3GPP TSG-RAN WG2 #113bis-e R2-21xxxxx

Electronic meeting, April 12th – 20th 2021

Agenda Item: 8.13.2.3

Source: CATT

Title: [Post113-e][852][NR R17 SON/MDT] 2 step RA and other SON changes (CATT)

Document for: Discussion

# 1 Introduction

This document captures the outcome of the following email discussion [1]

* [Post113-e][852][NR17 SON/MDT]  2 step RA and other SON changes (CATT)

- Scope:

2 step RA report enhancements (also potentially reply to RAN3 LS in R2-2008731)

Mobility history information enhancements

RA report related enhancements (from RAN2#113 contributions and RAN3 LS R2-2008723)

Other SON functions as proposed by companies for RAN2#113 meeting

Intended outcome: Report

Deadline: Long

Please provide your comments before Wednesday 24/03/2021 23:59 UTC, to leave time for preparing the summary.

This document is organized as the following. The discussions are in section 2, and the summary and proposals are in section 3.

# 2 Discussion

Rapporteur encourages the participating delegates to provide their contact information in this table.

|  |  |
| --- | --- |
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|  |  |

## 2.1 2-step RA report enhancements

In RAN2 #113-e meeting, many contributions [2]-[11] were submitted on 2-step RA report enhancements, and the following agreements were made [1]:

Agreements

1 The reporting granularity of whether the DL beam quality, associated to the used 2 step RA resource, is above or below the msgA-RSRP-ThresholdSSB is per-RA-attempt.

2 The RA report includes an indication that enables the network to know that the fallback from 2 step RA to 4 step RA was performed by the UE. FFS: Implicit vs explicit indication.

3 Choose ‘per RA procedure’ for the granularity of RA type (2 step RA vs 4 step RA) indication. FFS: Implicit vs explicit indication.

Agreement:

UE includes the measured RSRP of DL pathloss reference obtained just before performing RACH procedure in 2step RA report. FFS how to reduce the report overhead.

There are FFSs regarding fallback indication and RA type indication. Furthermore, some companies discuss the switching information from 2-step RA to 4-step RA [2]-[9]. In the reminder of this section, we discuss the following issues. Once these issues are concluded, RAN2 can further discuss the reply LS to RAN3 in [12].

* Issue 2.1-1: Fallback indication
* Issue 2.1-2: RA type indication
* Issue 2.1-3: Switching information
* Issue 2.1-4: DL beam quality
* Issue 2.1-5: Any other issues to discuss for sending reply LS to RAN3

### **Issue 2.1-1 Fallback indication**

According to the previous agreement, the remaining open issue is how exactly the indication is done. There are options as well summarized in [13].

In the following, we aim at collecting companies’ views on the possible options.

**Q1: Which option do you prefer for fallback indication?**

* **Option 1 – implicit indication (details to be clarified)**
* **Option 2 – explicit indication, the fallback indication is per RA attempt**
* **Option 3 – explicit indication, a single notification as to in which RA attempt did the UE performed the fallback**
* **Other options, if any**

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| --- | --- | --- |
| **Company** | **Preferred Option** | **Comments/explainations on your preferred option if any** |
| Qualcomm | Option 1 | There is several information that RA-report provides to determine this:   1. Fallback can happen only once in a RACH procedure, either upon the network instruction or UE reaching maximum retransmission. 2. If fallback happens, UE includes PRACH config used for 2-step and 4-step RACH. 3. UE does not use different PRACH resources in different RA-attempt. Therefore, it is not needed that in which RA attempt UE performed fallback. 4. Network knows what the max no. of msgA retransmission is configured to the UE. 5. RACH report includes the no. of RA attempt per beam, based on this network can determine that the fallback is initiated by the network, or UE performed fallback after reaching the max retransmission.   Therefore, I think there is no need for explicit indication. |
| Ericsson | Option 2 | We note that “fallback” does not mean that the UE restarts the RA with a 4-step RACH procedure. Rather the UE is required to send a msg3 and if RA attempt fails, the UE continues with msgA based on 2-step RA procedure itself. We also note that the UE does not do a fallback upon max number of msgA transmission, as QC is hinting. Rather, in case the UE reaches msgA-TransMax, the UE does a switch which in MAC is a different procedure than fallback.  Hence, upon fallback the UE does not need to include 4-step RA related information. The UE should just indicate as part of the 2-step related IE an indication of whether a 2-step procedure ended up with a fallback (i.e. msg3 transmission) or not.  We note that option 3 may not be applicable since within a single 2-step RA procedure, the UE may perform fallback multiple times, until success or switch to 4-step. Hence, multiple RA attempts within the same RA procedure can be subject to fallback, and this information should be included in the RA-Report. |
| CATT | Option 2 | The fallback indication in issue 2.1-1 refers to the case when the UE receives the fallback indication in MSGB. Since whether the fallback indication will be received by UE is in the granularity of per RA attempt, the fallback indication included in RA report should be per RA attempt.  For each RA attempt, the agreements of the DL beam quality or the contention detection cannot implicitly indicate that the fallback is performed by UE. Therefore, in our view the explicit indication is needed. |
| Sharp | Option 2 | We interpret that the fallback in this issue refers to the fallback upon the reception of a fallbackRAR for a 2-step RA attempt. There seems no other 4-step RA information for this fallback case in the corresponding RA report, thus we think an explicit fallback indication is needed unless some other information related to this fallback is agreed to include in the RA report. |
| CMCC | Option 2 | Agree with Ericsson, CATT and Sharp. |
| vivo | Option 2 | Upon reception of the fallback indicator, UE sends a msg3 to NW based on the UL carried in RAR, which is not irrelevant to 4-step PRACH config, thus there will be no 4-step RA information logged in fallback case. Our understanding is that an explicit indication should be included, otherwise the NW cannot identify the case where fallback happened. |
| OPPO | Option 2 | We think implicit indication is not feasible because we have not discussed any parameters that need to be recorded separately for fallback and no fallback case which can be used to distinguish different procedure. Therefore, we need to introduce an explicit indication.  Both Option2 and Option3 can work and the signaling overhead would be same. Since Option2 is better in readability, we prefer Option2. |
| Samsung | Option 2 |  |
| ZTE | Option 2 | We’d like to clarify this fallback means UE fallback to Msg3 transmission based on reception of fallbackRAR, in case of such fallback UE still utilize 2step RA resource. This is different from the switch to 4stepRA upon reaching the maximum allowed MsgA transmission configured by NW. It is the switch to 4step RA will happen only once during a complete RA procedure, and after switch UE will based on 4step RA resource to continue the rest of RA attempt.  Whether fallback is performed per RA attempt is one important parameter for NW to evaluate the 2step RA performance, it is preferred to have explicit fallback indication per RA attempt. |
| Huawei, HiSilicon | 2 | Agree with the comments above from Ericsson, CATT, Sharp, etc. |
| Lenovo&MM | Option 2 | Same view as CATT |
| Nokia | Option 2 | In our view, in each RACH attempt there should be an indication regarding the outcome of the attempt. There can be unified indicator that conveys whether there was a) a fallback, b) a switching, or c) a RACH success. Within the same RACH procedure fallback can be from 2-step CFRA to 2-step CBRA and from 2-step CBRA to 4-step CBRA. Therefore, Option 3 would not work. |
| Intel | Option 2 |  |

**Summary of issue 2.1-1**

**to be updated**

### **Issue 2.1-2 RA type indication**

RAN2 agreed to use ‘per RA procedure’ for the granularity of RA type (2 step RA vs 4 step RA) indication, FFS Implicit vs explicit indication. While the explicit indication per RA procedure is straightforward, how exactly the implicit indication is done may be clarified.

In the following, we aim at collecting companies’ views on the possible options.

**Q2: Which option do you prefer for RA type indication?**

* **Option 1 – implicit indication (details to be clarified)**
* **Option 2 – explicit indication**

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| **Company** | **Preferred Option** | **Comments/explainations to your preferred option if any** |
| Qalcomm | Option 1 | In the last meeting, we agreed “**UE includes the measured RSRP of DL pathloss reference obtained just before performing RACH ‎procedure in 2step RA report** “.  In my understanding, UE will add the information if configured with 2-step RA. Based on the measured RSRP values, the network can determined that whether 2-step or 4-step is performed. If UE is not configured with 2-step RA, then UE doesn’t included the RSRP of DL pathloss reference. Therefore, we donot need an explicit indication. |
| Ericsson | Option 2 (separate IE within existing RA-Report) | In RAN2#113, RAN2 agreed in R2-2102464 to include ellipis for the RA-Report and to make the ra-InformationCommon-r16 for 4-step RA optional. This makes the inclusion of 2-step RA related information in the RA-Report very simple and clear from the ASN.1 perspective. See e.g. below:    If the UE only performs 2-step RA or 4-step RA it will include the 2-stepRA-Report-r17 (for 2-step RA) or the ra-InformationCommon-r16 (for 4 step RA), while if it performs both 2-step RA and 4-step RA, the UE will include both IEs. |
| CATT | Option 1 | Smilar view as Qualcomm. Whether the measured RSRP values is included in RA report can implicitly indicate the RA type. |
| Sharp |  | The PRACH resource information in the RA report can be used to implicitly indicate the RA type is 2-step. However, we are also ok with the explicit RA type indication which is much clearer. |
| CMCC | Option 1 | Share the view with Qualcomm. |
| vivo | Option 1 | The parameters that uniquely introduced for 2-step RA report can be used to indicate the RA type.  As we agreed in the last meeting, UE will include the measured RSRP of DL pathloss reference obtained just before performing RACH ‎procedure in 2step RA report, we see the measured RSRP of DL pathloss reference can play such a role to implicitly indicate the RA type. |
| OPPO | Option1 | Same view with Qualcomm. |
| Samsung | Option 1 | We could identify the type wih 2SRA-specific info already agreed? e.g.   * msgA-FrequencyStart-r17 * msgA-FrequencyStartCFRA-r17 * msgA-SubcarrierSpacing-r17 * msgA-SubcarrierSpacingCFRA-r17 * msgA-FDM-r17 * msgA-FDMCFRA-r17 |
| ZTE | Option 2 | We prefer to have an explicit indication to indicate the RA type selected during the initialization part which only needed to include once during one RA procedure. Together with the maximum allowed transmission time configured by NW, NW shall be able to deduce whether RA type switch is performed and at which attempt RA type is switched.  As discussed in our contribution [11], since UE will share the same counter for 2step and 4step RA attempt for power ramping and number of RA attempt number in one RA procedure, it is preferred to use the same IE instead of separate IE to include complete RA information, which is similar to the way designed in current 4stepRA report. Another benefit is to save the RA report space since we don’t need to include some information (e.g., absoluteFrequencyPointA, locationAndBandwidth-r16,subcarrierSpacing-r16 ) twice unnecessarily. |
| Huawei, HiSilicon | 2 | Explicit indication is straightforward and can show the exact number of RA attempts for 2 step or 4 step |
| Lenovo&MM | Option 1 | Information included in the 2-step RA report can implicitly indicate the RA type. |
| Nokia | Option 2 | Since RACH Report will store both 2-step and 4-step RACH information we believe that it is better to have a new IE within RA Report to indicate whether the RACH procedure is a two-step or 4-step RACH. Explicit indication leaves no possibility for confusion. |
| Intel | Option 1 | Agree with Qualcomm that the measured RSRP value can be used as implicitly indication. |

**Summary of issue 2.1-2**

**to be updated**

### **Issue 2.1-3 Switching information**

In [2]-[9], it is proposed that UE should report the switching information, so that the network knows whether the UE switched from 2-step RA to 4-step RA in one RA procedure.

On the other hand, in RAN3 LS in [12]‎, it is required to include information that can distinguish 2-step RA from 4-step RA in the granularity of ***per-RA attempt***. ‎One may argue that since RAN2 agreed to choose ‘per RA procedure’ for the granularity of RA type (2-step RA vs 4-step RA) indication‎, it is unclear how network knows the RA type per RA attempt without switching information.

Firstly, companies are invited to share their views regarding whether switching information is included in RA report.

**Q3: Do you agree that network should know whether switching from 2-step RA to 4-step RA is performed by UE due to reaching a configured MSGA transmission times?**

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| **Company** | **Yes/No** | **Comments if any** |
| Qualcomm | Yes | We agreed that it may be beneficial for the network to figure this out. However, based on the information in RA-report, it can be determined. See our comment in Q1. |
| Ericsson | Yes, but no explicit indication from the UE about msgA-TransMax | Yes, the network should know if the UE performed a switch. However, we note that according to MAC specification, the UE performs a switch only upon reaching the maximum number of msgA transmission, i.e. msgA-TransMax. Hence there is no need for the UE to explicitly indicate that the switch occurred because of reaching msgA-TransMax.  Hence, the network can deduce the “switch” from the ra-report lists, since both 2-step and 4-step associated information are logged in the same ra-report. |
| CATT | Yes | It is useful to let the network know that the switching is performed by UE. |
| Sharp | Yes |  |
| CMCC | Yes | We are not sure whether the network would always keep the configured msgA-TransMax. |
| vivo | Yes |  |
| OPPO | Yes | Network can be aware of whether UE has any trouble to perform 2-step RA with this information. Accordingly, the network can make optimization to 2-step RA configuration. |
| Samsung | Yes |  |
| ZTE | Yes, but | No explicit indication is needed, since this information can be derived based on RA information stored in RA report as commented in Q2. |
| Huawei, HiSilicon | Yes |  |
| Lenovo&MM | Yes |  |
| Nokia | Yes | We think it is important that the network knows switching information. |
| Intel | Yes |  |

If your feedback to the above question is YES, please further comment on the preferred report information.

**Q4: Which Option do you prefer if your feedback to the previous question is YES?**

* **Option 1 - Network knows implicitly whether the switching is performed [3], [13]**
* **Option 2 - The configured maximum MSGA transmission number is included in the RA report [2]**
* **Other options, if any**

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| **Company** | **Preferred option** | **Comments and explainations** |
| Qualcomm | Option 1 | See response in Q1. |
| Ericsson | Option 1 | See response in Q3. |
| CATT | Option 2 | Since there is no 2-step RA attempt in one RA procedure after switching to 4-step RA type, the switching point (the configured maximum MSGA transmission number) should be included in RACH report to help the network knows the RA type per RA attempt.  Meanwhile, the RA report will be stored in UE until the network requests the RA report or the conditions of releasing the RA report are met. If the UE connects to other gNBs, the source gNB in which the RACH occured may have released the UE context. When the RA report is transmited back to source gNB, the source gNB may not know the previously configured maximum MSGA transmission number. Therefore, the configured maximum MSGA transmission number should be explicitly included in RA report. |
| Sharp | Option 1 | When the switching happens, the RA report entry will includes both information about the 2-step RA attempts and 4-step RA attempts. Network can deduce the switch from the information in the RA report. |
| CMCC | Option 2 | Share the view with CATT, when the RA report is transmited back to source gNB, the source gNB may not keep the previously configured maximum MSGA transmission number. Therefore, the configured maximum MSGA transmission number should be explicitly included in RA report. |
| vivo | Option 1 | Since the parameter *msgA-TransMax* is configured by NW and is cell-specific (*BWP-UplinkCommon*-> *MsgA-ConfigCommon*-> *RACH-ConfigCommonTwoStepRA* -> *msgA-TransMax*), and the cell ID of the cell in which the RA is performed is reported, so that the NW can be aware of the configured *msgA-TransMax* once receives the RA report. Consequently, NW is able to derive that whether the UE had switched to 4-step RA according to the PerRAInfo entries recorded within the report. For instance, NW only needs to compare the the number of PerRAInfo entries and the configured *msgA-TransMax*, if the former is not greater than the latter, then it means UE didn’t switch to 4-step RA during the whole procedure. |
| OPPO | Option 1 | We think it depends on whether we introduce a new filed dedicatedly for 2-step RA to record detailed RA information, which is similar with ra-InformationCommon for 4-step RA. The ASN.1 structure would be as follows:  RA-Report-r16 ::= SEQUENCE {  ra-InformationCommon-r16 RA-InformationCommon-r16,ra-InformationCommonTwoStep RA-InformationCommonTwoStep  }  Since the contents to be recorded for 2-step RA and 4-step RA are different, a new field for 2-step RA can avoid the change of the format of ra-InformationCommon.  If it is agreed, we think type switching can be implicitly indicated by determining whether two fields are included in RA-Report simultaneously. |
| Samsung | Other | For simplicity, we may introduce an explicit indication (e.g. 1-bit) |
| ZTE | Option 1 |  |
| Huawei, HiSilicon | 2 | Agree with CATT. The network can compare the configured maximum MSGA transmission and RA attempt for 2 step RA to determine whether UE did switch or not, and the configured maximum MSGA transmission is useful for the network to adjust this parameter. |
| Lenovo&MM | Option 1 | Agree with OPPO. If we use two separate IEs to record 2-step RA related information and 4-step RA related information, network knows implicitly whether type switching is performed. |
| Nokia | Option 1 | Switching can happen when UE attempts a maximum number of RACH transmissions (msgA-TransMax is reached). As another possibility in unlicensed access, a UE may need to do a separate LBT to send the PRACH preamble and then a separate one to send PUSCH for payload transmission. Therefore, the UE can change the RACH type to 4-step RACH because of channel unavailability and not because of a failure in PUSCH detection. Therefore, we think that an explicit indication to the network about what caused switching to 4-step RACH will be useful for the network to revert from the faulty situation. |
| Intel | Option 1 |  |

**Summary of issue 2.1-3**

**to be updated**

### **Issue 2.1-4 DL beam quality**

RAN2 has agreed that UE includes the measured RSRP of DL pathloss reference obtained just before performing RACH procedure in 2step RA report. While from RAN3 LS [12], information about whether the DL beam quality is above or below the *msgA-RSRP-Threshold-r16* should be included in RA report.

For whether the DL beam quality is above or below the *msgA-RSRP-Threshold-r16*, all companies agree that this information should be included, but view is split on the granularity, i.e. whether it should be per-RA-procedure or per-RA-attempt.

The RAN3 requirement can be met if network is aware of the previously configured *msgA-RSRP-Threshold*. This however depends on RAN3 understanding, and it is the rapporteur’s understanding that it is meaningful to indicate this in the reply LS to RAN3. Companies are invited to share their views regarding this aspect.

**Q5: Do you agree to the following**

**a) RAN2 already agreed “UE includes the measured RSRP of DL pathloss reference obtained just before performing RACH ‎procedure in 2step RA report. FFS how to reduce the report overhead.‎” With this agreement, RAN2 assumes it sufficient to address RAN3’s request on indication of whether DL beam quality is above or below the *msgA-RSRP-Threshold-r16* (per RA procedure)‎, as the configured *msgA-RSRP-Threshold-r16* is known by the network.**

**b) RAN2 asks RAN3 to clarify if any issue is identified in such assumption.**

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| **Company** | **Yes/No** | **Comments if not agreeable** |
| Qualcomm | May be | Don’t find a need of doing this. But fine with clarifying it with RAN3. |
| Ericsson | a) | No need to send any LS to RAN3.  The current agreement in the last meeting, inclusion of DL measured RSRP, is sufficient addressing the RAN3 request. |
| CATT | Yes | The request of RAN3 is whether the DL beam quality is above or below the msgA-RSRP-Threshold-r16, if the RACH configuration is released by gNB, the DL measured RSRP is not sufficient to address RAN3’s request.  Therefore, we think it is necessary to ask RAN3 to clarify this aspect. |
| Sharp | a) | Current RAN2 agreement is sufficient to address RAN3’s request |
| CMCC | a) | Current RAN2 agreement is sufficient to address RAN3’s request |
| vivo | May be | No strong view. |
| OPPO | a) | Current RAN2 agreement is sufficient to address RAN3’s request |
| Samsung | Yes |  |
| ZTE | a) | Current RAN2 agreement is sufficient to address RAN3’s request, no need for further clarification. |
| Huawei, HiSilicon | yes |  |
| Lenovo&MM |  | No strong opinion. |
| Nokia | Option a | RAN2 already agreed this topic during the last meeting. We don’t see any reason that RAN2 asks RAN3 for clarifications. |
| Intel | a) |  |

**Summary of issue 2.1-4**

**to be updated**

### **Issue 2.1-5 Any other issues to reply to RAN3 LS‎**

Companies are invited to share their comments if they see any other issues that need to be handled, to reply to RAN3 LS in [12]‎.

**Q6: Do you see any other issues that need to be handled, to reply to RAN3 LS in [12]?**

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| **Company** | **comments if any** |
| Qualcomm | No |
| Ericsson | No |
| CATT | No |
| Sharp | No |
| CMCC | No |
| vivo | No |
| OPPO | No |
| ZTE | No |
| Huawei, HiSilicon | No |
| Lenovo&MM | No |
| Nokia | No |
|  |  |

**Summary of issue 2.1-5**

**to be updated**

## 2.2 Mobility history information enhancements

Mobility history information enhancement was listed as one topic to further investigate in RAN2#112-e [14]. In [15], RAN3 agreed on the following

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| UE History Information in EN-DC  UE History Information (UHI) of SN does not include HO Cause  Wait for RAN2 agreements before discussing UE History Information from UE  Enhancement of UE History Information for Secondary Node does not apply to LTE DC scenarios  Include SN UHI in the SN addition and change messages (modification FFS); information flow in both directions is not precluded at this stage |

Basically, RAN3 has concluded some guidelines about this topic, and then RAN3 will wait for RAN2 agreements about the UE history information before further discussion.

Several issues have been discussed in company contributions on the topic in RAN2#113-e, i.e.,

* Issue 2.2-1 Structure of PSCell MHI (PSCell MHI together with PCell MHI or as a separate report) [18][23][28][30][33][34][36]
* Issue 2.2-2 Where to report PSCell related MHI [18][23][28][30][31][33]
* Issue 2.2-3 ‎Main content to report for PSCell MHI [18][23][28][30][31][33][34][36]
* Issue 2.2-4 Which ‎Message is used to report the PSCell MHI [23]
* Issue 2.2-5 ‎Applicable scenarios [18][34]

### **Issue 2.2-1 Structure of PSCell MHI**

This issue has been well summarized in [12], where two options are listed

* Option 1: PSCell MHI nested within the PCell MHI [18][23][28][33].
* Option 2: PSCell MHI as a separate report from PCell MHI [30][34][36]

For option 1, in each entry of PCell, multiple PSCells could be recorded. The correlation of the PCell and each PSCell is clear. From the information, the network can know the addition, release or change of the PSCell.

For option 2, the lists of PCell(s) and PSCell(s) are recorded separately, which may be more flexible. But on the other hand, the network may not know the association between the PScell and PCell based on the report.

Furthermore, the cell number of current PCell MHI list cannot exceed 16. This may also be taken into account in down selection between the options.

Companies are invited to share their preference between the options.

**Q7: Which option do you prefer for the structure of PSCell MHI enhancement?**

* **Option 1: PSCell MHI nested within the PCell MHI**
* **Option 2: PSCell MHI as a separate report from PCell MHI**

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| **Company** | **Option 1 or 2** | **Comments if any** |
| Qualcomm | Option 2 | We prefer option 2 considering the following:   1. In rel-16, the maximum entries that can be reported for the transition is considered as 8 to keep the memory usage at the UE low. In the nested list (option 1), there can be a large nested list. This can make the UHI/MHI report significantly huge.   We need to have a check on the memory usage for the reporting. Option 2 provide the solution for that where PCell MHI memory usage remains same as previous, while PSCell MHI memory usage can be optimized separately considering all the requirements. |
| Ericsson | Option 1 | With the PSCell MHI nested in the PCell MHI no extra complexity will be needed to link the visited PSCells with the visited PCell.  Option 2 has the drawback that it is needed to link the two lists in order to understand the correlation between the visited cells, while for the nested solution described in option 1 this is given implicitly.  We also note that in RAN3 it has been agreed that correlation between MN UHI and SN UHI is feasible and beneficial.  Regarding QC concern on memory, RAN2 can discuss the limit on the overall maximum amount of PSCells that the UE shall store, in order to limit the memory consumption. |
| CATT | Option 1 | We think it important to have a clear association of the PCells and the PSCells, in order to properly record and report the PSCell UHI. And how many PSCells could be correlated to one Pcell could be discussed further. |
| Sharp | Option 1 | Option 1 is a simple way to associate the PCells and PSCells. |
| CMCC |  | No strong view. |
| vivo | Option 1 | Agree with previous comments that option 1 offers a clearer picture of the relationship between PCells and PSCells. |
| OPPO | Option 2 | Agree with Qualcomm. Prefer not to touch the Pcell MHI structure. |
| Samsung | Option 2 | We prefer to go for Option 2 due to the following reasons:  1/ When UE history information (for PCell) was introduced, the purpose is for detecting handover ping-pong. For ping-pong purpose, a list of PSCell information alike what we have supported so far is enough. The use case for correlation of the PCell and eacn PSCell is not clear to us.  2/ For PCell MHI, the max number of cells is 16. The outdated data will be discarded for buffer size reason. If not linking, the same number of PSCell can be saved i.e. 16 or more number. If linking, it will leave to 16\*16 big list.  3/ If UE reports full or unambiguous Id of PSCell (e.g. global cell identity or global cell identity + tracking area code), there is no need to create such correlation. |
| ZTE | Option 1 | It is prefer to have one MHI for to record SpCell change information in both MN and SN, so that NW can obtain complete SpCell change info in one request. |
| Huawei, HiSilicon | Option 1 | The correlation of PCell MHI and PSCell MHI is useful (e.g. the MN or SN can more accurately estimate the mobility state based on the correlation.). Also the network may release the SN, we think the option 1 can indicate whether the SN is released. |
| Lenovo&MM | Option 1 | Option 1 clearly shows the relationship between PCells and the related PSCells. |
| Nokia | Option 2 | Mixing the two may prevent to have full information about one oft hem. For example if all the entries are taken by SN, MN would not have history for MN. |
| Intel | Option 1 | Agree with others, option 1 is the simple way to associate the PCell and PSCells. |

**Summary of issue 2.2-1**

**to be updated**

### **Issue 2.2-2 Where to report PSCell related MHI**

Two options have been listed according to company proposals:

* Option 1: PSCell MHI is reported to both PCell and PSCell MHI [23][30][31].
* Option 2: PSCell MHI is reported only to PCell [18] [28][34][33]

Based Option 1, the UE is allowed to send *mobilityHistoryAvail* indicator the SN node, and the SN node is also allowed to request for MHI result from UE.

For option 2, the UE reports all the MHI to the MN node. After receiving the MHI, the MN node could make use of the MHI itself to improve its corresponding configuration, and it may also forward the information to the SN.

Companies are invited to share their preference on the options.

**Q8: Which option do you prefer regarding where to report the PSCell related MHI?**

* **Option 1: PSCell MHI is reported to both PCell and PSCell**
* **Option 2: PSCell MHI is reported only to PCell**

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| --- | --- | --- |
| **Company** | **Preferred option** | **Comments if any** |
| Qualcomm | Option 2 | MHI report, in general, is not time sensitive. We have proper methodology to request PCell MHI using UEInformation request and response. As the PSCell MHI report is not time sensitive, there is no need to report it to PSCell and enhance signaling methods for that.  Therefore, PSCell MHI is reported to the PCell (MN) and MN can forward it to SN. Additionally, we can include the availability indicator for PSCell MHI in the SCGFailureInfromation such that it can be requested by the PCell, if needed. |
| Ericsson | Option 1 | First of all, we want to point out that independent of the conclusion on this issue, the conclusion on issue 2.2-1 should still hold. That is, if it is concluded to have PSCell MHI nested within the PCell MHI, the PSCell MHI referred to in Q8 should be interpreted as the nested MHI including both PCell MHI and PSCell MHI.  Given the above we prefer Option 1. i.e. reporting the nested MHI to both the PCell and the PSCell. Since all nodes (MN and SN) may not support fetching of the MHI, option 2 could lead to the PSCell not being able to get the MHI due to the support not being implemented in the PCell. To avoid the PSCell being dependent on the PCell to get the MHI we prefer Option 1.  Further, there is value in fetching PSCell related MHI by MN when to decide on the SCG configurations for this UE as the past visited list of PSCells indicates whether to configure PSCell on mid band or high band. Therefore, we prefer Option-1. |
| CATT | Option2 | After the MN receiving the report of all the UHI, the current MN node could use the UHI itself to improve i.e. HO or it could send to current SN to improve the i.e. PSCell change, if any.  There is no need to enhance the reporting straightforward to the SN node. |
| Sharp | Option 2 | Agree with QC that as the PSCell MHI report is not time sensitive, there is no need to report it to PSCell and enhance signaling methods for that. |
| CMCC | Option 2 | It seems unnecessary to report PSCell MHI to PSCell. |
| vivo | Option 1 | Both option1/2 enable the MN and SN to receive the MHI report, the difference is whether SN can request/fetch the MHI report independently. Since option 2 can already be supported by reusing legacy mechanism, we’d like to support the independence of MHI report fetching for SN, and left the flexibility of choice to NW implementation (i.e., NW can decide whether SN shall directly request the report or not). |
| OPPO | Option 2 | Establishing SRB3 only for transmitting MHI report may not be needed. |
| Samsung | Option 2 | We think it is not essential to go for Option 1 as others commented. |
| ZTE | Option 2 | In current specs, PSCell change can be initiated either by MN or SN, where SN is aware of the complete SN change info while SN triggered PSCell change info is not available at MN’s side. Considering PSCell change information is useful for MN to decide whether and how to add/delete SN, it is prefer for UE to report the MHI to MN, which has less spec impact.  Once MN obtained the information, it is possible for MN to forward the SN related information to SN if needed, which can be easily supported with RAN3’s signalling, no additional signalling is needed to be specified in RAN2. |
| Huawei, HiSilicon | Option 2 | As commented in issue 2.2-1, the PSCell MHI is nested within the PCell MHI. Therefore the PSCell MHI will be reported to the MN. Then the MN only needs to forward the PSCell/PCell MHI to the SN. Option 2 can reduce the signaling overhead. |
| Lenovo&MM | Option 2 | Reporting PSCell MHI to PSCell requires that SRB3 is supported in SN and seems not so necessary. |
| Nokia | Option 1 | The UHI couls be usefull to SN when making autonomous SN change. |
| Intel | Option 2 | We tend to agree with others:  1 PSCell MHI report is not time sensitive;  2 MCG could also us it; |

**Summary of issue 2.2-2**

**to be updated**

### **Issue 2.2-3 Main content for PSCell MHI**

The content of PSCell MHI was also discussed in company contributions, where possible information include

1. PSCell ID (may include CGI or frequency+PCI);[18][23][28][30][33]
2. The time UE stayed in each PSCell; [18][23][28][30][33]
3. Beam related information; [36]
4. Sensor information, location information; [31]
5. Mobility state; [31]
6. RRC state;[31]
7. Deployment characteristics(e.g. size of the cell);[31]
8. Other information, if any.

Companies are invited to share their preference on the necessary content in PSCell MHI.

**Q9: Which information can be included in PSCell MHI?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred information** | **Comments if any** |
| Qualcomm | A and B | PSCell MHI should be similar as PCell MHI. |
| Ericsson | A, B (at least) | Similar to PCell MHI |
| CATT | A, B and C | Besides the information inherit from the PCell UHI, the beam information could also be considered to further represent the location history within the same cell. |
| Sharp | A,B | This is similar to PCell MHI |
| CMCC | A, B, C | Beam information is more accurate. |
| vivo | A,B | Follow the legacy PCell MHI design. |
| OPPO | A and B | PCell MHI contents should be taken as reference. |
| Samsung | a), b) | It's sufficient to be aligned between PCell and PSCell. We do not see any benefit for other parameters |
| ZTE | A,B | It is sufficient to include similar information as in PCell MHI. |
| Huawei, HiSilicon | a,b,h(the time spent without SCG) | We think the UE should record the successive PSCell UHI and the time spent without SCG can be used to analyze the ping pong (e.g.the PSCell MHI is {PSCell 3, PSCell 4 without SCG, PSCell 3, PSCell 4,}. If the stay time without PSCell is quite large, the network will not consider the sequences as a pingpong). |
| Lenovo&MM | A,B | Same as legacy PCell MHI. |
| Nokia | A,B | Similar to PCell MHI |
| Intel | A, B | Similar to PCell MHI. |

As there are proposals to also enhance PCell MHI (entries c-g in the list above).‎ Companies are invited to share their preference on the necessary enhancements to PCell MHI.

**Q10: Which information can be added to PCell MHI?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred information** | **Comments if any** |
| Qualcomm | No |  |
| CATT | No |  |
| Sharp | No |  |
| CMCC | No |  |
| vivo | No |  |
| OPPO | No |  |
| Samsung | No |  |
| ZTE | No | Current PCell MHI is sufficient. |
| Huawei, HiSilicon | None | We do not see the benefit of this information |
| Lenovo&MM | No |  |
| Nokia | No |  |
|  |  |  |

**Summary of issue 2.2-3**

**to be updated**

### **Issue 2.2-4 Message used to convey PSCell MHI**

Furthermore, which message could carry the PSCell MHI has also been discussed [23]. Note this issue may depend on the conclusion of the previous questions.

1. UEAssistanceInformation;
2. UEInformationResponse;
3. SCGFailureInformation (QC: Include the available flag in this message[30])

**Q11: Which message should be used to convey the PSCell MHI?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option** | **Comments if any** |
| **Qualcomm** | (c). SCGfailure indicates the availability, Pcell may request PSCell MHI on such request | See our comment in Q. 8. |
| Ericsson | b) | Based on our answers to Question 7 and 8 the PSCell MHI can be reported to MN. We already use UEInformationResponse to report PCell MHI to MN, and PSCell MHI being nested within PCell MHI enables the PSCell MHI to be reported to MN using the same UEInformationResponse message.  There are multiple usecases discussed wherein the SN would like to fetch the UE collected information, e.g., RAReport (as discussed in section 2.3.1) and PSCell MHI. Considering we are having more and more use cases that require UE collected information reporting to SN, we believe using UEInformationResponse as the message to report MHI to SN makes sense. This can be fetched via SRB1 or SRB3 just like any other RRC message fetching from the UE by the SN. |
| CATT | b | The PSCell UHI could be reported together with the PCell UHI, and use the same message as the PCell UHI. |
| Sharp | b |  |
| CMCC | b |  |
| vivo | b |  |
| OPPO | b | Prefer reuse the legacy mechanism for retrieving the MHI for Pcell, especially if it is agreed that MHI of PSCell is only transmitted towards the MN. |
| Samsung | b) |  |
| ZTE | b) | As commented in Q7, we prefer to use one MHI for both PCell and PSCell change information, it is only nature to reuse the current MHI report design. |
| Huawei, HiSilicon | b) | As commented in issue 2.2-1, the PSCell MHI is nested within the PCell MHI. Therefore we think UEInformationResponse is used to carry the PSCell MHI |
| Lenovo&MM | b |  |
| Nokia | b |  |
| Intel | b |  |

**Summary of issue 2.2-4**

**to be updated**

### **Issue 2.2-5 Applicable scenarios**

It is RAN3 agreement that “Enhancement of UE History Information for Secondary Node applies to all MR-DC scenario” and “Enhancement of UE History Information for Secondary Node does not apply to LTE DC scenarios”. Therefore it is also meaningful to discuss the appropriate DC scenario in RAN2.

The possible scenarios proposed by companies include:

1. EN-DC; [18][34]
2. (NG)EN-DC; [18]
3. NR-DC; [18]
4. NE-DC.

Companies are invited to share their view on this issue.

**Q12: Which scenario(s) are applicable for PSCell MHI enhancements?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred scenario(s)** | **Comments if any** |
| **Qualcomm** |  | May be all. |
| **Ericsson** | All |  |
| CATT | a, b and c | We consider that NE-DC is not a commonly used scenario and no enhancement for it is needed. |
| Sharp | All |  |
| CMCC | all |  |
| vivo | a, b and c | Similar view with CATT, not sure if NE-DC is really needed. |
| OPPO |  | Up to network vendor and MNO needs |
| Samsung | See our comments | It is clearly specified in the WID that enhancement of UE history information is in EN-DC. If we support other MR-DC scenarios, we think the WID needs to be updated. In addition, we do not see much value on enhancement on LTE SCG case i.e. NR SCG should be the main enhancement on this. |
| ZTE | All | We don’t see any difference in supporting scenarios listed above. |
| Huawei, HiSilicon | All: a,b,c,d |  |
| Lenovo&MM |  | All, no strong view. |
| Nokia | See comment | Agree with Samsung observation, but also we don‘t think a dedicated handling should be specified for various deployments |
| Intel | all |  |

**Summary of issue 2.2-5**

**to be updated**

## 2.3 RA report related enhancements

### 2.3.1 SgNB RACH report

RAN3 has sent LS [40] to RAN2, which indicates:

|  |
| --- |
| RAN3 discussed the use cases of RACH report for SgNBs, and observed that there was no means for the SgNB to retrieve from UE in MR-DC any information on RACH access procedure at SgNB, and thus there was no input for SON algorithm to adjust the RA related parameters in SgNBs. |

RAN3 asks RAN2 to consider UE RACH report for SgNBs and provide feedback to RAN3. This topic was only briefly discussed in RAN2#112-e. In RAN3#113-e, several contributions discuss on the topic, which covers the basic options for SgNB RACH report, as well as detailed signalling enhancements.

As listed in [17], there are two basic options for SgNB RACH report

* Option 1: UE reports the SN RACH report to the MN, and then MN sends the SN RACH report to the SN;
* Option 2: SN requests SgNB RACH report, and then UE reports the SN RACH report to the SN, directly via SRB3 or via SRB1;

First of all, in order for RACH configuration optimization, the RACH report may need to be forwarded by either the MN (in Option 1) or by the SN (in Option 2), to the SN for which the RACH procedure actually occurred. Therefore the following observation is made.

**Observation 2.3.1-1 The mechanism that the current MN or SN forward the SN RACH report to the SN for which the RACH procedure actually occurred is anyway needed, no matter whether Option 1 or 2 is used.**

Then, based on companies contributions [9][17][20], the RAN2 specification impact of Option 1 and 2 can be summarized as the following.

Specification impact of Option 1 [17]:

* For NR-DC case, current *rapurpose* already supported SN related RACH report, so there is no specification impact;
* For EN-DC case, the LTE RACH Report may need to include a NR container about SgNB UE RACH Report content.

Specification impact of Option 2 [20]:

* Legacy UEInformationRequest message can be embedded in EUTRA/NR DLInformationTransferMRDC to enable the interaction between SN and UE;
* Enhancements on the support of SgNB RACH report are required, potential solutions include:

a) The UE tr*a*nsfers the SN-related RACH report to SN via *ULInformationTransferMRDC*.

b) A new message, e.g., UEInformationReponseSCG, is used to transfer the SN RACH report to SN via SRB1 or SRB3 (if configured).

Companies are invited to provide their views regarding the above specification impact analysis of the options.

**Q13: Do you agree with the above specification impact analysis of Option 1 and 2?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments if any** |
| **Qualcomm** | Yes. | I agree that “For EN-DC case, the LTE RACH Report may need to include a NR container about SgNB UE RACH Report content “ |
| Ericsson | Yes, but | For Option 1:  “For NR-DC case, current rapurpose already supported SN related RACH report, so there is no specification impact” -> We do not believe that raPurpose contains SN-related info, so we are not sure what this statement means. |
| CATT | Yes | From the field description of “raPropose”, it is mentioned that “The indicator beamFailureRecovery is used in case of beam failure recovery failure 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 in a serving cell by a PDCCH order [3].”  Therefore more than one raPropose could be used for SN. The current procedure of RA report could be directly used for SN related info report. |
| CMCC | Yes |  |
| vivo | Yes |  |
| OPPO | Yes |  |
| Samsung | No | I am not sure why new message UEInformationResponseSCG is required, i.e.  In SRB1, UEInformationRequest and UEInformationResponse would be carried over DLInformationTransferMRDC and ULInformationTransferMRDC.  And, if SRB3 has been configured, UEInformationRequest and UEInformationResponse would be carried over SRB3. |
| ZTE | Yes | Current RA report as specified in RRC specs supports all RA triggering event and supports storing RA information in both SpCells and SCells. Since cell id is included in Raa report, NW shall be able to know whether the stored RA entry is in MN or SgNB, therefore it can decide whether or how to forward the SgNB related RA report to SgNB.  Based on above analysis, there is no modification in **RRC specs** is needed to store and report RA report of SgNB. |
| Huawei, HiSilicon | Yes |  |
| Lenovo&MM | Yes |  |
| Nokia | Yes |  |
| Intel | Yes |  |

Companies are invited to share their preference between Option 1 and 2, based on the previous discussions.

**Q14: Which option do you prefer for SgNB RACH report?**

* **Option 1: UE reports the SN RACH report to the MN, and then MN sends the SN RACH report to the SN;**
* **Option 2: SN requests SgNB RACH report, and then UE reports the SN RACH report to the SN, directly via SRB3 or via SRB1;**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option** | **Comments if any** |
| **Qualcomm** | Option 1 | RA-report is not time sensitive. MN can report this to SN. Furthermore, NR RA-report already reports the RA process attempted on PSCell. Therefore, reporting to MN is a default choice. |
| **Ericsson** | Option 2 | As said in Q8, all nodes (MN and SN) may not support fetching of the MHI, hence option 2 can give the possibility to directly fetch the SN report, in case the PCell does not support MHI fetching. |
| CATT | Option 1 | Just to make it clear, this is about the RA report fetching not the MHI fetching.  Since the RACH report may always need to be forwarded to the SN for which the RACH procedure actually occurred, it is suggested to choose option 1 which is already supported for NR-DC. And for (NG)EN-DC, some enhancement such as the container is needed in Uu. |
| Sharp | Option 1 |  |
| vivo | Option 2 | For option 1, SN can only wait for the determination of MN on report retrieval, but cannot fetch the SN-related RACH report autonomously with the legacy mechanism. Moreover, if the MN-related RACH report is fetched by NW at the very first time when UE comes back to the connected state, MN will consider no RACH report available at the UE side until the next RRC transition to MN is initiated. Thus MN will no longer request UE to send the RACH report (which later might include the SN-related RACH report when SN is configured to UE).  So it is more reasonable to separate the MN-related process from SN. |
| OPPO | Option 1 |  |
| Samsung | Option 1 |  |
| ZTE | Option 1 | As commented above, MN can based in the cell id included to pick-out the RA report of SgNB,and forward it to NW. This option can satisfied the RACH optimization requirement with less specs impact, there is no need to have separate SgNB RA report. |
| Huawei, HiSilicon | 1 |  |
| Lenovo&MM | Option 1 |  |
| Nokia | Option 1 | It is much more straightforward and follows existing reporting procedures. |
| Intel | 1 |  |

**Summary of SgNB RACH report**

**to be updated**

### 2.3.2 Other RACH Optimization

There are other possible RACH optimizations, e.g., in [31] several aspects have been proposed:

1. UE also includes the PCell in the RA report in case the RA occurred in an SCell;
2. UE includes the location information and the radio measurement in the RA report depending on the *raPurpose*, e.g. in case of SR failure, beam recovery failure, UL synchronization issues.
3. Introduce raPurpose into RLF report, if the RLF cause is *randomAccessProblem*.
4. Introduce the information related to whether the UE selected the RA group A or B;
5. Introduce the indication or information about the msgA/msg3 payload size and the passloss;
6. Introduce the reason of the contention detection, i.e. “collision” reasons or radio reasons.

Companies are invited to provide their views on necessary enhancements on RACH report, if not already discussed in the previous sections. The intention of such discussion is to form a possible list of enhancements that receive wide support.

**Q15: Do you see any other RACH enhancements, if not already discussed in previous sections?**

|  |  |
| --- | --- |
| **Company** | **Potential RACH enhancements** |
| **Qualcomm** | Yes for (a). No for others. |
| **Ericsson** | **Yes: a, b, d, e, f**  **No strong view: c**  a): As per Rel-16 specification, in case the RA is performed in an SCell, the UE can indicate the physical cell identity and the carrier frequency of the Scell, but not the CGI of the corresponding Pcell. Hence, if the RA-report is received by a gNB different than the gNB in which RA occurred, it is not possible for this gNB to identify the Scell (and hence the gNB) in which the RA was performed.  b): if the UE triggered random access because of beam failure recovery issues or SR failure, or UL unsynch issues, then it would be good to include also the location information and the radio measurement to aid the network to identify possible coverage issues.  c): As per Rel-16 specification, The RLF report contains the RA-InformationCommon, but not the raPurpose. Hence, from the RLF report it is not possible to know for which reason the UE triggered the random access that eventually resulted into an RLF.  d) This information would allow the network to optimize the configuration of the RA preambles for the group A and group B, and for the case of msgA also to determine how to dimension the msgA PUSCH configuration, i.e. the msgA-PUSCH-ResourceGroupA and msgA-PUSCH-ResourceGroupB. For example, if very few UEs are using the group B preambles, the network may consider to deconfigure the group B configuration or to reduce the threshold on the msg3 size, i.e. ra-Msg3SizeGroupA, to increase the probability that the group B resources are selected, and hence to better distribute the UEs among the two groups  e): We do think there is the need to have explicit information about the msgA/3 size, but at least an indication of whether the payload size is above or below the ra-Msg3SizeGroupA threshold can be beneficial to determine whether the UE selected a certain group because of the payload size, or pathloss. Additionally, knowing the pathloss at RA would allow the network to adjsut the RACH transmitting parameters, e.g. the preambleReceivedTargetPower, powerRampingStep.  f): As per Rel-16 specification, the UE includes in RA-Report the flag contentionDetected, but from this flag it is not possible for the network to determine whether the UE declared the contention unsuccessful, because of 1) the UE Contention Resolution Identity MAC CE carried in the msg4 does not match the CCCH SDU transmitted in Msg3, or because the 2) ra-ContentionResolutionTimer expires. Knowing whether 1) or 2) occurred would be important for the network since 1) can be considered as an unfortunate case, while 2) might be due to radio reasons and the network can for example adjust the MCS for the msg3/msg4. |
| CATT | We do not have strong view to these further enhancements. |
| Sharp | Yes for (a), (a) has the benefit to make the network know the PCell that associated with the RA procedure.  No strong view for others. |
| CMCC | a, e |
| vivo | For a, we understand the intention, but wonder whether the CGI of Scell can be recorded directly, instead of associating the physical cell ID of SCell with the CGI of PCell.  No strong view for the rest. |
| ZTE | Yes for a,d, e;  b) could be helpful for BFR case but this is can be discussed further;  (f) might not necessary. Based on current specs UE will only include the contentionDetected upon expiry of ra-ContentionResolutionTimer.If the radio is bad UE might not receive the RAR therefore Msg3 won’t be transmitted in this case UE won’t set contentionDetected.Therefore this indication itself served as implicit indication the failure RA attempt is due to failure contention Resolution not bad radio link. |
| Huawei, HiSilicon | No |
| Nokia | Yes to a), b), c), d), e)  No to f)   1. can help the network deliver the RA Report to the gNB where RACH took place if for some reason it is received by some other gNB. 2. Knowing location information can also be useful to determine the reason of the failure. 3. Including raPurporse in RLF report could help to make the RLF report in sync with the RACH Report. 4. Including information whether UE selected RA group A or B helps the network to optimize the two groups e.g., the *ra-Msg-ASizeGroupA and ra-Msg3SizeGroupA* parameters.   We think it is useful to include payload size and pathloss information in the rach report to help the network determine a possible failure of the PUSCH payload. |
|  |  |

**Summary of Other RACH Optimization**

**to be updated**

## 2.4 Other SON functions as proposed by companies

### 2.4.1 UL/DL coverage imbalance

In RAN2#111-e the following was captured [16]:

=> Study the necessity of introducing new method for more precise identification of the DL coverage quality during the UL coverage outage.

Then in RAN2#112-e RAN2 the following was captured [14]:

=> RAN2 to investigate UL/DL coverage imbalanced.

In RAN2#113-e, possible enhancements are proposed:

* Option 1: Extend RLF report
  + Option 1.1: Extended with “DL quality” information [19]
  + Option 1.2: Add conditions to identify UL availability [34]
* Option 2: Introduce a list of CEF reports [28][33]
  + Option 2-1 enhance CEF report to allow inclusion of list of cells UE has experienced in order
* Option 3: Include the location information and the radio measurement in the RA report, for some of the *raPurpose* [31]
* Other Options, if any

Companies are invited to share their views on its necessity and their preference on these enhancements if any.

**Q16: Whether and if yes, which option(s) should be supported to identify and solve the problem about UL/DL coverage imbalance?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option(s)** | **Comments if any** |
| **Qualcomm** | Option 1.1, however theproposal talks about extending CEF report not RLF | We can extend the CEF report to indicate DL quality. |
| **Ericsson** | Option 3 (preferred)  Option 1, 2 (acceptable) | If the UE includes the radio measurements in the RA-report, then the network can deduce the DL coverage when the UE triggered RA. For example, if the UE triggered RA because of UL unsynch (e.g. TAT timer expired), then the network can get to know which was the DL coverage in correspondance to this UL event. Similarly, if the UE triggered RA because of maximum SR attempts, the network can determine whether the issue was on the UL (i.e. SR not received by the network) or DL coverage (UL grants not received by the UE).  Option 1, 2 are also acceptable. |
| CATT | Option 2 | A list of CEF reports can assist the network to identify the UL/DL coverage imbalance, compared with the CEF number used in R16. |
| CMCC | Option 2 | Agree with CATT. |
| OPPO | Option 2 |  |
| Samsung | Option 1.2 | Proponent |
| ZTE | Option 2-1, or option 2 is acceptable | As discussed in our contribution, the numOfCEF as in R16 report might not so useful, but a list of cells where UE has experienced CEF together with the number of CEF experienced in the cell can be served as minimum information for NW to know which cell has experienced UL/DL imbalance issue, so that NW can initiate MDT task towards the specific cell if needed. This has less specs impact and less report size comparing to list of CEFs. But we are also fine to have CEFs if it is majority view. |
| Huawei, HiSilicon | 2 | In case of UL/DL imbalance, it is possible that UE doesn’t detect DL RLF but has UL failure upon initiating connection request. Thus, there will be CEF report instead of RLF report.  Currently, the CEF report just provides the detailed information for the last CEF. This is not enough in case of consecutive CEFs. It is desirable to introduce a list of CEF reports. |
| Nokia | Option 1.1  Potentially Option 2 | Why Option 1.1: As described in our contribution, the problem start with RLF caused by UL coverage issue (expressed by failureType “maximum number of RLC retransmission reached”, and this failureType occurs only if DL is visible for the, otherwise UE would lose sync gNB anyway.  The next step is a re-establishment attempt, but RRC msg will not reach gNB because of weak UL, and goes to IDLE.  Now connection establishment attempt might follow, if DL is measurable. Multiple contiguous CEFs after RLF are indicating good DL but UL coverage issue.  But CEFs are per se independent from RLF.  Now, giving up the connection establishment attempts would indicate that no DL cell is measurable, and this is not expressed in CEF, it is just missing attempt.  And this information could be added to RLF report with an information like “DL disappeared”.  Option 2: The node receiving RLF report and CEF report including list failed CE attempts simultaneously from one UE, it can use them together for more detailed root cause analysis provided that node can identify and verify that the problems are linked. An interruption of CE attempts will most likely destroy information of one part of CEF report. Therefore, option 1.1. is beneficial. |
|  |  |  |

**Summary of UL/DL coverage imbalance**

**to be updated**

### 2.4.2 Enhancement related to MCG/SCG failure

#### **Issue 2.4.2-1 RLF triggered by MCG/SCG failure**

For RLF triggered by MCG/SCG failure, the contents below are proposed by [26] to be included in RLF report:

1. a new failure type of *rlfOfBothMCGAndSCG* in *connectionFailureType*;
2. container of *SCGFailureInformation*, if RLF is triggered by SCG and MCG transmission is suspended;
3. container of *MCGFailureInformation* or *measResultSCG*, if RLF is triggered by MCG and SCG transmission is suspended;

Companies are invited to share their views on these enhancements.

**Q17: Whether and if yes, which content should be supported in RLF report for MCG/SCG failure enhancement?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option(s) if any** | **Comments if any** |
| **Qualcomm** |  | Issue discussed in 2.4.2-1 and 2.4.3 are the same. |
| Ericsson | b) | We see value in b) and if SCGFailureInformaiton is included in the RLFReport, then a) can be implicitly derived by the network. |
| CATT | a) | If both MN and SN have radio link problem, the RLF report need to record this case.  We think this issue 2.4.2-1 is that UE has suffered failure and then “intend to” perform the CG recovery but the other leg is suspended, and this could be used for either MCG or SCG. But issue 2.4.3 only focus on the fast recovery of MCG which could be separate to 2 cases:  UE has already send MCGFailureInformation and T316 expire;  UE intends to send MCGFailureInformation but SCG is disabled.  The application scenario of the 2 issues may have overlap and could be discussed together. And we can further discuss the detail solution (e.g. which failure type, which enhanced info in RLF report) after deciding whether to introduce “fast MCG link recovery” or “fast MCG link recovery failure” related information in RLF report, or only focus on the “SCG/MCG failure info”. |
| Samsung | Nothing | I see no sufficient motivation.  It seems sufficient with measResultNeighCells included in RLF report. |
| ZTE | 1. With modification | Considering it is an new function and it is useful for NW to be able to distinguish fast MCG recovery failure from other case so that NW can perform necessary optimization if needed, e.g., configuration of T316.  But I think the correct connectionfailureType shall be fastMCGRecooveryFailure, *rlfOfBothMCGAndSCG* isfast MCG Recovery Failure Cause*.* Based on current specs, fast MCG recovery failure can be due to both MCG and SCG failure or due to expiry of T316. Therefore, based on above analysis we proposed to have fastMCGRecoveryFailure as connectionFailureType, and has T316 expiry and rlfonMCGandSCG as failureCause. |
| Huawei, HiSilicon | Postpone | The fast MCG recovery scheme is complicated. In our understanding, we need to fully discuss the relationship between the MCG/SCGFailureInformation message and the RLF report before considering the enhancements on RLF report.  We need more consideration on this topic and prefer to discuss it later. |
| Lenovo&MM | A, b |  |
| Nokia | Nothing | In general, RLFreport is supposed to pass the information available from the time of failure either for MDT or/and for SON purposes. In both cases it is essential to understand motivation behing adding new information into the report.  If we add it for MDT with no acknowleged use case behind, we think it may be never used for analysis (while RRC impacted).  If we add it for SON but RAN3 has no interest, it will be likely never used by SON algorithms. |
|  |  |  |

**Summary of issue 2.4.2-1**

**to be updated**

#### **Issue 2.4.2-2 Enhancement for SN change failure**

In RAN2#113 meeting, companies provided several scenarios about the SCG failure, and propose to introduce indications or information. But for SN change failure, it has been pointed out in [28] that the feature are still under discussed in RAN3 and RAN2 can wait for the progress in RAN3. Therefore the following question is raised.

**Q18: Whether to wait for RAN3 progress about SN change failure?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments** |
| **Qualcomm** | Yes | We should wait for RAN3 progress. |
| Ericsson | RAN3 has already sent an LS (R3-211332  ) | RAN3 has already sent an LS and we should progress this topic based on that LS. |
| CATT | Yes | Agree with Ericsson. |
| Sharp | Yes |  |
| CMCC | Yes |  |
| vivo | Yes |  |
| OPPO | Yes |  |
| Samsung | Yes | RAN3 has provided their opinion with LS, R3-211332.  It would be a baseline. |
| ZTE | Yes |  |
| Huawei, HiSilicon | Yes | Just to note, the RAN3 LS R3-211332 on SN change failure has been agreed and sent to RAN2. |
| Lenovo&MM | Yes |  |
| Nokia | No | An LS R3-211332 was sent in RAN3 #111e asking RAN2 to confirm what kind of information should be sent from the UE and to define the corresponding reporting mechanisms. |
| Intel | Yes |  |

Some enhancements to the contents are provided:

1. Introduce a new failure type of *reconfigureWithSyncFailurSCG* in *connectionFailureType* [26]
2. Include *perRAInfoList* field related to SCG failures in NR in a separate message, rather than the current SCG failure message [31]
3. Include *previousPSCellID*, *failedPSCellID*, *connectionFailureType* and *timeConnFailure* related to SCG failures in NR and EUTRA in a separate message, rather than the current SCG failure message [31]
4. Others if any

Companies are invited to provide their preference on these content if their answer to the previous question is NO.

**Q19: Which of the above enhancement(s) to the content do you prefer for SN change failure?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| **Qualcomm** |  | We should wait for RAN3 progress. |
| Ericsson | a, b, c in a new message (see comments) | We support the inclusion of a), b) and c). However, considering SCGFailureInformation is a ‘mandatory’ message from the UE upon declaring SCG failure, we do not want to increase the size of such a message. Increasing the size of any mandatory message is not the ‘SON approach’.  Therefore, we propose to discuss the inclusion of the information in a), b) and c) via a new message from the UE to the MN or the SN. |
| CATT | a), b) and c) | As requested by RAN3, all the content above should be introduced. Since the UEInformationResponse could also report the SN-related info (See Q13), this message could also be used by UE to report the SN change failure info to the network. |
| Samsung |  | Contents introduced in RAN3 LS, R3-211332 would be baseline.  On the other hand, we may need to further check if current SCG failure can be reused or new message is required. |
| Huawei, HiSilicon |  | We can use RAN3 LS |
| Lenovo&MM |  | We should wait for RAN3 progress. |
| Nokia |  | RAN3 LS should be the baseline |
|  |  |  |

**Summary of issue 2.4.2-2**

**to be updated**

### 2.4.3 Fast MCG Recovery

In RAN2#113-e, companies provided several scenarios about the fast MCG recovery.

Since the fast MCG Recovery is not part of the WID, first companies are invited to provide their view on whether to introduce fast MCG link recovery related information in RLF report.

**Q20: Do you see it necessary to introduce fast MCG link recovery related information in RLF report?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Comments if any** |
| **Qualcomm** | Yes | Upon MCG recovery failure, it needs to be identified the recovery failure happened due to t316 expiry or SCG Failure. Furthermore, the failure here is different compared to RLF and HoF. |
| Ericsson | Lower priority | We are open to discuss it, but the priority should be given to what is already in the WID. |
| CATT | No | This is out of R17 scope, and we consider only the “MCG failure” case could be recorded in this release, if the RLF info is not removed because of successful fast MCG recovery. |
| Sharp | Yes | Agree with Qualcomm. |
| vivo | Yes |  |
| OPPO | No | Out of R17 scope |
| Samsung | Yes | But positive view with simple enhancement only |
| ZTE | Yes | Current RLF report already includes fast MCG recovery information, some enhancement is needed for NW to distinguish this case,and perform necessary optimization. |
| Huawei, HiSilicon | No | See the answer in Q17 |
| Lenovo&MM | Yes | Agree with QC. |
| Nokia | No | Out of WID |
| Intel | Low priority | Agree with Ericsson, we should focus on items that already in the WID. |

Several potential enhancements are proposed in company contributions, i.e.,

1. Add a new failure type of “*Fast-MCG-Recovery-Failure”* in *connectionFailureType* [34][38][39]
2. Add *“t316-expiry”* and *“scg-failure”* as new rlf-cause [38]
3. Add SCG CGI and reason for SCG-failure in the RLF-report, if the RLF-cause is set as *“scg-failure”* [38]
4. others enhancements if any

Companies are invited to share their preference on these contents, if their feedback to the previous question is YES.

**Q21: Which content(s) should be supported in RLF report for fast MCG Recovery?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Preferred option** | **Comments** |
| **Qualcomm** | a, b, and c |  |
| Ericsson | Lower priority | Same comments as previous question. |
| Sharp | b) | We understand if b) is used, then it seems a) is not needed. |
| vivo | B (at least) |  |
| Samsung | b | A new indication to indicate fast MCG link recovery failure (i.e. the expiry of T316) can be introduced, e.g. as rlf-cause |
| ZTE | a,b, |  |
| Lenovo&MM | A,B |  |
|  |  |  |

**Summary of Fast MCG Recovery**

**to be updated**

### 2.4.4 Other Optimizations

Some other optimizations are proposed in company contributions, e.g.,

1. Introduce failure information of Inter-RAT HO from NR to E-UTRA/UTRA into RLF report, for the voice fallback purpose [27],
2. Introduce cause value *t312-Expiry* into RLF report [28],
3. Introduce the report of conditional PSCell addition/change failure [24], and
4. NR-U related enhancement [30][31].

Companies are invited to provide their views on other necessary optimizations, if not already discussed in the previous sections. The intention of such discussion is to form a possible list of enhancements that receive wide support.

**Q22: Do you see any other necessary optimizations, if not already discussed in the previous sections?**

|  |  |
| --- | --- |
| **Company** | **Please explain if any other necessary optimimations** |
| **Qualcomm** | A and C are not part of WI. Although, D is deprioritized, it should be discussed in the coming meeting. |
| **Ericsson** | Agree with QC. D should be prioritized over the other optimizations since that is included in the WID. |
| CATT | Agree with QC |
| Sharp | Agree with QC |
| CMCC | Agree with QC |
| vivo | Agree with QC |
| OPPO | Agree with QC |
| Samsung | Available location info is also added into MCGFailureInformation as in SCGFailureInformation |
| ZTE | The same view as Samsung. NR-U can be discussed if we made sufficient progress on other aspects. |
| Huawei, HiSilicon | b) is OK.  The t312-expiry is one reason to trigger RLF, and the UE will record the RLF report. It is reasonable to add the correct cause value in the RLF report. |
| Lenovo&MM | a is associated with SRVCC topic, which aims to hand over one UE with ongoing IMS voice from NR to UTRAN based on the measurement result and traffic. It is helpful to study this case to optimize the voice experience.  For b, it can be discussed in R17 WI.  For c, RAN3 has excluded it from R17 scope.  For d, it is deprioritized. |
| Nokia | NR-U enhancement should be prioritized since it has been part of the WI but no discussions have taken place so far on the topic. |

**Summary of other SON optimization**

to be updated

# 3 Conclusion

To be updated

# 4 References

1. Draft RAN2#113-e Chairman Notes, see https://www.3gpp.org/ftp/tsg\_ran/WG2\_RL2/TSGR2\_113-e/Report
2. R2-2100192 Discussion on RACH Report for 2-step RACH CATT
3. R2-2100286 Further discussion on SON aspects of 2-step RA China Telecommunication
4. R2-2100601 RACH report logging of 2-step and 4-step RACH information Nokia, Nokia Shanghai Bell
5. R2-2100710 Discussion on RA information for 2-step RA SHARP Corporation
6. R2-2101252 Discussion on 2 step RA related SON aspects Huawei, HiSilicon
7. R2-2101439 2-Step RA information for SON purposes Ericsson
8. R2-2101641 SON Enhancement for 2-step RA CMCC
9. R2-2101603 RA Report Enhanements for 2-step RA Samsung
10. R2-2100698 Discussion on contents and signalling model of 2-step RACH report vivo
11. R2-2101587 RA related enhancements ZTE Corporation, Sanechips
12. R2-2008731 LS to RAN2 on RACH report for 2-step RACH
13. R2-2102265 Summary of AI 8.13.2 Ericsson
14. R2-2100001 Report of 3GPP TSG RAN2#112-e meeting, Online
15. RP-202322 Status report for WI on enhancement of data collection for SON\_MDT in NR and EN-DC CMCC, Ericsson
16. R2-2008701 Report of 3GPP TSG RAN2#111-e meeting, Online
17. R2-2100193 Further Consideration on the UE RACH Report for SN CATT
18. R2-2100194 Enhancement on Mobility History Information CATT
19. R2-2100602 Refined UL Coverage Outage Detection Nokia, Nokia Shanghai Bell
20. R2-2100699 Discussion and reply on R3 LS for SgNB RACH report vivo
21. R2-2100700 Discussion on SON enhancements for Successful HO vivo
22. R2-2100748 Discussion on successful handover report NEC
23. R2-2100774 Discussion on collection of UE history information in EN-DC NTT DOCOMO, INC.
24. R2-2100779 Discussion on conditional PSCell addition/change failure report NTT DOCOMO, INC.
25. R2-2100845 Consideration on successful handover report and UE history information in EN-DC OPPO
26. R2-2101082 Discussion on rel-17 Radio Link Failure Report enhancement NTT DOCOMO INC.
27. R2-2101104 SON enhancement for Inter-RAT handover Lenovo, Motorola Mobility
28. R2-2101253 Discussion on other SON aspects Huawei, HiSilicon
29. R2-2101348 Successful Handover Report QUALCOMM INCORPORATED
30. R2-2101350 Open Issues in Other WID related SON features QUALCOMM INCORPORATED
31. R2-2101440 Other WID related SON features Ericsson
32. R2-2101588 Considerations on successful HO report
33. R2-2101589 Consideration on MHI and UL/DL imbalance ZTE Corporation, Sanechips
34. R2-2101604 SON Enhancements Samsung
35. R2-2101643 Discussion on Successful Handover Report CMCC
36. R2-2101644 Enhancement for Mobility History Information CMCC
37. R2-2100776 Discussion on successful handover report NTT DOCOMO, INC.
38. R2-2101343 SON aspects of DAPS HO and Fast MCG Recovery Optimizations QUALCOMM INCORPORATED
39. R2-2101105 SON enhancement for fast MCG link recovery Lenovo, Motorola Mobility
40. R3-205662 LS to RAN2 on RACH report for SgNB RAN3