellGlobalId-r16 CGI-InfoEUTRALogging,

pci-arfcn-r16 SEQUENCE {

physCellId-r16 EUTRA-PhysCellId,

carrierFreq-r16 ARFCN-ValueEUTRA

}

}

},

reconnectCellId-r16 CHOICE {

nrReconnectCellId-r16 CGI-Info-Logging-r16,

eutraReconnectCellId-r16 CGI-InfoEUTRALogging

} OPTIONAL,

timeUntilReconnection-16 TimeUntilReconnection-16 OPTIONAL,

reestablishmentCellId-r16 CGI-Info-Logging-r16 OPTIONAL,

timeConnFailure-r16 INTEGER (0..1023) OPTIONAL,

timeSinceFailure-r16 TimeSinceFailure-r16,

connectionFailureType-r16 ENUMERATED {rlf, hof},

rlf-Cause-r16 ENUMERATED {t310-Expiry, randomAccessProblem, rlc-MaxNumRetx,

beamFailureRecoveryFailure, lbtFailure-r16,

bh-rlfRecoveryFailure, spare2, spare1},

locationInfo-r16 LocationInfo-r16 OPTIONAL,

noSuitableCellFound-r16 ENUMERATED {true} OPTIONAL,

ra-InformationCommon-r16 RA-InformationCommon-r16 OPTIONAL,

...,

[[

secondCHOFailureCell-r17 CHOICE {

cellGlobalId-r17 CGI-Info-Logging-r17,

pci-arfcn-r17 SEQUENCE {

physCellId-r17 PhysCellId,

carrierFreq-r17 ARFCN-ValueNR

}

} OPTIONAL,

hoType-r17 ENUMERATED {CHO, DAPS, spare2, spare1} OPTIONAL,

timeCHOConfig2Failure-r17 TimeCHOConfig2Failure-r17 OPTIONAL,

allAgreedNewFields

]]

},

eutra-RLF-Report-r16 SEQUENCE {

failedPCellId-EUTRA CGI-InfoEUTRALogging,

measResult-RLF-Report-EUTRA-r16 OCTET STRING,

...

}

}

MeasResultList2NR-r16 ::= SEQUENCE(SIZE (1..maxFreq)) OF MeasResult2NR-r16

MeasResultList2EUTRA-r16 ::= SEQUENCE(SIZE (1..maxFreq)) OF MeasResult2EUTRA-r16

MeasResult2NR-r16 ::= SEQUENCE {

ssbFrequency-r16 ARFCN-ValueNR OPTIONAL,

refFreqCSI-RS-r16 ARFCN-ValueNR OPTIONAL,

measResultList-r16 MeasResultListNR

}

MeasResultListLogging2NR-r16 ::= SEQUENCE(SIZE (1..maxFreq)) OF MeasResultLogging2NR-r16

MeasResultLogging2NR-r16 ::= SEQUENCE {

carrierFreq-r16 ARFCN-ValueNR,

measResultListLoggingNR-r16 MeasResultListLoggingNR-r16

}

MeasResultListLoggingNR-r16 ::= SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultLoggingNR-r16

MeasResultLoggingNR-r16 ::= SEQUENCE {

physCellId-r16 PhysCellId,

resultsSSB-Cell-r16 MeasQuantityResults,

numberOfGoodSSB-r16 INTEGER (1..maxNrofSSBs-r16) OPTIONAL

}

MeasResult2EUTRA-r16 ::= SEQUENCE {

carrierFreq-r16 ARFCN-ValueEUTRA,

measResultList-r16 MeasResultListEUTRA

}

MeasResultRLFNR-r16 ::= SEQUENCE {

measResult-r16 SEQUENCE {

cellResults-r16 SEQUENCE{

resultsSSB-Cell-r16 MeasQuantityResults OPTIONAL,

resultsCSI-RS-Cell-r16 MeasQuantityResults OPTIONAL

},

rsIndexResults-r16 SEQUENCE{

resultsSSB-Indexes-r16 ResultsPerSSB-IndexList OPTIONAL,

ssbRLMConfigBitmap-r16 BIT STRING (SIZE (64)) OPTIONAL,

resultsCSI-RS-Indexes-r16 ResultsPerCSI-RS-IndexList OPTIONAL,

csi-rsRLMConfigBitmap-r16 BIT STRING (SIZE (96)) OPTIONAL

} OPTIONAL

}

}

TimeSinceFailure-r16 ::= INTEGER (0..172800)

TimeCHOConfig2Failure-r17 ::= INTEGER (0..172800)

MobilityHistoryReport-r16 ::= VisitedCellInfoList-r16

TimeUntilReconnection-16 ::= INTEGER (0..172800)

-- TAG-UEINFORMATIONRESPONSE-STOP

-- ASN1STOP

|  |
| --- |
| ***UEInformationResponse-IEs* field descriptions** |
| ***logMeasReport***  This field is used to provide the measurement results stored by the UE associated to logged MDT. |
| ***measResultIdleEUTRA***  EUTRA measurement results performed during RRC\_INACTIVE or RRC\_IDLE. |
| ***measResultIdleNR***  NR measurement results performed during RRC\_INACTIVE or RRC\_IDLE. |
| ***ra-Report***  This field is used to provide the list of RA reports that is stored by the UE for the past upto *maxRAReport-r16* number of successful random access procedues. |
| ***rlf-Report***  This field is used to indicate the RLF report related contents. |

|  |
| --- |
| ***LogMeasReport* field descriptions** |
| ***absoluteTimeStamp***  Indicates the absolute time when the logged measurement configuration logging is provided, as indicated by NR within *absoluteTimeInfo*. |
| ***anyCellSelectionDetected***  This field is used to indicate the detection of *any cell selection* state, as defined in TS 38.304 [20]. The UE sets this field when performing the logging of measurement results in RRC\_IDLE or RRC\_INACTIVE and there is no suitable cell or no acceptable cell. |
| ***measResultServingCell***  This field refers to the log measurement results taken in the Serving cell. |
| ***numberOfGoodSSB***  Indicates the number of good beams (beams that are above *absThreshSS-BlocksConsolidation,* if configured by the network) associated to the cells within the R value range (which is configured by network for cell reselection) of the highest ranked cell as part of the beam level measurements. If the UE has no SSB of a neighbour cell whose measurement quantity is above the *absThreshSS-BlocksConsolidation* or if the network has not configured the *absThreshSS-BlocksConsolidation*, then the UE does not include *numberOfGoodSSB* for the corresponding neighbour cell. If the UE has no SSB of the serving cell whose measurement quantity is above the *absThreshSS-BlocksConsolidation* or if the network has not configured the *absThreshSS-BlocksConsolidation*, then the UE shall set the *numberOfGoodSSB* for the serving cell to one. |
| ***relativeTimeStamp***  Indicates the time of logging measurement results, measured relative to the *absoluteTimeStamp*. Value in seconds. |
| ***tce-Id***  Parameter Trace Collection Entity Id: See TS 32.422 [52]. |
| ***traceRecordingSessionRef***  Parameter Trace Recording Session Reference: See TS 32.422 [52]. |

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| --- |
| ***ConnEstFailReport* field descriptions** |
| ***measResultFailedCell***  This field refers to the last measurement results taken in the cell, where connection establishment failure or connection resume failure happened. |
| ***measResultNeighCells***  This field refers to the neighbour cell measurements when connection establishment failure or connection resume failure happened. |
| ***numberOfConnFail***  This field is used to indicate the latest number of consecutive failed RRCSetup or RRCResume procedures in the same cell independent of RRC state transition. |
| ***numberOfPreamblesSent***  This field is used to indicate the number of random access preambles that were transmitted. |
| ***timeSinceFailure***  This field is used to indicate the time that elapsed since the connection (establishment or resume) failure. Value in seconds. The maximum value 172800 means 172800s or longer. |

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| --- |
| ***RA-Report* field descriptions** |
| ***absoluteFrequencyPointA***  This field indicates the absolute frequency position of the reference resource block (Common RB 0). |
| ***cellID***  This field indicates the CGI of the cell in which the associated random access procedure was performed. |
| ***contentionDetected***  This field is used to indicate that contention was detected for the transmitted preamble in the given random access attempt or not. This field is not included when the UE performs random access attempt is using contention free random-access resources or when the *raPurpose* is set to *requestForOtherSI*. |
| ***csi-RS-Index***  This field is used to indicate the CSI-RS index corresponding to the random access attempt. |
| ***dlRSRPAboveThreshold***  This field is used to indicate whether the DL beam (SSB) quality associated to the random access attempt was above or below the threshold *rsrp-ThresholdSSB* in *beamFailureRecoveryConfig* in UL BWP configuration of UL BWP selected for random access procedure initiated for beam failure recovery; Otherwise, *rsrp-ThresholdSSB* in *rach-ConfigCommon* in UL BWP configuration of UL BWP selected for random access procedure. |
| ***locationAndBandwidth***  Frequency domain location and bandwidth of the bandwidth part associated to the random-access resources used by the UE. |
| ***numberOfPreamblesSentOnCSI-RS***  This field is used to indicate the total number of successive RA preambles that were transmitted on the corresponding CSI-RS. |
| ***numberOfPreamblesSentOnSSB***  This field is used to indicate the total number of successive RA preambles that were transmitted on the corresponding SS/PBCH block. |
| ***perRAAttemptInfoList***  This field provides detailed information about a random access attempt. |
| ***perRAInfoList***  This field provides detailed information about each of the random access attempts in the chronological order of the random access attempts. |
| ***perRACSI-RSInfoList***  This field provides detailed information about the successive random access attempts associated to the same CSI-RS. |
| ***perRASSBInfoList***  This field provides detailed information about the successive random access attempts associated to the same SS/PBCH block. |
| ***raPurpose***  This field is used to indicate the RA scenario for which the RA report entry is triggered. The RA accesses associated to Initial access from RRC\_IDLE, transition from RRC-INACTIVE and the MSG3 based SI request are indicated using the indicator 'accessRelated'. The indicator *beamFailureRecovery* is used in case of successful beam failure recovery related RA procedure in the SpCell [3]. The indicator *reconfigurationWithSync* is used if the UE executes a reconfiguration with sync. The indicator *ulUnSynchronized* is used if the random access procedure is initiated in a SpCell by DL or UL data arrival during RRC\_CONNECTED when the timeAlignmentTimer is not running in the PTAG or if the RA procedure is initiated in a serving cell by a PDCCH order [3]. The indicator *schedulingRequestFailure* is used in case of SR failures [3]. The indicator *noPUCCHResourceAvailable* is used when the UE has no valid SR PUCCH resources configured [3]. The indicator *requestForOtherSI* is used for MSG1 based on demand SI request. |
| ***ra-InformationCommon***  This field is used to indicate the common random-access related information between *RA-report* and *RLF-report*. For RA report, this field is mandatory presented. For *RLF-report*, this field is optionally included when c*onnectionFailureType* is set to 'hof' or when *connectionFailureType* is set to 'rlf' and the *rlf-Cause* equals to 'randomAccessProblem' or 'beamRecoveryFailure'; otherwise this field is absent. |
| ***ssb-Index***  This field is used to indicate the SS/PBCH index of the SS/PBCH block corresponding to the random access attempt. |
| ***subcarrierSpacing***  Subcarrier spacing used in the BWP associated to the random-access resources used by the UE. |

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| --- |
| ***RLF-Report* field descriptions** |
| ***connectionFailureType***  This field is used to indicate whether the connection failure is due to radio link failure or handover failure. |
| ***csi-rsRLMConfigBitmap***  This field is used to indicate the CSI-RS indexes that are also part of the RLM configurations. |
| ***c-RNTI***  This field indicates the C-RNTI used in the PCell upon detecting radio link failure or the C-RNTI used in the source PCell upon handover failure. |
| ***failedPCellId***  This field is used to indicate the PCell in which RLF is detected or the target PCell of the failed handover. For intra-NR handover *nrFailedPCellId* is included and for the handover from NR to EUTRA *eutraFailedPCellId* is included. The UE sets the ARFCN according to the frequency band used for transmission/ reception when the failure occurred. |
| ***failedPCellId-EUTRA***  This field is used to indicate the PCell in which RLF is detected or the source PCell of the failed handover in an E-UTRA RLF report. |
| ***measResultListEUTRA***  This field refers to the last measurement results taken in the neighboring EUTRA Cells, when the radio link failure or handover failure happened. |
| ***measResultListNR***  This field refers to the last measurement results taken in the neighboring NR Cells, when the radio link failure or handover failure happened. |
| ***measResultLastServCell***  This field refers to the log measurement results taken in the PCell upon detecting radio link failure or the source PCell upon handover failure. |
| ***measResult-RLF-Report-EUTRA***  Includes the E-UTRA *RLF-Report-r9* IE as specified in TS 36.331 [10]. |
| ***noSuitableCellFound***  This field is set by the UE when the T311 expires. |
| ***previousPCellId***  This field is used to indicate the source PCell of the last handover (source PCell when the last *RRCReconfiguration* message including *reconfigurationWithSync* was received). For intra-NR handover *nrPreviousCell* is included and for the handover from EUTRA to NR *eutraPreviousCell* is included. |
| ***reconnectCellId***  This field is used to indicate the cell in which the UE comes back to connected after connection failure and after failing to perform reestablishment. If the UE comes back to RRC CONNECTED in an NR cell then *nrReconnectCellID* is included and if the UE comes back to RRC CONNECTED in an LTE cell then *eutraReconnectCellID* is included |
| ***reestablishmentCellId***  This field is used to indicate the cell in which the re-establishment attempt was made after connection failure. In the case of CHO related RLF report, this is the cell identifier in which the *RRCReestablishmentRequest* message transmission was initiated by the UE. |
| ***rlf-Cause***  This field is used to indicate the cause of the last radio link failure that was detected. In case of handover failure information reporting (i.e., the *connectionFailureType* is set to '*hof*'), the UE is allowed to set this field to any value. |
| ***secondCHOFailrueCell***  This field is used to indicate the selected cell after the UE declares the failure which happens to be a candidate CHO cell configured at the UE. This field is included only if the attempted access to this cell also fails i.e., the UE experiences successive failures. |
| ***ssbRLMConfigBitmap***  This field is used to indicate the SS/PBCH block indexes that are also part of the RLM configurations. |
| ***timeConnFailure***  This field is used to indicate the time elapsed since the last HO initialization until connection failure. Actual value = field value \* 100ms. The maximum value 1023 means 102.3s or longer. |
| ***timeSinceFailure***  This field is used to indicate the time that elapsed since the connection (radio link or handover) failure. Value in seconds. The maximum value 172800 means 172800s or longer. |
| ***timeUntilReconnection***  This field is used to indicate the time that elapsed between the connection (radio link or handover) failure and the next time the UE comes to RRC CONNECTED in an NR or EUTRA cell. Value in seconds. The maximum value 172800 means 172800s or longer. |

### 2.1.2 Option-2: Dual RLF reports, one each per failure

/\*start of first changes\*/

#### 5.3.3.4 Reception of the *RRCSetup* by the UE

The UE shall perform the following actions upon reception of the *RRCSetup*:

1> if the *RRCSetup* is received in response to an *RRCReestablishmentRequest*; or

1> if the *RRCSetup* is received in response to an *RRCResumeRequest* or *RRCResumeRequest1*:

2> discard any stored UE Inactive AS context and *suspendConfig*;

2> discard any current AS security context including the KRRCenc key, the KRRCint key, the KUPint key and the KUPenc key;

2> release radio resources for all established RBs except SRB0, including release of the RLC entities, of the associated PDCP entities and of SDAP;

2> release the RRC configuration except for the default L1 parameter values, default MAC Cell Group configuration and CCCH configuration;

2> indicate to upper layers fallback of the RRC connection;

2> stop timer T380, if running;

1> perform the cell group configuration procedure in accordance with the received *masterCellGroup* and as specified in 5.3.5.5;

1> perform the radio bearer configuration procedure in accordance with the received *radioBearerConfig* and as specified in 5.3.5.6;

1> if stored, discard the cell reselection priority information provided by the *cellReselectionPriorities* or inherited from another RAT;

1> stop timer T300, T301 or T319 if running;

1> if T390 is running:

2> stop timer T390 for all access categories;

2> perform the actions as specified in 5.3.14.4;

1> if T302 is running:

2> stop timer T302;

2> perform the actions as specified in 5.3.14.4;

1> stop timer T320, if running;

1> if the *RRCSetup* is received in response to an *RRCResumeRequest*, *RRCResumeRequest1* or *RRCSetupRequest*:

2> if T331 is running:

3> stop timer T331;

3> perform the actions as specified in 5.7.8.3;

2> enter RRC\_CONNECTED;

2> stop the cell re-selection procedure;

1> consider the current cell to be the PCell;

1> if the UE has radio link failure or handover failure information available in *VarRLF-Report* and if the RPLMN is included in *plmn-IdentityList* stored in *VarRLF-Report*:

2> if *reconnectCellId* in *VarRLF-Report* is not set:

3> set *timeUntilReconnection* in *VarRLF-Report* to the time that elapsed since the last radio link failure or handover failure;

3> set *nrReconnectCellId* in *reconnectCellId* in *VarRLF-Report* to the global cell identity and the tracking area code of the PCell;

1> if the UE has radio link failure or handover failure information available in *VarSecondRLF-Report* and if the RPLMN is included in *plmn-IdentityList* stored in *VarSecondRLF-Report*:

2> if *reconnectCellId* in *VarSecondRLF-Report* is not set:

3> set *timeUntilReconnection* in *VarSecondRLF-Report* to the time that elapsed since the last radio link failure or handover failure;

3> set *nrReconnectCellId* in *reconnectCellId* in *VarSecondRLF-Report* to the global cell identity and the tracking area code of the PCell;

1> if the UE supports RLF report for inter-RAT MRO NR as defined in TS 36.306 [62], and if the UE has radio link failure or handover failure information available in *VarRLF-Report* of TS 36.331 [10] and if the RPLMN is included in *plmn-IdentityList* stored in *VarRLF-Report* of TS 36.331 [10]:

2> if *reconnectCellId* in *VarRLF-Report* of TS 36.331[10] is not set:

3> set *timeUntilReconnection* in *VarRLF-Report* of TS 36.331[10] to the time that elapsed since the last radio link failure or handover failure in LTE;

3> set *nrReconnectCellId* in *reconnectCellId* in *VarRLF-Report* of TS 36.331[10] to the global cell identity and the tracking area code of the PCell;

1> set the content of *RRCSetupComplete* message as follows:

2> if upper layers provide a 5G-S-TMSI:

3> if the *RRCSetup* is received in response to an *RRCSetupRequest*:

4> set the *ng-5G-S-TMSI-Value* to *ng-5G-S-TMSI-Part2*;

3> else:

4> set the *ng-5G-S-TMSI-Value* to *ng-5G-S-TMSI*;

2> if upper layers selected an SNPN or a PLMN and in case of PLMN UE is either allowed or instructed to access the PLMN via a cell for which at least one CAG ID is broadcast:

3> set the *selectedPLMN-Identity* from the *npn-IdentityInfoList*;

2> else:

3> set the *selectedPLMN-Identity* to the PLMN selected by upper layers from the *plmn-IdentityList*;

2> if upper layers provide the 'Registered AMF':

3> include and set the *registeredAMF* as follows:

4> if the PLMN identity of the 'Registered AMF' is different from the PLMN selected by the upper layers:

5> include the *plmnIdentity* in the *registeredAMF* and set it to the value of the PLMN identity in the 'Registered AMF' received from upper layers;

4> set the *amf-Identifier* to the value received from upper layers;

3> include and set the *guami-Type* to the value provided by the upper layers;

2> if upper layers provide one or more S-NSSAI (see TS 23.003 [21]):

3> include the *s-NSSAI-List* and set the content to the values provided by the upper layers;

2> set the *dedicatedNAS-Message* to include the information received from upper layers;

2> if connecting as an IAB-node:

3> include the *iab-NodeIndication*;

2> if the SIB1 contains *idleModeMeasurementsNR* and the UE has NR idle/inactive measurement information concerning cells other than the PCell available in *VarMeasIdleReport*; or

2> if the SIB1 contains *idleModeMeasurementsEUTRA* and the UE has E-UTRA idle/inactive measurement information available in *VarMeasIdleReport*:

3> include the *idleMeasAvailable*;

2> if the UE has logged measurements available for NR and if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport*:

3> include the *logMeasAvailable* in the *RRCSetupComplete* message;

3> if Bluetooth measurement results are included in the logged measurements the UE has available for NR and if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport*:

4> include the *logMeasAvailableBT* in the *RRCSetupComplete* message;

3> if WLAN measurement results are included in the logged measurements the UE has available for NR and if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport*:

4> include the *logMeasAvailableWLAN* in the *RRCSetupComplete* message;

2> if the UE has connection establishment failure or connection resume failure information available in *VarConnEstFailReport* and if the RPLMN is equal to *plmn-Identity* stored in *VarConnEstFailReport*:

3> include *connEstFailInfoAvailable* in the *RRCSetupComplete* message;

2> if the UE has radio link failure or handover failure information available in *VarRLF-Report* and if the RPLMN is included in *plmn-IdentityList* stored in *VarRLF-Report*, or

2> if the UE has radio link failure or handover failure information available in *VarRLF-Report* of TS 36.331 [10], and if the UE is capable of cross-RAT RLF reporting and if the RPLMN is included in *plmn-IdentityList* stored in *VarRLF-Report* of TS 36.331 [10]:

3> include *rlf-InfoAvailable* in the *RRCSetupComplete* message;

2> if the UE supports storage of mobility history information and the UE has mobility history information available in *VarMobilityHistoryReport*:

3> include the *mobilityHistoryAvail* in the *RRCSetupComplete* message;

2> if the *RRCSetup* is received in response to an *RRCResumeRequest*, *RRCResumeRequest1* or *RRCSetupRequest*:

3> if *speedStateReselectionPars* is configured in the *SIB2*:

4> include the *mobilityState* in the *RRCSetupComplete* message and set it to the mobility state (as specified in TS 38.304 [20]) of the UE just prior to entering RRC\_CONNECTED state;

1> submit the *RRCSetupComplete* message to lower layers for transmission, upon which the procedure ends.

/\*Next changes\*/

5.7.10.3 Reception of the *UEInformationRequest* message

Upon receiving the *UEInformationRequest* message, the UE shall, only after successful security activation:

1> if the *idleModeMeasurementReq* is included in the *UEInformationRequest* and the UE has stored *VarMeasIdleReport* that contains measurement information concerning cells other than the PCell:

2> set the *measResultIdleEUTRA* in the *UEInformationResponse* message to the value of *measReportIdleEUTRA* in the *VarMeasIdleReport, if available*;

2> set the *measResultIdleNR* in the *UEInformationResponse* message to the value of *measReportIdleNR* in the *VarMeasIdleReport*, if available;

2> discard the *VarMeasIdleReport* upon successful delivery of the *UEInformationResponse* message confirmed by lower layers;

1> if the *logMeasReportReq* is present and if the RPLMN is included in *plmn-IdentityList* stored in *VarLogMeasReport*:

2> if *VarLogMeasReport* includes one or more logged measurement entries, set the contents of the *logMeasReport* in the *UEInformationResponse* message as follows:

3> include the *absoluteTimeStamp* and set it to the value of *absoluteTimeInfo* in the *VarLogMeasReport*;

3> include the *traceReference* and set it to the value of *traceReference* in the *VarLogMeasReport*;

3> include the *traceRecordingSessionRef* and set it to the value of *traceRecordingSessionRef* in the *VarLogMeasReport;*

3> include the *tce-Id* and set it to the value of *tce-Id* in the *VarLogMeasReport*;

3> include the *logMeasInfoList* and set it to include one or more entries from the *VarLogMeasReport* starting from the entries logged first, and for each entry of the *logMeasInfoList* that is included, include all information stored in the corresponding *logMeasInfoList* entry in *VarLogMeasReport*;

3> if the *VarLogMeasReport* includes one or more additional logged measurement entries that are not included in the *logMeasInfoList* within the *UEInformationResponse* message:

4> include the *logMeasAvailable*;

4> if *bt-LocationInfo* is included in *locationInfo* of one or more of the additional logged measurement entries in *VarLogMeasReport* that are not included in the *logMeasInfoList* within the *UEInformationResponse* message:

5> include the *logMeasAvailableBT*;

4> if *wlan-LocationInfo* is included in *locationInfo* of one or more of the additional logged measurement entries in *VarLogMeasReport* that are not included in the *logMeasInfoList* within the *UEInformationResponse* message:

5> include the *logMeasAvailableWLAN*;

1> if *ra-ReportReq* is set to *true* and the UE has random access related information available in *VarRA-Report* and if the RPLMN is included in *plmn-IdentityList* stored in *VarRA-Report*:

2> set the *ra-ReportList* in the *UEInformationResponse* message to the value of *ra-ReportList* in *VarRA-Report*;

2> discard the *ra-ReportList* from *VarRA-Report* upon successful delivery of the *UEInformationResponse* message confirmed by lower layers;

1> if *rlf-ReportReq* is set to *true*:

2> if the UE has radio link failure information or handover failure information available in *VarRLF-Report* and if the RPLMN is included in *plmn-IdentityList* stored in *VarRLF-Report*:

3> set *timeSinceFailure* in *VarRLF-Report* to the time that elapsed since the last radio link failure or handover failure in NR;

3> set the *rlf-Report* in the *UEInformationResponse* message to the value of *rlf-Report* in *VarRLF-Report*;

3> discard the *rlf-Report* from *VarRLF-Report* upon successful delivery of the *UEInformationResponse* message confirmed by lower layers;

2> else if the UE is capable of cross-RAT RLF reporting as defined in TS 38.306 [26] and has radio link failure information or handover failure information available in *VarRLF-Report* of TS 36.331 [10] and if the RPLMN is included in *plmn-IdentityList* stored in *VarRLF-Report* of TS 36.331 [10]:

3> set *timeSinceFailure* in *VarRLF-Report* of TS 36.331 [10] to the time that elapsed since the last radio link failure or handover failure in EUTRA;

3> set failedPCellId-EUTRA in the *rlf-Report* in the *UEInformationResponse* message to indicate the PCell in which RLF was detected or the source PCell of the failed handover in the *VarRLF-Report* of TS 36.331 [10];

3> set the *measResult-RLF-Report-EUTRA* in the *rlf-Report* in the *UEInformationResponse* message to the value of *rlf-Report* in *VarRLF-Report* of TS 36.331 [10];

3> discard the *rlf-Report* from *VarRLF-Report* of TS 36.331 [10] upon successful delivery of the *UEInformationResponse* message confirmed by lower layers;

1> if *rlf-SecondReportReq* is set to *true*:

2> if the UE has radio link failure information or handover failure information available in *VarSecondRLF-Report* and if the RPLMN is included in *plmn-IdentityList* stored in *VarSecondRLF-Report*:

3> set *timeSinceFailure* in *VarSecondRLF-Report* to the time that elapsed since the last radio link failure or handover failure in NR;

3> set the *rlf-Report* in the *UEInformationResponse* message to the value of *rlf-Report* in *VarSecondRLF-Report*;

3> discard the *rlf-Report* from *VarSecondRLF-Report* upon successful delivery of the *UEInformationResponse* message confirmed by lower layers;

2> else if the UE is capable of cross-RAT RLF reporting as defined in TS 38.306 [26] and has radio link failure information or handover failure information available in *VarSecondRLF-Report* of TS 36.331 [10] and if the RPLMN is included in *plmn-IdentityList* stored in *VarSecondRLF-Report* of TS 36.331 [10]:

3> set *timeSinceFailure* in *VarSecondRLF-Report* of TS 36.331 [10] to the time that elapsed since the last radio link failure or handover failure in EUTRA;

3> set failedPCellId-EUTRA in the *rlf-Report* in the *UEInformationResponse* message to indicate the PCell in which RLF was detected or the source PCell of the failed handover in the *VarSecondRLF-Report* of TS 36.331 [10];

3> set the *measResult-RLF-Report-EUTRA* in the *rlf-Report* in the *UEInformationResponse* message to the value of *rlf-Report* in *VarSecondRLF-Report* of TS 36.331 [10];

3> discard the *rlf-Report* from *VarSecondRLF-Report* of TS 36.331 [10] upon successful delivery of the *UEInformationResponse* message confirmed by lower layers;

1> if *connEstFailReportReq* is set to *true* and the UE has connection establishment failure or connection resume failure information in *VarConnEstFailReport* and if the RPLMN is equal to *plmn-Identity* stored in *VarConnEstFailReport*:

2> set *timeSinceFailure* in *VarConnEstFailReport* to the time that elapsed since the last connection establishment failure or connection resume failure in NR;

2> set the *connEstFailReport* in the *UEInformationResponse* message to the value of *connEstFailReport* in *VarConnEstFailReport*;

2> discard the *connEstFailReport* from *VarConnEstFailReport* upon successful delivery of the *UEInformationResponse* message confirmed by lower layers;

1> if the *mobilityHistoryReportReq* is set to *true*:

2> include the *mobilityHistoryReport* and set it to include entries from *VarMobilityHistoryReport*;

2> include in the *mobilityHistoryReport* an entry for the current cell, possibly after removing the oldest entry if required, and set its fields as follows:

3> set *visitedCellId* to the global cell identity or the physical cell identity and carrier frequency of the current cell:

3> set field *timeSpent* to the time spent in the current cell;

1> if the *logMeasReport* is included in the *UEInformationResponse*:

2> submit the *UEInformationResponse* message to lower layers for transmission via SRB2;

2> discard the logged measurement entries included in the *logMeasInfoList* from *VarLogMeasReport* upon successful delivery of the *UEInformationResponse* message confirmed by lower layers;

1> else:

2> submit the *UEInformationResponse* message to lower layers for transmission via SRB1.

/\*Next changes\*/

– *UEInformationRequest*

The *UEInformationRequest* message is used by the network to retrieve information from the UE.

Signalling radio bearer: SRB1

RLC-SAP: AM

Logical channel: DCCH

Direction: Network to UE

***UEInformationRequest message***

-- ASN1START

-- TAG-UEINFORMATIONREQUEST-START

UEInformationRequest-r16 ::= SEQUENCE {

rrc-TransactionIdentifier RRC-TransactionIdentifier,

criticalExtensions CHOICE {

ueInformationRequest-r16 UEInformationRequest-r16-IEs,

criticalExtensionsFuture SEQUENCE {}

}

}

UEInformationRequest-r16-IEs ::= SEQUENCE {

idleModeMeasurementReq-r16 ENUMERATED{true} OPTIONAL, -- Need N

logMeasReportReq-r16 ENUMERATED {true} OPTIONAL, -- Need N

connEstFailReportReq-r16 ENUMERATED {true} OPTIONAL, -- Need N

ra-ReportReq-r16 ENUMERATED {true} OPTIONAL, -- Need N

rlf-ReportReq-r16 ENUMERATED {true} OPTIONAL, -- Need N

mobilityHistoryReportReq-r16 ENUMERATED {true} OPTIONAL, -- Need N

lateNonCriticalExtension OCTET STRING OPTIONAL,

nonCriticalExtension UEInformationRequest-r17-IEs OPTIONAL

}

UEInformationRequest-r17-IEs ::= SEQUENCE {

rlf-SecondReportReq-r16 ENUMERATED {true} OPTIONAL, -- Need N

lateNonCriticalExtension OCTET STRING OPTIONAL,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

-- TAG-UEINFORMATIONREQUEST-STOP

-- ASN1STOP

|  |
| --- |
| ***UEInformationRequest-IEs* field descriptions** |
| ***connEstFailReportReq***  This field is used to indicate whether the UE shall report information about the connection failure. |
| ***idleModeMeasurementReq***  This field indicates that the UE shall report the idle/inactive measurement information, if available, to the network in the *UEInformationResponse* message. |
| ***logMeasReportReq***  This field is used to indicate whether the UE shall report information about logged measurements. |
| ***mobilityHistoryReportReq***  This field is used to indicate whether the UE shall report information about mobility history information. |
| ***ra-ReportReq***  This field is used to indicate whether the UE shall report information about the random access procedure. |
| ***rlf-ReportReq***  This field is used to indicate whether the UE shall report information about the radio link failure. |
| ***rlf-SecondReportReq***  This field is used to indicate whether the UE shall report information about the radio link failure associated to the second failure. |

– *UEInformationResponse*

The *UEInformationResponse* message is used by the UE to transfer information requested by the network.

Signalling radio bearer: SRB1 or SRB2 (when logged measurement information is included)

RLC-SAP: AM

Logical channel: DCCH

Direction: UE to network

***UEInformationResponse message***

-- ASN1START

-- TAG-UEINFORMATIONRESPONSE-START

UEInformationResponse-r16 ::= SEQUENCE {

rrc-TransactionIdentifier RRC-TransactionIdentifier,

criticalExtensions CHOICE {

ueInformationResponse-r16 UEInformationResponse-r16-IEs,

criticalExtensionsFuture SEQUENCE {}

}

}

UEInformationResponse-r16-IEs ::= SEQUENCE {

measResultIdleEUTRA-r16 MeasResultIdleEUTRA-r16 OPTIONAL,

measResultIdleNR-r16 MeasResultIdleNR-r16 OPTIONAL,

logMeasReport-r16 LogMeasReport-r16 OPTIONAL,

connEstFailReport-r16 ConnEstFailReport-r16 OPTIONAL,

ra-ReportList-r16 RA-ReportList-r16 OPTIONAL,

rlf-Report-r16 RLF-Report-r16 OPTIONAL,

mobilityHistoryReport-r16 MobilityHistoryReport-r16 OPTIONAL,

lateNonCriticalExtension OCTET STRING OPTIONAL,

nonCriticalExtension UEInformationResponse-r17-IEs OPTIONAL

}

UEInformationResponse-r17-IEs ::= SEQUENCE {

secondRlf-Report-r17 RLF-Report-r16 OPTIONAL,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

/\*some parts skipped\*/

RLF-Report-r16 ::= CHOICE {

nr-RLF-Report-r16 SEQUENCE {

measResultLastServCell-r16 MeasResultRLFNR-r16,

measResultNeighCells-r16 SEQUENCE {

measResultListNR-r16 MeasResultList2NR-r16 OPTIONAL,

measResultListEUTRA-r16 MeasResultList2EUTRA-r16 OPTIONAL

} OPTIONAL,

c-RNTI-r16 RNTI-Value,

previousPCellId-r16 CHOICE {

nrPreviousCell-r16 CGI-Info-Logging-r16,

eutraPreviousCell-r16 CGI-InfoEUTRALogging

} OPTIONAL,

failedPCellId-r16 CHOICE {

nrFailedPCellId-r16 CHOICE {

cellGlobalId-r16 CGI-Info-Logging-r16,

pci-arfcn-r16 SEQUENCE {

physCellId-r16 PhysCellId,

carrierFreq-r16 ARFCN-ValueNR

}

},

eutraFailedPCellId-r16 CHOICE {

cellGlobalId-r16 CGI-InfoEUTRALogging,

pci-arfcn-r16 SEQUENCE {

physCellId-r16 EUTRA-PhysCellId,

carrierFreq-r16 ARFCN-ValueEUTRA

}

}

},

reconnectCellId-r16 CHOICE {

nrReconnectCellId-r16 CGI-Info-Logging-r16,

eutraReconnectCellId-r16 CGI-InfoEUTRALogging

} OPTIONAL,

timeUntilReconnection-16 TimeUntilReconnection-16 OPTIONAL,

reestablishmentCellId-r16 CGI-Info-Logging-r16 OPTIONAL,

timeConnFailure-r16 INTEGER (0..1023) OPTIONAL,

timeSinceFailure-r16 TimeSinceFailure-r16,

connectionFailureType-r16 ENUMERATED {rlf, hof},

rlf-Cause-r16 ENUMERATED {t310-Expiry, randomAccessProblem, rlc-MaxNumRetx,

beamFailureRecoveryFailure, lbtFailure-r16,

bh-rlfRecoveryFailure, spare2, spare1},

locationInfo-r16 LocationInfo-r16 OPTIONAL,

noSuitableCellFound-r16 ENUMERATED {true} OPTIONAL,

ra-InformationCommon-r16 RA-InformationCommon-r16 OPTIONAL,

...,

[[

hoType-r17 ENUMERATED {CHO, DAPS, spare2, spare1} OPTIONAL,

timeCHOConfig2Failure-r17 TimeCHOConfig2Failure-r17 OPTIONAL,

allAgreedNewFields

]]

},

eutra-RLF-Report-r16 SEQUENCE {

failedPCellId-EUTRA CGI-InfoEUTRALogging,

measResult-RLF-Report-EUTRA-r16 OCTET STRING,

...

}

}

MeasResultList2NR-r16 ::= SEQUENCE(SIZE (1..maxFreq)) OF MeasResult2NR-r16

MeasResultList2EUTRA-r16 ::= SEQUENCE(SIZE (1..maxFreq)) OF MeasResult2EUTRA-r16

MeasResult2NR-r16 ::= SEQUENCE {

ssbFrequency-r16 ARFCN-ValueNR OPTIONAL,

refFreqCSI-RS-r16 ARFCN-ValueNR OPTIONAL,

measResultList-r16 MeasResultListNR

}

MeasResultListLogging2NR-r16 ::= SEQUENCE(SIZE (1..maxFreq)) OF MeasResultLogging2NR-r16

MeasResultLogging2NR-r16 ::= SEQUENCE {

carrierFreq-r16 ARFCN-ValueNR,

measResultListLoggingNR-r16 MeasResultListLoggingNR-r16

}

MeasResultListLoggingNR-r16 ::= SEQUENCE (SIZE (1..maxCellReport)) OF MeasResultLoggingNR-r16

MeasResultLoggingNR-r16 ::= SEQUENCE {

physCellId-r16 PhysCellId,

resultsSSB-Cell-r16 MeasQuantityResults,

numberOfGoodSSB-r16 INTEGER (1..maxNrofSSBs-r16) OPTIONAL

}

MeasResult2EUTRA-r16 ::= SEQUENCE {

carrierFreq-r16 ARFCN-ValueEUTRA,

measResultList-r16 MeasResultListEUTRA

}

MeasResultRLFNR-r16 ::= SEQUENCE {

measResult-r16 SEQUENCE {

cellResults-r16 SEQUENCE{

resultsSSB-Cell-r16 MeasQuantityResults OPTIONAL,

resultsCSI-RS-Cell-r16 MeasQuantityResults OPTIONAL

},

rsIndexResults-r16 SEQUENCE{

resultsSSB-Indexes-r16 ResultsPerSSB-IndexList OPTIONAL,

ssbRLMConfigBitmap-r16 BIT STRING (SIZE (64)) OPTIONAL,

resultsCSI-RS-Indexes-r16 ResultsPerCSI-RS-IndexList OPTIONAL,

csi-rsRLMConfigBitmap-r16 BIT STRING (SIZE (96)) OPTIONAL

} OPTIONAL

}

}

TimeSinceFailure-r16 ::= INTEGER (0..172800)

TimeCHOConfig2Failure-r17 ::= INTEGER (0..172800)

MobilityHistoryReport-r16 ::= VisitedCellInfoList-r16

TimeUntilReconnection-16 ::= INTEGER (0..172800)

-- TAG-UEINFORMATIONRESPONSE-STOP

-- ASN1STOP

|  |
| --- |
| ***UEInformationResponse-IEs* field descriptions** |
| ***logMeasReport***  This field is used to provide the measurement results stored by the UE associated to logged MDT. |
| ***measResultIdleEUTRA***  EUTRA measurement results performed during RRC\_INACTIVE or RRC\_IDLE. |
| ***measResultIdleNR***  NR measurement results performed during RRC\_INACTIVE or RRC\_IDLE. |
| ***ra-Report***  This field is used to provide the list of RA reports that is stored by the UE for the past upto *maxRAReport-r16* number of successful random access procedues. |
| ***rlf-Report***  This field is used to indicate the RLF report related contents. |

|  |
| --- |
| ***LogMeasReport* field descriptions** |
| ***absoluteTimeStamp***  Indicates the absolute time when the logged measurement configuration logging is provided, as indicated by NR within *absoluteTimeInfo*. |
| ***anyCellSelectionDetected***  This field is used to indicate the detection of *any cell selection* state, as defined in TS 38.304 [20]. The UE sets this field when performing the logging of measurement results in RRC\_IDLE or RRC\_INACTIVE and there is no suitable cell or no acceptable cell. |
| ***measResultServingCell***  This field refers to the log measurement results taken in the Serving cell. |
| ***numberOfGoodSSB***  Indicates the number of good beams (beams that are above *absThreshSS-BlocksConsolidation,* if configured by the network) associated to the cells within the R value range (which is configured by network for cell reselection) of the highest ranked cell as part of the beam level measurements. If the UE has no SSB of a neighbour cell whose measurement quantity is above the *absThreshSS-BlocksConsolidation* or if the network has not configured the *absThreshSS-BlocksConsolidation*, then the UE does not include *numberOfGoodSSB* for the corresponding neighbour cell. If the UE has no SSB of the serving cell whose measurement quantity is above the *absThreshSS-BlocksConsolidation* or if the network has not configured the *absThreshSS-BlocksConsolidation*, then the UE shall set the *numberOfGoodSSB* for the serving cell to one. |
| ***relativeTimeStamp***  Indicates the time of logging measurement results, measured relative to the *absoluteTimeStamp*. Value in seconds. |
| ***tce-Id***  Parameter Trace Collection Entity Id: See TS 32.422 [52]. |
| ***traceRecordingSessionRef***  Parameter Trace Recording Session Reference: See TS 32.422 [52]. |

|  |
| --- |
| ***ConnEstFailReport* field descriptions** |
| ***measResultFailedCell***  This field refers to the last measurement results taken in the cell, where connection establishment failure or connection resume failure happened. |
| ***measResultNeighCells***  This field refers to the neighbour cell measurements when connection establishment failure or connection resume failure happened. |
| ***numberOfConnFail***  This field is used to indicate the latest number of consecutive failed RRCSetup or RRCResume procedures in the same cell independent of RRC state transition. |
| ***numberOfPreamblesSent***  This field is used to indicate the number of random access preambles that were transmitted. |
| ***timeSinceFailure***  This field is used to indicate the time that elapsed since the connection (establishment or resume) failure. Value in seconds. The maximum value 172800 means 172800s or longer. |

|  |
| --- |
| ***RA-Report* field descriptions** |
| ***absoluteFrequencyPointA***  This field indicates the absolute frequency position of the reference resource block (Common RB 0). |
| ***cellID***  This field indicates the CGI of the cell in which the associated random access procedure was performed. |
| ***contentionDetected***  This field is used to indicate that contention was detected for the transmitted preamble in the given random access attempt or not. This field is not included when the UE performs random access attempt is using contention free random-access resources or when the *raPurpose* is set to *requestForOtherSI*. |
| ***csi-RS-Index***  This field is used to indicate the CSI-RS index corresponding to the random access attempt. |
| ***dlRSRPAboveThreshold***  This field is used to indicate whether the DL beam (SSB) quality associated to the random access attempt was above or below the threshold *rsrp-ThresholdSSB* in *beamFailureRecoveryConfig* in UL BWP configuration of UL BWP selected for random access procedure initiated for beam failure recovery; Otherwise, *rsrp-ThresholdSSB* in *rach-ConfigCommon* in UL BWP configuration of UL BWP selected for random access procedure. |
| ***locationAndBandwidth***  Frequency domain location and bandwidth of the bandwidth part associated to the random-access resources used by the UE. |
| ***numberOfPreamblesSentOnCSI-RS***  This field is used to indicate the total number of successive RA preambles that were transmitted on the corresponding CSI-RS. |
| ***numberOfPreamblesSentOnSSB***  This field is used to indicate the total number of successive RA preambles that were transmitted on the corresponding SS/PBCH block. |
| ***perRAAttemptInfoList***  This field provides detailed information about a random access attempt. |
| ***perRAInfoList***  This field provides detailed information about each of the random access attempts in the chronological order of the random access attempts. |
| ***perRACSI-RSInfoList***  This field provides detailed information about the successive random access attempts associated to the same CSI-RS. |
| ***perRASSBInfoList***  This field provides detailed information about the successive random access attempts associated to the same SS/PBCH block. |
| ***raPurpose***  This field is used to indicate the RA scenario for which the RA report entry is triggered. The RA accesses associated to Initial access from RRC\_IDLE, transition from RRC-INACTIVE and the MSG3 based SI request are indicated using the indicator 'accessRelated'. The indicator *beamFailureRecovery* is used in case of successful beam failure recovery related RA procedure in the SpCell [3]. The indicator *reconfigurationWithSync* is used if the UE executes a reconfiguration with sync. The indicator *ulUnSynchronized* is used if the random access procedure is initiated in a SpCell by DL or UL data arrival during RRC\_CONNECTED when the timeAlignmentTimer is not running in the PTAG or if the RA procedure is initiated in a serving cell by a PDCCH order [3]. The indicator *schedulingRequestFailure* is used in case of SR failures [3]. The indicator *noPUCCHResourceAvailable* is used when the UE has no valid SR PUCCH resources configured [3]. The indicator *requestForOtherSI* is used for MSG1 based on demand SI request. |
| ***ra-InformationCommon***  This field is used to indicate the common random-access related information between *RA-report* and *RLF-report*. For RA report, this field is mandatory presented. For *RLF-report*, this field is optionally included when c*onnectionFailureType* is set to 'hof' or when *connectionFailureType* is set to 'rlf' and the *rlf-Cause* equals to 'randomAccessProblem' or 'beamRecoveryFailure'; otherwise this field is absent. |
| ***ssb-Index***  This field is used to indicate the SS/PBCH index of the SS/PBCH block corresponding to the random access attempt. |
| ***subcarrierSpacing***  Subcarrier spacing used in the BWP associated to the random-access resources used by the UE. |

|  |
| --- |
| ***RLF-Report* field descriptions** |
| ***connectionFailureType***  This field is used to indicate whether the connection failure is due to radio link failure or handover failure. |
| ***csi-rsRLMConfigBitmap***  This field is used to indicate the CSI-RS indexes that are also part of the RLM configurations. |
| ***c-RNTI***  This field indicates the C-RNTI used in the PCell upon detecting radio link failure or the C-RNTI used in the source PCell upon handover failure. |
| ***failedPCellId***  This field is used to indicate the PCell in which RLF is detected or the target PCell of the failed handover. For intra-NR handover *nrFailedPCellId* is included and for the handover from NR to EUTRA *eutraFailedPCellId* is included. The UE sets the ARFCN according to the frequency band used for transmission/ reception when the failure occurred. |
| ***failedPCellId-EUTRA***  This field is used to indicate the PCell in which RLF is detected or the source PCell of the failed handover in an E-UTRA RLF report. |
| ***measResultListEUTRA***  This field refers to the last measurement results taken in the neighboring EUTRA Cells, when the radio link failure or handover failure happened. |
| ***measResultListNR***  This field refers to the last measurement results taken in the neighboring NR Cells, when the radio link failure or handover failure happened. |
| ***measResultLastServCell***  This field refers to the log measurement results taken in the PCell upon detecting radio link failure or the source PCell upon handover failure. |
| ***measResult-RLF-Report-EUTRA***  Includes the E-UTRA *RLF-Report-r9* IE as specified in TS 36.331 [10]. |
| ***noSuitableCellFound***  This field is set by the UE when the T311 expires. |
| ***previousPCellId***  This field is used to indicate the source PCell of the last handover (source PCell when the last *RRCReconfiguration* message including *reconfigurationWithSync* was received). For intra-NR handover *nrPreviousCell* is included and for the handover from EUTRA to NR *eutraPreviousCell* is included. |
| ***reconnectCellId***  This field is used to indicate the cell in which the UE comes back to connected after connection failure and after failing to perform reestablishment. If the UE comes back to RRC CONNECTED in an NR cell then *nrReconnectCellID* is included and if the UE comes back to RRC CONNECTED in an LTE cell then *eutraReconnectCellID* is included |
| ***reestablishmentCellId***  This field is used to indicate the cell in which the re-establishment attempt was made after connection failure. In the case of CHO related RLF report, this is the cell identifier in which the *RRCReestablishmentRequest* message transmission was initiated by the UE. |
| ***rlf-Cause***  This field is used to indicate the cause of the last radio link failure that was detected. In case of handover failure information reporting (i.e., the *connectionFailureType* is set to '*hof*'), the UE is allowed to set this field to any value. |
| ***secondCHOFailrueCell***  This field is used to indicate the selected cell after the UE declares the failure which happens to be a candidate CHO cell configured at the UE. This field is included only if the attempted access to this cell also fails i.e., the UE experiences successive failures. |
| ***ssbRLMConfigBitmap***  This field is used to indicate the SS/PBCH block indexes that are also part of the RLM configurations. |
| ***timeConnFailure***  This field is used to indicate the time elapsed since the last HO initialization until connection failure. Actual value = field value \* 100ms. The maximum value 1023 means 102.3s or longer. |
| ***timeSinceFailure***  This field is used to indicate the time that elapsed since the connection (radio link or handover) failure. Value in seconds. The maximum value 172800 means 172800s or longer. |
| ***timeUntilReconnection***  This field is used to indicate the time that elapsed between the connection (radio link or handover) failure and the next time the UE comes to RRC CONNECTED in an NR or EUTRA cell. Value in seconds. The maximum value 172800 means 172800s or longer. |

/\*Next Changes\*/

– *VarRLF-Report*

The UE variable *VarRLF-Report* includes the radio link failure information or handover failure information.

***VarRLF-Report* UE variable**

-- ASN1START

-- TAG-VARRLF-REPORT-START

VarRLF-Report-r16 ::= SEQUENCE {

rlf-Report-r16 RLF-Report-r16,

plmn-IdentityList-r16 PLMN-IdentityList2-r16

}

-- TAG-VARRLF-REPORT-STOP

-- ASN1STOP

– *VarSecondRLF-Report*

The UE variable *VarSecondRLF-Report* includes the radio link failure information or handover failure information.

***VarSecondRLF-Report* UE variable**

-- ASN1START

-- TAG-VARSECONDRLF-REPORT-START

VarSecondRLF-Report-r16 ::= SEQUENCE {

rlf-Report-r16 RLF-Report-r16,

plmn-IdentityList-r16 PLMN-IdentityList2-r16

}

-- TAG-VARSECONDRLF-REPORT-STOP

-- ASN1STOP