3GPP TSG-RAN WG2 Meeting #116 electronic R2-21xxxxx

Online, 1st – 12th November 2021

Source: vivo

Title: Summary of [AT116-e][628][Relay] Signalling from relay UE for cell (re)selection and failure cases (vivo)

Agenda Item: 8.7.3.2

Document for: Discussion and Decision

# Introduction

The following offline discussion is summarized in this discussion:

* [AT116-e][628][Relay] Signalling from relay UE for cell (re)selection and failure cases (vivo)

Scope: Discuss P1 -P6 of R2-2111223 and attempt to converge. Discussion of P5 excludes the RLF case which is discussed in [AT116-e][622].

Intended outcome: Report to CB session

Deadline: Wednesday 2021-11-10 1600 UTC

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# Discussion

For the below questions from section 3.2 to 3.5, rapporteur would like to first clarify that all of them should focus on in which case should the relay UE send indication to remote UE and what is the information content/type. For the remote UE’s behavior, it simply says ‘may trigger relay reselection’. Whether remote UE of different RRC state should behavior differently can be clarified in the comment by companies, if needed.

In rapporteur’s understanding, for all the below questions which say ‘may trigger relay reselection’, it is applicable to at least IDLE/INACTIVE remote UE. Whether CONNECTED remote UE is also included is up to the discussion on Proposal 11 in R2-2111276 (as follows) and the discussion in CP agenda in case remote UE would trigger RRC re-establishment procedure followed by relay reselection.

*Proposal 11 (In R2-2111276): Relay (re)selection procedure is not performed by a L2 Remote UE in RRC\_CONNECTED, except for the case of RLF.*

And for the question organization,

* Cell (re)selection has impacts on IDLE/INACTIVE relay UE, so it is separately discussed in 3.1;
* 3.2 is when the relay UE’s Uu link becomes better;
* 3.3 is when the relay UE’s Uu link deteriorates;

The success/failure cases in 3.2/3.3 are separately discussed as the remote UE has opposite behaviours (i.e. may trigger relay reselection or stop relay reselection), and it may have impact on cause value design (e.g. if a single message to indicate both success/failure case then of course we need different cause value).

## 3.1 Cell (re)selection

**Proposal 1: RAN2 to discuss when relay UE performs cell (re)selection, whether relay UE may send an indication/message to its connected remote UE(s) which may trigger relay reselection.**

* **Option-1: Yes**
* **Option-2: Yes, only when (re)select to a new gNB**
* **Option-3: No**

### **Q1: Which option do companies prefer in the above Proposal 1?**

|  |  |  |
| --- | --- | --- |
| Company | Option # | Comments |
| MediaTek | Option-1 | We see the need to notify the connected remote UE(s) when the Relay UE performs cell (re)selection. This is especially needed for Remote UE in connected state, since this cell (re)selection may interrupt Remote UE’s connection with the network. Meanwhile, there may be different reasons for Relay UE to perform cell (re)selection (e.g. including RLF) |
| OPPO | Option-1 | An indication to connected remote UE may be beneficial for remote UE to recover the service quickly. |
| Qualcomm | Option-1 | We share the same view as MediaTek and OPPO.  In addition, please note that Clause 4.1 of SI TR captured”  *- For L2 UE-to-Network Relay, it is supported as baseline that after Remote UE connects via Relay UE, Relay UE and Remote UE are controlled by the Relay UE’s serving cell*  “  Actually, we don’t further specify how to support non-baseline (i.e., not controlled by same serving cell). Thus, we tend to think relay UE at least should be allowed to send the indication of cell reselection to remote UE on the non-baseline case. |
| Ericsson | Option 1 | As other companies mentioned, it is beneficial to let remote UE be informed of cell selection and reselection performed by relay UE regardless which cell/gNB the relay UE selects. |
| Sharp | Option 1 | We think the notification should be done when a new cell is reselected/selected by relay UE. When a remote UE receives such notification, it is remote UE implementation to reselect a relay UE or not. |
| ZTE | Option 1 | We think it is necessary for the remote UE to be informed of the cell (re)selection of relay UE. However, we think the indication/message sent by the relay UE to remote UE can reuse legacy signalling. For example, The updated NCGI in the discovery message from relay UE can work as the indication of relay UE’s (re)selection. |
| CATT | Option-1 | There is no harmful to send this in principle. For option-2, we fail to see there is limitation for intra-gNB for (re)selection. |
| Lenovo | Option 1 | After sending this indication, it is remote UE implementation to decide whether to perform cell/relay reselection. |
| Samsung | Option 1 |  |
| Huawei, HiSilicon | Option-1 | We share the same view as MediaTek and OPPO  We think such indication to connected remote UE is beneficial for remote UE to quickly recover the connection |
| Kyocera | Option-1 | Agree with MediaTek |
| Intel | Option 1 | We think that the indication could be generic informing Remote UE of Uu RLF, HO, cell reselection using different cause values. |
| InterDigital | Option 1 | For this case, the relay and remote UE are either in IDLE/INACTIVE. The remote UE should be informed, in case (for example) the remote UE needs to perform reselection or RAN area update as a result of the reselection by the relay UE. |
| Spreadtrum | Option 1 | The indication is helpful and whether to perform cell/relay reselection is up to remote UE implementation. |
| vivo | Option 2 | For cell reselection case, the relay UE may just update the cell ID in discovery message, instead of sending indication immediately. It is not urgent as the connection is not established now and there is no ongoing service. |
| Nokia | Option 1 |  |

## 3.2 RLF recovery case

**Proposal 2: RAN2 to discuss When Uu RLF is recovered by relay UE, whether relay UE may send an indication/message to its connected remote UE(s).**

### **Q2: Do companies support that, when Uu RLF is recovered by relay UE, relay UE may send an indication/message to its connected remote UE(s)?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | During RLF, the Remote UE connection with the network may be suspended a bit and then the data transmission is held-on. The data transmission between Remote UE and the network can recover if a recovery indication can be received |
| OPPO | No | We have already agreed that when Uu RLF is happened, relay UE may send an indication/message to its connected remote UE. But when/whether to send the message can be up to relay UE implementation. Therefore, we do not need to specify additional message for Uu RLF recovery. |
| Qualcomm | No | In our understanding, if relay UE would like remote UE to temporarily keep the unicast PC5 link (e.g., wait outcome of RLF recovery), it can hold the transmission of PC5-S/other notification message to remote UE (e.g., until RLF recovery failure).  Thus, benefit of introducing an explicit indication of RLF recovery is not clear to us. |
| Ericsson | No | Share the same view as OPPO and Qualcomm. RAN2 has already agreed that relay UE informs remote UE when RLF is triggered, which is sufficient for Rel-17. |
| Sharp | No | The agreed Uu RLF notification is enough. Not sure about the intention for RLF recovery notification. |
| ZTE | Yes | When remote UE receive the RLF detection indication, remote UE may only initiate the relay discovery procedure to find nearby suitable relay UE. After a while, if the relay UE recover the Uu link at original gNB, relay UE may send the RLF recovery notification to remote UE and remote UE continues the PC5 transmission with this relay UE. |
| CATT | Yes | Especially when the remote UE is not in RRC-connected mode, under that case, when the relay UE’s UU RLF happens, for remote UE, it can hold the current connection for a while. Since there is the possibility that the relay UE’s UU RLF can recovery, and the relay UE can send an indication/message to its connected remote UE(s) to maintain the connections. |
| Lenovo | Yes | After remote UE receives indication from relay UE, the remote UE may decide to keep PC5 link. e.g the ongoing service can wait for the relay recovery. Once the RLF is recovered, remote UE should be notified. Otherwise, the remote UE is not aware whether the RLF has be recovered or not. |
| Samsung | No | We share the view that the existing agreement is sufficient i.e., an indication can be transmitted from relay UE to the connected remote UE when Uu RLF happens. |
| Huawei, HiSilicon | Yes | We think that such indication could help remote UE determine when to stop relay reselection procedure after it was triggered due to Uu RLF and the data transmission can begin after the remote UE receives this indication. |
| Kyocera | No |  |
| Intel | No | We can keep it simple in Rel-17. |
| InterDigital | No | Indication of Uu RLF is sufficient. Recovery would seem more of an optimization to allow the remote UE to maintain the link in case of recovery, and we can skip that for Rel17. |
| Spreadtrum | No |  |
| vivo | No |  |
| Nokia | No |  |

## 3.3 Other failure case

**Proposal 3: RAN2 to discuss which of the following case should also be agreed for the relay UE to send an indication/message to its connected remote UE(s) which may trigger relay reselection:**

**Case-1: Uu Recovery failure**

**Case-2: HO failure**

**Case-3: Uu RRC reconfiguration failure**

### **Q3: Which case(s) do companies prefer to support?**

|  |  |  |
| --- | --- | --- |
| Company | Case # | Comments |
| MediaTek | Case-2 | We see the need for Relay UE to notify the Handover failure to its connected remote UE(s), since this is a typical case to trigger RRC reestablishment for Relay UE. For case-1/3, it is not clear to us. |
| OPPO | Case-3 | For case-1: We have already agreed that when Uu RLF is happened, relay UE may send an indication/message to its connected remote UE. But when/whether to send the message can be up to relay UE implementation. Therefore, we do not need to specify additional message for Uu RLF recovery failure afterwards.  For case-2: We have already agreed that when HO of relay UE is happened, relay UE may send an indication/message to its connected remote UE. But when/whether to send the message can be up to relay UE implementation. Therefore, we do not need to specify additional message for HO recovery failure afterwards.  For case-3: It is similar to case-1,2 where Uu RRC reconfiguration failure will trigger relay UE to perform RRC re-establishment procedure. Therefore, the similar indication shall be applied to case 3 as well. |
| Qualcomm | None | * For Case-1, we have agreed notification of Uu RLF. Then, if relay UE would like remote UE to temporarily keep the unicast PC5 due to waiting outcome of RLF recovery, it can hold the transmission of PC5-S/other notification message to remote UE until RLF recovery failure. We don’t think an explicit indication is required. * For Case-2, we have agreed notification for HO. Then, Then, if relay UE knows remote UE can work after HO, it can hold the transmission of PC5-S/other notification message to remote UE until HO failure. We don’t think an explicit indication is required. * For Case-3, Uu RRC reconfiguration failure is a rare case. It usually only happens in first release due to unmature deployment. We tend to not over-optimization. |
| Ericsson | none | Share the same view as Qualcomm. In Rel-17, it is sufficient for relay UE in RRC CONNECTED to inform remote UE of   1. Trigger of RLF 2. Trigger of HO |
| Sharp | Case-2 and Case -3 | Regarding to case-2 and case-3, they are similar with RLF failure which are within the Uu failure scope. We think remote UEs in idle/inactive state should be aware of the Uu link quality of the relay UE. And the notification of these two case may be necessary. |
| ZTE | Case-1 | We think case-2 and case-3 can be represented by the RLF detection indication since both cases will trigger RRC re-establishment. For the case-1, we think it can be supported together with RLF recovered indication. Upon receiving such indication, remote UE may initiate cell or relay (re)selection. |
| CATT | Case1 and case3 | For case1, please refer to our answer to Q2.  For case2, RAN2 has agreement already.  Proposal 5: When relay performs HO to another gNB, relay UE may send a PC5-S message (similar to LTE) to its connected remote UE(s) and this message may trigger relay reselection. FFS other indication/message can also be used for notification  For case3, it can be used for remote UE to perform RRC re-establishment procedure. |
| Lenovo | Case1, Case 2. | **Case-1: Uu Recovery failure**  After remote UE receives indication from relay UE, the remote UE may decide to keep PC5 link. Once the recovery fails, remote UE should be notified and perform reselection quickly. Otherwise, the remote UE need to wait for a long time.  **Case-2: HO failure**  After remote UE receives indication of HO from relay UE, the remote UE may decide to keep PC5 link. Once the HO fails, remote UE should be notified and perform reselection quickly. Otherwise, the remote UE need to wait for a long time. |
| Samsung | None | For case 1 and case 2, the existing agreements on Uu RLF and HO are sufficient.  For case 3, we somewhat share the view from Qualcomm. |
| Huawei, HiSilicon | Case 1, Case 3 | Case 1- If we decide to support Uu RLF is recovered indication in proposal 2 then Uu Recovery failure might also be beneficial to let the remote UE know of Uu Recovery failure.  Case 3 – This indication can help the remote UEs to be aware of the issues encountered on the Uu interface of the relay UE. |
| Kyocera | Case 2 | Agree with MediaTek regarding trigger for RRC reestablishment. We also assume that the HO failure may be due to inter-gNB handover. |
| Intel | None or case-3 if majority prefer | We could support case 3 if a generic indication is utilized although we also agree it is a corner case. |
| InterDigital | Case 2 and case 3 | If we agree to only RLF indication, then case 1 is not needed. Case 2 and case 3 could occur, and the remote UE should be aware of them. For example, we have a HO indication which is needed by the remote UE to be aware of successful HO. But the remote UE should be informed of HO failure, which results in a different remote UE action (e.g. re-establishment). |
| Spreadtrum | None | For Uu RLF and HO, we can rely on existing agreements. For Case 3, we think it is a corner case. |
| vivo | None  Or a general indication |  |
| Nokia | None |  |

## 3.4 Cause value

**[Cross WG]Proposal 4: RAN2 to discuss whether different cause value is needed in PC5-S message for HO, RLF and other cases(if agreed in Proposal 1, Proposal 2 and Proposal 3).**

* **Option-1: Yes**
* **Option-2: No**
* **Option-3: Up to CT1**

### **Q4: Which option do companies prefer?**

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| --- | --- | --- |
| Company | Option # | Comments |
| MediaTek | No | It would be a bit strange for RAN2 to discuss the signalling content of a signalling managed by other WG.  We suggest to not put the AS layer failure information into PC5-S, which cause unnecessary inter-layer interaction |
| OPPO | Option-3 | The cause value is defined in TS24.334, which is CT1 spec. |
| Qualcomm | Option-1 or Option-3  (See comments) | Our first preference is the agreed PC5-S message can include cause value of RLF or HO. However, considering it involved SA2 and CT1 efforts, we questioned whether RAN2 can introduce cause value in PC5-S message in the remaining 2 meetings. And we think it is important for remote UE to know the cause value. Otherwise, how remote UE can decide whether to keep or release serving PC5 link?  Thus, we can also accept below option:   * Besides the agreed PC-S signaling, also introduce a new PC5 RRC message with cause value of RLF or HO or cell reselection for indication only. * Upon reception of new PC5 RRC message with cause value, if remote UE determines to release the serving PC5 link, it triggers the legacy L2 release procedure. |
| Ericsson | Option 3 | It seems more reasonable to leave the job to CTI, but meanwhile, RAN2 may send LS to CT1 inform them of relevant RAN2 agreements (e.g., agreements made by P1, P2, or P3 if agreed)  In addition, regarding whether to introduce PC5-RRC signaling, we don’t have strong views. We can follow the majority view. |
| Sharp | Option 3 | It is within the CT1’s scope. |
| ZTE | Option 2 or Option 3 | We prefer new PC5-RRC message for the indication. However, if majority companies think it should be included in PC5-S signalling, the detailed design of PC5-S message can be up to CT1. |
| CATT | Option-2 | There is no need to distinguish the PC5-S message since the remote UE will perform the same procedure – to release the current connection. |
| Lenovo | Option 1 with comments | If PC5 RRC message can be agreed, the cause can be added in the PC5 RRC message directly, which will not impact on CT1. |
| Samsung | Option 3 | It is CT1 scope. |
| Huawei, HiSilicon | Option 2 | Agree with other companies that we need not discuss this in the RAN 2 |
| Kyocera | Option 2 | We prefer to use a new PC5-RRC message for the indications of RLF, recovery, HO failure. |
| Intel | Option 3 | Agree with other companies that it is up to CT1. |
| InterDigital | Option 3 |  |
| Spreadtrum | Option 3 |  |
| vivo | Option 3 |  |
| Nokia | Option 1 |  |

## 3.5 New PC5-RRC message

As indicated in the email scope, P5 is modified to exclude the RLF case which is discussed in [AT116-e][622] Q6.13.

Considering companies may think we need PC5-RRC message only for some of the cases, the question is asked in a way to split cases for convenience.

**Proposal 5: RAN2 to discuss whether new message/ indication is needed (e.g. PC5-RRC) for HO and other cases(if agreed in Proposal 1, Proposal 2 and Proposal 3).**

### **Q5: Which of the following case do you think a new PC5 RRC message should be used for sending indication to the remote UE by relay UE (if agreed in Proposal 1, Proposal 2 and Proposal 3)?**

**Case-1: HO**

**Case-2 (if agreed): Cell (re)selection**

**Case-3 (if agreed): Uu RLF recovered**

**Case-4 (if agreed): Uu Recovery failure**

**Case-5 (if agreed): HO failure**

**Case-6 (if agreed): Uu RRC reconfiguration failure**

|  |  |  |
| --- | --- | --- |
| Company | Case # | Comments |
| MediaTek | Case-3 and Case-5 | We prefer a new PC5 RRC message to make such indication from Relay UE to Remote UE. Or rather, we can use the same PC5-RRC message as discussed for RLF indication but with a different cause value. |
| OPPO | None | PC5-S signalling is sufficient.  We see the attempt behind the PC5-RRC signalling is to pursue further complicated UE behaviour during various failure cases, yet that seem optimization given no support on group-mobility in this release anyway. |
| Qualcomm | Case-1  Case-2  And Uu RLF | As comment in Q4, we are fine to introduce a new PC5 RRC message with cause value included, which is helpful for remote UE to decide whether to keep or release serving PC5 link.  For the trigger conditions, we aligned our preference on PC5-S (i.e., case-1, case-2 and Uu RLF). |
| Ericsson | Case 1  Case 2  In addition to Uu RLF |  |
| Sharp | None | We prefer a PC5-S signaling. |
| ZTE | Case 1, 3, 4, 7 | As we mentioned before, the indication of relay UE’s cell (re)selection can reuse the updated NCGI in discovery message. The indication of HO failure or Uu RRC Reconfiguration failure can reuse the RLF detection indication, which implies that RRC reestablishment shall be initiated. |
| CATT | Case-2,Case3,Case4 and Case 6 |  |
| Lenovo | All cases | We need a unified way. |
| Samsung | See comment | We prefer to reuse PC5-S as an indication. The indication can be used for case 1 and case 2. |
| Huawei, HiSilicon | Cases 1-4 and Case 6 | We think it will be beneficial to introduce a new PC5 RRC message rather than enhancing the PC5-S signalling.  In general the relay UE can use PC5-RRC message for indication and then remote UE will determine whether in needs to trigger PC5-S message to release unicast connection |
| Kyocera | Case 2, Case-3, Case-5 and Uu RLF | The failures are associated with the AS layer, so the use of PC5-S signaling is not appropriate. A PC5-RRC message with indication is the cleaner solution.  If a new PC5-RRC message is introduced, there is also no reason to exclude Uu RLF indication as part of this message, rather than the use of PC5-S. |
| Intel | Case 1, 2 and Uu RLF from CP summary | We think that these cases are fundamental and indication in AS layer is helpful for Remote UE to make appropriate decision. |
| InterDigital | Case 1, 2, 5, and 6 | Given that we have agreed to a PC5-RRC message for the RLF indication in the control plane discussion, we should be consistent with these cases as well. |
| Spreadtrum | None | PC5-S is enough, as 113e agreement, when Uu RLF is detected by relay UE or relay performs HO to another gNB, a PC5-S message (similar to LTE) to its connected remote UE(s) and this message may trigger relay reselection. |
| vivo | At least 1 | For RLF, we agreed that PC5-RRC can be used. This can be the same for case 1. Others are FFS. |
| Nokia | All (for the agreed ones) | The same PC5 RRC message should be used for agreed cases with cause value indicating the reason. |

## 3.6 PC5-S message type

For the Disconnect Request Message, it is proposed by Qualcomm(R2-2109432) and is included in the summary document. It is specified in TS 23.287.

|  |
| --- |
| **23.287**6.3.3.3            Layer-2 link release over PC5 reference point Figure 6.3.3.3-1 shows the layer-2 link release procedure over PC5 reference point.  cid:image001.png@01D7D253.21960F80  Figure 6.3.3.3-1: Layer-2 link release procedure  0.  UE-1 and UE-2 have a unicast link established as described in clause 6.3.3.1.  1.  UE-1 sends a Disconnect Request message to UE-2 in order to release the layer-2 link and deletes all context data associated with the layer-2 link.  2.  Upon reception of the Disconnect Request message UE-2 may respond with a Disconnect Response message and deletes all context data associated with the layer-2 link.       The V2X layer of each UE informs the AS layer that the unicast link has been released. The V2X layer uses PC5 Link Identifier to indicate the released unicast link. This enables the AS layer to delete the context related to the released unicast link. |

**[Cross WG]Proposal 6: RAN2 to discuss whether the agreed “PC5-S message (similar to LTE) to notify remote UE Uu RLF and HO” is the Disconnect Request message, or is up to SA2.**

### **Q6: What do you think the agreed “PC5-S message (similar to LTE) to notify remote UE Uu RLF and HO” should be?**

**Option-1: Up to SA2**

**Option-2: Disconnect Request message**

**Option-3: Other PC5-S message (Please specify)**

|  |  |  |
| --- | --- | --- |
| Company | Option # | Comments |
| MediaTek | No | We prefer a new PC5 RRC message (instead of PC5-S) to make such indication from Relay UE to Remote UE. |
| OPPO | Option-1/2 |  |
| Qualcomm | Option-1 or Option-2 | For MediaTek’s comments, RAN2 has agreed PC5-S for notification (as one message), and it was also specified in LTE relay. Let’s not revert this agreement.  As a summary, we think there are two options on notification signaling:   1. A PC5-S message without cause value (i.e., legacy Disconnect request message like LTE), and a new PC5 RRC message with cause value.    * Upon reception of new PC5 RRC message with cause value, if remote UE determines to release the serving PC5 link, it triggers the legacy L2 release procedure. 2. A PC5-S message with cause value.   Although our first preference is b), we can accept a). |
| Ericsson | Option 1 or 2 | Agree with Qualcomm comments |
| Sharp | Option 1 |  |
| ZTE | No | Agree with MediaTek on this. |
| CATT | Option-1 or Option-2 |  |
| Lenovo | No | The existing PC5-S e.g Diconnection request cannot be reused.  TS23.287 6.3.3.3:  *UE-1 sends a Disconnect Request message to UE-2 in order to release the layer-2 link and deletes all context data associated with the layer-2 link.*  *Upon reception of the Disconnect Request message UE-2 may respond with a Disconnect Response message and deletes all context data associated with the layer-2 link.*  Based on the above in TS23.287 6.3.3.3, after the relay UE transmits Diconnection request to remote UE, the relay UE will delete the context regardless of that the remote UE responds or not. (see TS23.287 6.3.3.3 and TS24.587 6.1.2.4.5). In remote UE side, remote UE also needs to delete context even reasons is not transmitted. Therefore, Diconnection request procedure cannot be reused directly.  According to the above analysis, a new PC5 RRC message is needed. |
| Samsung | Option 1 or option 2 |  |
| Huawei, HiSilicon | No | We prefer that the relay UE uses PC5-RRC message to indicate the failure cause and then remote UE will determine whether in needs to trigger PC5-S message to release unicast connection |
| Kyocera | None | We prefer to go with a new PC5-RRC message. |
| Intel | Option 1 or 2 |  |
| InterDigital | None | We prefer PC5-RRC message. |
| Spreadtrum | Option 1 |  |
| vivo | Option 1 | The PC5-S message has been agreed before as Qualcomm mentioned. So wonder how we can select none of the options. At least option-1 is OK to us. |
| Nokia | See comment | We prefer PC5 RRC message to be used for such an indication. Using Disconnect Request is only acceptable when the relay UE is no longer able to serve as a relay anymore. |

# Conclusion

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Reference

1. R2-2111223, Summary of AI 8.7.3.2 Relay (re)selection, vivo, 3GPP TSG-RAN WG2 Meeting #116 electronic, Online, 1st – 12th November 2021