**3GPP TSG RAN2 #115-e R2-21xxxxx**

**Electronic Meeting, 16th – 27th Aug 2021**

**Agenda Item:**  **R17 SON**

**Source: Huawei (email rapporteur)**

**Title:** **Report of [Post114-e][851][SONMDT] Procedures and Modeling of successful HO report (Huawei)**

**Document for: Discussion and Decision**

### 1 Introduction

This is the email report of [Post114-e][851] SONMDT:

* [Post114-e][851][SON/MDT] Procedures and Modeling of successful HO report (Huawei)

Scope：

Procedures for triggering of successful HO report

Modeling of successful HO report configuration and reporting

Use the current Rel-16 version (after Jun Plenary) as 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

Please add company contact details into the following table.

|  |  |  |
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### 2 Discussion

At RAN2#113b-e and RAN2#114, all agreements related to SHR are listed in section 4.

The scope of the email is:

* (a) Procedures
* (b) Modeling
* (c) Open issues
* (d) Potential ASN.1 changes

After checking the latest progress, open issues can be discussed in procedures and modeling. ASN.1 changes can be discussed later. So it is suggested to have two phases:

**Phase 1: progress on (a), (b) and (c). from 26 June to 26 July**

* **Expected outcome: agreeable proposals**
* **Related sections: 2.1, 2.2, 2.3**

**Phase 2: progress on (d). from 27 July to 6 Aug**

* **Expected outcome: potential changes**
* **Related sections: 6**

The open issues for SHR (from RAN2#114-e) are listed as below:

**RAN2#114-e:**

30 RAN2 to further discuss configuration aspects of T310/T312/T304 thresholds for SHR triggering conditions.

37 FFS whether to include in SHR the ra-InformationCommon of RA report.

33 No further SHR triggering conditions is considered at the moment.

Issue#30 is to be discussed in section 2.1, and issue#37 is to be discussed in section 2.3.

**RAN2#113b-e:**

3 The following radio related measurements are as part of the successful HO report:

a. Latest radio measurement results of the candidate target cells in the case of conditional HO. FFS best cell(s) should be included in.

Issue#3a is to be discussed in section 2.3.

#### 2.1 Procedures for triggering of successful HO report

Based on RAN2#113b-e and RAN2#114-e agreements, the triggering is as below:

|  |  |
| --- | --- |
|  | **Triggering condition of SHR** |
| 1 | Upon exceeding thresholds on T310 |
| 2 | Upon exceeding thresholds on T312 |
| 3 | Upon exceeding thresholds on T304 |
| 4 | The UE does not log SHR if no triggering conditions are configured |

It is observed that 1/2/3 is triggering condition, and 4 is a general principle for not logging SHR. In TS 38.331 [4], definitions of T310/T312/T304 are listed as below:

t310 ENUMERATED {ms0, ms50, ms100, ms200, ms500, ms1000, ms2000, ms4000, ms6000},

T312-r16 ::= ENUMERATED { ms0, ms50, ms100, ms200, ms300, ms400, ms500, ms1000}

t304 ENUMERATED {ms50, ms100, ms150, ms200, ms500, ms1000, ms2000, ms10000},

For the open issue “30 RAN2 to further discuss configuration aspects of T310/T312/T304 thresholds for SHR triggering conditions.”, it can be seen that thresholds may need some discussions. There are 3 options:

* Option 1: Thresholds for T310/T312/T304 can be defined the same as existing values. For example, the thresholds for T310 are one of {ms0, ms50, ms100, ms200, ms500, ms1000, ms2000, ms4000, ms6000}
* Option 2: Thresholds for T310/T312/T304 can be defined and only some of existing values are used, and FFS on specific values. For example, the thresholds for T310 are one of {ms100, ms1000}
* Option 3: Defines new values for Thresholds for T310/T312/T304 (which are not listed in existing values), or mix of existing values and new values. For example, the thesholds for T310 are one of {ms100, ms1000, ms5000}, ms100 and ms1000 are from existing definitions and ms5000 is a new value

**Question 1: Regarding configuration aspects of T312/T312/T304, which option is preferred?**

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| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| Qualcomm | Option 3 | In our understanding, the threshold values should be smaller than the t310, t312, or t304 values. To us, it is still not clear what values should be considered critical for the success/failure of a handover procedure. For example, if the t310 timer is set as 100 ms what should be set as a threshold value for SHR? If we set the threshold quite low, we would be generating quite a lot of unnecessary SHR report. On the contrary, if we set quite high, we might miss the required enhancements. The network can implement binary search to set an appropriate threshold value. |
| OPPO | Option 2 | We agree with Qualcomm that if the timer value is set too low ,it may end up with unnecessarily lots of SHR report. In our opinion, some of the existing values, especially the large ones for the T310/T312/T304 to be reserved for SHR are enough. |
| Lenovo | Option 3 | If T310 value is 100ms, the threshold should be less than 100ms. If option1 or option2 is applied, the value should be 50ms. However, the possible value could be 60ms or 80ms. Therefore, option 3 could be better. |
| Sasmung | Option 3 | Share with Qualcomm, Oppo, Lenovo’s view. We have assumed FFS on the new values, and which existing value(s) will be excluded. |
| Huawei, HiSilicon | Option 3 | Option 3 is more flexible than Option 1 and Option 2. For new values, one way may be as below:   * For the existing values, the thresholds can be 80%, 60%, and 40% of the values. The network can select one from all possible values * For t310, the thresholds are: ms50 -> ms40, ms30, ms20. Ms100 -> ms80, ms60, ms40. Ms200 -> ms160, ms120, ms80, and etc * The total thresholds for t310 are 24 values (8\*3) |
| NEC | Option 3 | Thressholds smaller than existing T310 values are required. |
| Sharp | Option 3 | Share Qualcomm’s view. |
| CATT | Option 3 | As mentioned by Huawei, except for configuring the actual threshlds according to 80%, 60%, and 40% to the UE, the network also can configure the percentage (e.g. 80%, 60%, and 40%) directly to the UE and the UE will get to know the actual threshold. |
| vivo | Option 3 | Share similar view with HW’s solution, and agree with CATT that one simpler way to achieve the same purpose could be as follows:   * Define a series of fractions in a new IE, such as *Threshold\_SHR* = {80%, 60%, 40%}; * NW would configure a specific T310 and a specific *Threshold\_SHR* to UE, e.g., T310 = ms50, *Threshold\_SHR* = 80%, then the real threshold for creating the SHR is 50\*80% = 40ms; * In this manner, we only need to define A NEW IE to enable the different threshold of creating SHR under T310/T312/T304, the total bits are restricted from 24 to 3. * Further, the IE *Threshold\_SHR* could be varied for different timers or could be used as a common threshold for T310/T312/T304. |
| Nokia | Option 1 | The available values are configurable choices for the network. Which value is chosen fo the concrete UE/HO, will depend on individual settings and scenario in the network.  Threshold for ‘generating’ the SHO should be always the point in time when the UE experience the actual configured value elapsed. Since it will be very tiny window in the overall processing, we believe definition of the thresholds and additional time instances leads tp over-engineering. |
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**Question 2: For procedures, if anything is missing or needs to be discussed here, please provide your comments.**

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| **Company** | **Comments** |
| Qualcomm | No |
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#### 2.2 Modeling of successful HO report configuration and reporting

Based on RAN2#114-e agreements, the modeling is as below:

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| **Step** | **Direction** | **Behaviours** |
| 1 | NW->UE | SHR configuration |
| 2 | UE | When a successful HO happens (legacy HO, CHO) and triggering condition of SHR is met, the UE stores SHR related info in its variable varSuccHOReport. The UE only stores the latest SHR entry |
| 3 | UE->NW | Indicate the availability of SHR report in each RRC completed message |
| 4 | NW->UE | Network requests UE to send SHR report |
| 5 | UE->NW | UEInformationReponse (include SHR report) |

The modeling of SHR is near complete, and some details may need to be discussed here.

**(1) About the SHR configuration**

For Step 1, it can be discussed which network node can configure the SHR configuration, e.g. the source cell, or the target cell (as part of the handover command), or both. This step could be even before NW->UE but could also be part of the NW->UE step.

From email rapporteur’s point of view, so far only the thresholds of T310/T312/T304 have been identified as the SHR configuration.

**Question 3: Which network node can configure the SHR configuration?**

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| --- | --- | --- |
| **Company** | **Source, Target, or both** | **Comments** |
| Qualcomm | Source | All the threshold timer values are associated with the source cell; therefore, the source should configure the SHR configuration. |
| OPPO | Source | The purpose of the SHR reporting is to help the source gNB for tuning the HO related parameter setting. Of course, it should be the source gNB deciding whether or not SHR is needed. |
| Lenovo | Source for T310 and T312.  Target for T304 | The threshold associated with T310 and T312 can be configured by source since both T310 and T312 are configured by source.  T304 is configured by target. If source decides the threshold, source needs to ‘read’ the RRC configuration provided by target. |
| Samsung | Source | We have assumed that the source configures SHR, but any coordination with the target may be required. |
| Huawei, HiSilicon | Source | The source cell should be responsible for configuring the SHR for the UE. |
| NEC | Source | SHR is useful for the source gNB to check and enhance the imperfect triggering timing or configuration for one successful handover event. In this sense, whether to perform successful handover report should be configured by the source gNB. |
| Sharp | both | It is the source cell that initiates the handover procedure, to facilitate the source to collect the SHR for handover parameter optimization, source should be allowed to configure the SHR configuration.  If T304 is configured in SHR configuration, maybe it is target that configures it, as only target knows the T304 configuration in handover command. |
| CATT | Source | The source cell makes decision for the handover and the SHR will be retrieved to source cell for handover optimization. As mentioned by companies, the source cell may need to get the actual T304 value from the target cell for T304 threshold configuration. |
| vivo | Source | We think SHR is used by the source node to optimize the relevant parameters, such as the threshold to trigger HO. Besides, SHR will be finally delieverd to source node instead of being used by target node, so we believe the SHR configuration should also be initiated by source node.  If the percentage/fraction IE is used to indicate the threshold of different timers, then source dose not necessarily need to know the exact value of T304, source node only needs to select one of the percentage from the candidate values. |
| Nokia | Source | The configuration should contain triggering conditions themselves (e..g which timer). |
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**(2) UE capability**

For this feature SHR, it seems that a UE capability is needed because it needs some UE efforts to implement it.

**Question 4: Need of UE capability of SHR?**

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| **Company** | **Yes/No** | **Comments** |
| Qualcomm | Yes |  |
| OPPO | Yes | Supporting SHR reporting should not be a mandatory requirement. |
| Lenovo | Yes | Agree with rapporteur. |
| Samsung | Yes |  |
| Huawei, HiSilicon | Yes |  |
| NEC | Yes |  |
| Sharp | Yes |  |
| CATT | Yes |  |
| vivo | Yes |  |
| Nokia | No | Ideally, UE should be capable of generating SHR as RLFreport |
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**(3) Validity period**

RAN2 agreed the following:

40 The UE includes the availability of successful HO report to NW in each completed message send in RRC procedure, i.e., RRCReconfigurationComplete, RRCReestablishmentComplete, RRCSetupComplete, RRCResumeComplete message if it has available successful HO report to be reported.

For RLF report, TS 38.331 defines that:

The UE may discard the radio link failure information or handover failure information, i.e. release the UE variable *VarRLF-Report*, 48 hours after the radio link failure/handover failure is detected.

After UE indicating the availability of SHR via UL messages, the network may or may request the UE to report the SHR. If requested, the UE should immediately send the SHR; otherwise, it is FFS whether the UE should keep it and how long the SHR will be stored.

**Question 5: Whether the UE needs to store SHR for a period (e.g. 48 hours) between when the UE generate a SHR and it is not requested by the network?**

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| **Company** | **Yes/No** | **Comments** |
| Qualcomm | May be | UE overwrites the old SHR if a new SHR is generated. |
| OPPO | Maybe |  |
| Lenovo | Yes | In the case of too early handover, UE may store SHR first. Then, UE stores the rlf-report once RLF on target cell. In this case, UE can release SHR and only report rlf-report.  If SHR is not released e.g in the case of too early handover, a period e.g. 48 hours is needed. |
| Samsung | Yes | It is preferable to have a consistency with the existing reporting mechanism. UE should be able to discard the content if it has not been requested for too long time. |
| Huawei, HiSilicon | Yes | We see some benefits for the UE to store SHR for a period. There may be some reasons for the netowrk to not immediately request the SHR from the UE, but the UE’s SHR may be still useful and then the network may request it later.  For example, the UE initially stays in Cell 1, and receives the SHR configuration from Cell 1. When the UE performs HO from Cell 1 to Cell 2, it should store the SHR report in its variable (if the network has not requested the report and there is no new SHR) for a period, and later the report may be requested again by the network. |
| NEC | Yes | If the SHR is not request by the network immediately, it shall be stored for a while before discarded. |
| Sharp | Yes |  |
| CATT | Yes | That the UE stores SHR for a time period seems useful, and similar period as RLF report can be considered. |
| vivo | Maybe with a shorter time period | SHR is NOT as important as the other types of reports, in case the NW does not request the SHR immediately, our preference would be to discard SHR, or at least to store the SHR for less than 48 hours (such as 12 or 24 hours). |
| Nokia | Yes | Same behaviour as with RLFreport |
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**Question 6: For modeling, if anything is missing or needs to be discussed here, please provide your comments.**

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| **Company** | **Comments** |
| Qualcomm | No |
| Nokia | A similar behaviour as thet of the RLFreport would make most sense |
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#### 2.3 Open issues

This section mainly discusses the following open issues.

37 FFS whether to include in SHR the ra-InformationCommon of RA report.

In TS 38.331 [4], ASN.1 definitions of ra-InformationCommon are listed as below:

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| RA-Report-r16 ::= SEQUENCE {  cellId-r16 CHOICE {  cellGlobalId-r16 CGI-Info-Logging-r16,  pci-arfcn-r16 SEQUENCE {  physCellId-r16 PhysCellId,  carrierFreq-r16 ARFCN-ValueNR  }  },  ra-InformationCommon-r16 RA-InformationCommon-r16 OPTIONAL,  raPurpose-r16 ENUMERATED {accessRelated, beamFailureRecovery, reconfigurationWithSync, ulUnSynchronized,  schedulingRequestFailure, noPUCCHResourceAvailable, requestForOtherSI,  spare9, spare8, spare7, spare6, spare5, spare4, spare3, spare2, spare1},  ...  }  RA-InformationCommon-r16 ::= SEQUENCE {  absoluteFrequencyPointA-r16 ARFCN-ValueNR,  locationAndBandwidth-r16 INTEGER (0..37949),  subcarrierSpacing-r16 SubcarrierSpacing,  msg1-FrequencyStart-r16 INTEGER (0..maxNrofPhysicalResourceBlocks-1) OPTIONAL,  msg1-FrequencyStartCFRA-r16 INTEGER (0..maxNrofPhysicalResourceBlocks-1) OPTIONAL,  msg1-SubcarrierSpacing-r16 SubcarrierSpacing OPTIONAL,  msg1-SubcarrierSpacingCFRA-r16 SubcarrierSpacing OPTIONAL,  msg1-FDM-r16 ENUMERATED {one, two, four, eight} OPTIONAL,  msg1-FDMCFRA-r16 ENUMERATED {one, two, four, eight} OPTIONAL,  perRAInfoList-r16 PerRAInfoList-r16,  ...  } |

**Question 7: Whether the SHR should include** **the ra-InformationCommon of RA report?**

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| **Company** | **Yes/No** | **Comments** |
| Qualcomm | May be |  |
| OPPO | Under specific conditions | ra-InformationCommon is very big. It should be only included in the SHR under certain conditions to save the air-interface resource and memory space of UE, for example, RACH problems have been encounter by the UE. Further details on RACH problem description could be discussed, such as improper dedicated RACH resource was configured so that UE has to perform CBRA on other beam, etc. |
| Lenovo | Depending on trigger condition | According to the current trigger condition associated with T310/T312/T304, ra-InformationCommon of RA report is not needed.  If the new condition associated with RA problem, e.g The number of preamble attempt in target cell is greater than one threshold, RA information can be reported. |
| Samsung | Yes |  |
| Huawei, HiSilicon | Depends | We think that ra-InformationCommon is useful but we have the following concerns:   * It is useful only for some cases, e.g. related to T304 threshold * The information size should be considered. Otherwise, if ra info is included in every SHR report, the uplink overhead issue may be significant   Our suggestions are as below:   * If ra-InformationCommon is to be included, there should be some conditions * One condition is that the info is only related to T304, i.e. the UE includes the ra info only when T304 threshold is configured and triggered * Another condition is similar as Lenovo’s comments, e.g. consider the number of preamble attempt in target cell |
| NEC | Mybe No | Currently, the triggering conditions of SHR do not include RA problem related. And the target cell can obtain RA performance of HO by existing RA-report already. So, it is better to avoid features with similar functionally. |
| Sharp | Maybe no. | Not clear about the benefit, current RA-report seems enough from RA optimization. |
| CATT | Depends | We agree that whether to included the ra-InformationCommon in SHR depends on the trigger condition. |
| vivo | Maybe no. | Agree with Sharp and NEC that RA-repot is sufficient. |
| Nokia | Depends | If connection failure in SHR report is due to RA issues it could be helpful, but on the other hand RA-report can be retrieved by the network anyway. |
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For the content of SHR, so far the agreements are as below:

34 The UE indicates in the SHR which triggering conditions for generating the SHR were fulfilled, e.g. flag for T310, T304, T312 indications.

35 Include in the SHR, the latest radio link quality of neighbour cells before HO execution for all HO types.

36 For location config/reports for SHR, location info for RLF report can be reused.

42 The UE only stores the latest SHR entry.

3 The following radio related measurements are as part of the successful HO report:

a. Latest radio measurement results of the candidate target cells in the case of conditional HO. FFS best cell(s) should be included in.

b. Flag to indicate RLF issues in source cell during DAPS HO

4 The following time-related measurements are as part of the successful HO report:

a. Time elapsed between the CHO execution towards the target cell and the corresponding latest CHO configuration received for the selected target cell

5 Location information is included as part of the successful HO report.

Agreements:

Contents of the HO success report:

The source cell and target cell related identifiers and measurements are to be included in the successful HO report.

And then the content of SHR is summarized as below:

* Souce cell ID
* Target cell ID
* Triggering conditions (e.g. flags)
* Latest RL quality of neighbour cells for conventional HO. For CHO, latst measurements of candidate target cells. For DAPS, a flag for indicating RLF issues in source cell
* Time period between CHO configuration and CHO execution
* Location info

For above RAN2 agreements, one FFS is about “FFS best cell(s) should be included in”, so it is proposed to collect companies’ opinions on it.

**Question 8: For CHO, whether the SHR should include the best cell(s)?**

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| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| Qualcomm | May be |  |
| OPPO | Maybe |  |
| Lenovo | No | If CHO candidate cell is not suitable, the CHO failue will happen. Then, UE will report something to network using rlf-repport. |
| Samsung | Yes | We do not see any consistency with other reporting mechanisms at all. For all HO types, we would like to keep the current model to typically log the measurement results for consistency, i.e. N best cells.  For CHO, as agreed in the RLF Report of CHO failure, we can introduce  *Indication of whether a measured neighbour cell included in the existing measResultNeighCells was a CHO candidate cell or not.* |
| Huawei, HiSilicon | No | If the best cell(s) are in the candidate target cells, there is no need to include the best cell(s) information.  If the best cell(s) are not in the candidate target cells, there may be the following possibilities:   * If there is no CHO failure, the SHR report is sufficient * If there is CHO failure, the UE will log such info in its RLF report, and then the network will know the problem   In general, we do not see the need to include the best cell(s) in the SHR. |
| NEC | No strong view |  |
| Sharp |  | We don’t have strong view. But maybe measurement of candidate cells is enough for CHO. |
| CATT | Maybe |  |
| vivo | No | Agree with Huawei. |
| Nokia | Maybe | SHR could include same content as measResultNeighCells in RLFreport: 8 best cells, mix of candidate and non-candidate cells |
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**Question 9: For open issues, if anything is missing or needs to be discussed here, please provide your comments.**

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| **Company** | **Comments** |
| Lenovo | According to the current agreement, the trigger condition for SHR report is ‘exceeding thresholds on T310/T312/T304’which is associated with the source cell. The above conditions for T310 and T312 are used to optimize the mobility from source link point of view. However, we did not optimize the successful HO from target point of view. For example, we need to discuss another successful HO case that T310/T312 in target cell is started after a short time of successful HO. In this case, the HO is a little early. |
| Nokia | In case the are configurable thresholds, it may make more sense to include the actual values of elapsed T310/312/304.  For ‘Time period between CHO configuration and CHO execution’, it would need to be clarified what the timer refers to: initial failure in case of CHO failure or time between CHO configuration and CHO recovery |
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### 3 Conclusion

[To be added]

### 4 References

[1] R2-114-e SONMDT HuNan 2021-05-27-0900 UTC

[2] R2-2106641 RAN2#113bis-e Meeting Report MCC report

[3] R2-2106637 Summary of AI 8.13.2.1 Handover related SON aspects Ericsson

[4] TS 38.331 v16.4.1

### 5 Agreements made in RAN2#113-e, RAN2#113b-e and RAN2#114-e

**Agreements:**

At RAN2#114-e:

Agreements:

31 The UE does not log SHR if no triggering conditions are configured.

32 The UE generates Successful HO report upon exceeding thresholds on T310, T312 and T304 exceed also for CHO case (in addition to regular HO)

34 The UE indicates in the SHR which triggering conditions for generating the SHR were fulfilled, e.g. flag for T310, T304, T312 indications.

35 Include in the SHR, the latest radio link quality of neighbour cells before HO execution for all HO types.

36 For location config/reports for SHR, location info for RLF report can be reused.

38 UE logs successful HO report in case prior configuration is received for successful HO report (interested trigger and corresponding configuration), otherwise UE doesn’t store successful HO report.

39 The varSuccHOReport is introduced to store the parameters for successful HO report.

40 The UE includes the availability of successful HO report to NW in each completed message send in RRC procedure, i.e., RRCReconfigurationComplete, RRCReestablishmentComplete, RRCSetupComplete, RRCResumeComplete message if it has available successful HO report to be reported.

41 UEInformationRequest/UEInformationResponse message is used for successful HO report request and report.

42 The UE only stores the latest SHR entry.

43 The SHR scenario 3b, i.e. “Successful HO completion, but RLF in source during DAPS HO” is part of the SHR.

44 The SHR scenario 2c, i.e. “Successful CHO recovery while initial failure” is part of the RLF-Report.

At RAN2#113b-e:

4 At least the following triggering conditions are applied for generating an HO Success Report in the case that the HO succeeds:

a. The UE logs the HO success report if, while doing HO, T310 value exceeds a threshold

b. The UE logs the HO success report if, while doing HO, T312 value exceeds a threshold

c. The UE logs the HO success report if, while doing HO, T304 exceeds a threshold

d. In case of DAPS, if the UE gets an RLF in the source while doing DAPS.

Agreements:

1 RAN2 to focus on the following scenarios for HO Success Report:

a. Scenario 1 (ordinary HO): 1a, 1b

b. Scenario 2 (CHO): 2a, 2b

c. Scenario 3 (DAPS): 3a

2 RAN2 for further discuss whether the following scenarios should be considered under the RLF report or under the HO success report:

a. Scenario 2c

b. Scenario 3b

3 The following radio related measurements are as part of the successful HO report:

a. Latest radio measurement results of the candidate target cells in the case of conditional HO. FFS best cell(s) should be included in.

b. Flag to indicate RLF issues in source cell during DAPS HO

4 The following time-related measurements are as part of the successful HO report:

a. Time elapsed between the CHO execution towards the target cell and the corresponding latest CHO configuration received for the selected target cell

5 Location information is included as part of the successful HO report.

At RAN2#113-e:

Agreements:

Contents of the HO success report:

The source cell and target cell related identifiers and measurements are to be included in the successful HO report.

### 6 Draft changes

[to be added]