3GPP TSG-RAN WG2 Meeting #118-e R2-210xxxx

Electronic Meeting, May, 2022

Agenda: 6.7.2.1

Source: InterDigital

Title: Summary of [AT118-e][632][Relay] Cell change for remote UE (InterDigital)

Document for: Discussion, Decision

# 1 Introduction

The following email discussion was triggered at RAN2#118-e[1]:

* [AT118-e][632][Relay] Cell change for remote UE (InterDigital)

Scope: Discuss P10a and P10b from R2-2206339 and attempt to reach an agreeable conclusion.

Intended outcome: Report to Monday week 2 session

Deadline: Friday 2022-05-13 1800 UTC

# 2 Discussion Summary

The following proposals from the pre-meeting summary in [2] were discussed online:

Proposal 10a: The remote UE shall stop T301, T300, T302, T319 and T390, if running, upon cell change due to reception of reconfigurationWithSync or cell (re)-selection of the relay UE.

Proposal 10b: RAN2 to discuss whether remote UE judges “cell change” when the received SIB1 includes a different cell.

To summarize the discussion, the first main question discussed was whether the remote UE, following a cell change that occurs due to cell re-selection performed by the relay UE, or due to reconfigurationWithSync at the relay UE, would stop any of the relevant timers, if started at the remote UE (i.e. T301, T300, T302, T319, and T390).

Based on significant majority view in the pre-summary discussion (10 out of 12 companies), and comments online, it seems RAN2 can agree that the timers should in fact be stopped by the remote UE when a cell change of the relay UE occurs. This aligns the remote UE behaviour with legacy Uu. It also avoids delay in connection establishment at the remote UE that would be associated with the alternative (i.e. to let the timers expire). Furthermore, it seems the main issue in the pre-meeting and online discussion is not tied to whether the timers are reset or not, but how this is handled in the specification:

*Discussion:*

*CATT doubt the necessity of these proposals; they think the timer expiry can handle these situations and they see this as an optimisation, but they can accept if there is a majority view. Ericsson agree.*

*vivo think the proposals are a bit confusing: P10a says the remote UE shall stop the timer, and P10b defines the “cell change”. So they think we should settle the definition of cell change before agreeing on P10a.*

*Lenovo understand that the point of P10b is how the remote UE recognises that the relay UE is served by a new cell: from a notification message by the relay UE or from SIB1, and the proposal is to align on SIB1. They think the UE will receive the notification message first, and the updated SIB1 comes later, and they think this creates an ambiguity period.*

*OPPO have some concern about P10a because of the phrase “upon cell change”; they think the triggering condition should be something that happens to the remote UE, not the relay UE, so they would like to reword P10a to say “upon cell change of relay UE”. ZTE have a similar concern, and also think that for the idle/inactive remote UE, the cell change can be regarded as cell reselection and the stop condition for the timers would then already be covered.*

*LG think in P10a, the timers can stop based on the cause value in the notification message from relay UE, and on P10b they have a similar concern to Lenovo that there is an ambiguity period between the notification message and SIB1.*

*InterDigital are OK with P10a, and think the relay can handle the ambiguity in P10b; so they think we may not need spec impact for the remote UE’s behaviour, considering that the notification message can signal the cell change.*

Based on this, rapporteur suggests that we focus the email discussion on how to capture the resetting of the timers at the remote UE, and not whether the remote UE resets the timers (as it seems agreeable to all companies).

**Proposal 1 – RAN2 agrees that the remote UE shall stop T301, T300, T302, T319, and T390, if running, when there is a cell change at the relay UE (i.e. caused by reception of reconfigurationWithSync at the relay, or cell (re)selection by the relay) and discusses how to capture this in 38.331.**

**Q1) Any companies that have a strong objection to agreeing with proposal 1, please indicate the specific reason in the comments.**

|  |  |
| --- | --- |
| Company with strong objection to P1 | Comments |
| Ericsson | We think that the part of the proposal that everybody can agree on is: “**RAN2 agrees that the remote UE shall stop T301, T300, T302, T319, and T390, if running, when there is a cell change at the relay UE**”  Maybe better to rephrase P1 according to this understanding. |
| Huawei, HiSilicon | We do not have a strong objection, just wondering why only consider the case relay receiving reconfigurationWithSync or performing cell reselection. The case relay performing reestablishment (e.g. triggered by Uu RLF) should have the similar impact on timer handling at remote UE? For instance, after relay UE forwarding the msg3 to network, relay UE performs reestablishment meantime sends Notification messge to remote UE, the remote UE’s RRC procedure has been interrupted (whether the cell changes or not is not the key point), which means the timer should be stopped. In this sense, the remote UE’s behavior after reception of Notification message could be aligned. |
|  |  |

Summary from Rapporteur:

* There is no strong objection to agree to the proposal. For the comment from Huawei, rapporteur agrees that this has not been considered in the scope of this email discussion, but has added another question to the second phase to resolve this issue.

**Proposal 1 [17/17] – RAN2 agrees that the remote UE shall stop T301, T300, T302, T319, and T390, if running, when there is a cell change at the relay UE (i.e. caused by reception of reconfigurationWithSync at the relay, or cell (re)selection by the relay).**

# 3 Capturing Remote UE Behavior

### 3.1 Detection of Cell Change by the Relay

One issue discussed is how the remote UE detects that the relay UE has performed a reselection or a handover. In pre-meeting and online discussions, there were two options discussed:

Option 1: Rely on NotificationMessageSidelink

One option would be for the remote UE to rely on reception of the NotificationMessageSidelink, which is sent by the relay when the relay UE performs HO, Uu RLF or cell re-selection. Since the NotificationMessageSidelink is already sent at cell change of the relay, there is no additional specification impact related to this option in the RRC.

Option 2: Detect a change in the cell identity upon reception of new SIB1

A second option would be for the remote UE to detect a cell change at the relay based on reception of SIB1. This would require (as proposed by [3]) the following additions to 5.2.2.4.2 to detect a cell change in the newly acquired SIB1:

<begin>

*5.2.2.4.2 Actions upon reception of the SIB1*

*Upon receiving the SIB1 the UE shall:*

*1> store the acquired SIB1;*

1> if the L2 U2N Remote UE is in RRC\_IDLE or in RRC\_INACTIVE,

2> if the *cellIdentity* in the acquired *SIB1* is different from the stored *cellIdentity,*

*….*

<end>

It was noted by several companies online that, in addition to requiring extra specification changes, option 2 has the issue that there is an ambiguity period between the notification message and reception of the updated SIB1. Based on this, and the fact that option 1 has already been specified in the RRC, it would seem option 2 is not needed. Rapporteur would like to confirm that this is common understanding to companies.

**Q2) Do companies agree that the remote UE is already aware of cell change at the relay UE (from reception of the NotificationMessageSidelink), and that additional specification to determine this at the remote UE (i.e. using option 2 above) is not necessary.**

|  |  |  |
| --- | --- | --- |
| Company | Response (Y/N) | Comments |
| Apple | Y | Same view as Rapporteur. No additional trigger condition is needed to be captured. We think remote UE implementation can resolve the ambiguity issue raised online. |
| MediaTek | Y | Same view as Rapporteur. |
| Xiaomi | Y |  |
| OPPO | Y | Same view as Rapp |
| Lenovo | Comment | We are fine with the majority view. But we would like to point out the following case.  NotificationMessageSidelink message is sent due to relay handover, cell reselection, Uu RLF. For relay handover, relay UE will still connect to source cell in the case of too early handover, which is defined in 36.300/38.300. Namely, after handover failure, UE re-establish to source cell. For Uu RLF, relay UE can still select the original cell during cell selection when performing re-establishment. Therefore, cell change does not happen in some cases even remote UE receives NotificationMessageSidelink message.  [Rapporteur]: For relay HO, it is assumed the notification is only sent for the case of successful HO, and so no notification would be sent following handover failure. Is this correct understanding of companies? For Uu RLF, rapporteur has added follow-up questions based on similar comment from Huawei. |
| vivo | Y |  |
| CATT | Y | Agree with Rapporteur. |
| Ericsson | Y | Our understanding is that remote UE may understand by implementation (according to the reception of the NotificationMessageSidelink or via other means) when the relay UE changes his cell. Therefore, we tend to agree to not make this overcomplicated and specify specifically how the remote UE figure this out. |
| Sharp | Y | During the online discussion, it was commented that *there could be an ambiguity period between the notification message and SIB1 and* option 2 would bring delay. So we are ok with option 1. |
| Samsung | Y | We agree with Rapporteur’s view that option 2 is not needed. |
| InterDigital | Y | We should avoid adding further specification effort if not needed. |
| Intel | Y |  |
| Kyocera | Y | We have the same view as the Rapporteur. |
| Qualcomm | Y |  |
| Huawei, HiSlicon | See comments | As commented to Q1, if we want to specify this new timer stop condition, we do not think cell change is the only point, and relay UE’s reestablishment due to Uu RLF should also trigger remote UE to stop the timer. Based on this assumption, we agree with rapporteur that relying on notification message is sufficient.\  [Rapporteur: We assume the response here is yes, since the question is about whether to use the notification message or not to detect the cell change. For the other cases, the rapporteur will add an additional question.] |
| Futurewei | Y |  |
| LG | Y |  |
| ZTE | Y | If the relay UE performs HO or re-establishment with the original cell, the relay UE may choose not to send the NotificationMessageSidelink. |

Summary from Rapporteur:

* From the comments, view seems unanimous.

**Proposal 2 [17/17] – The remote UE determines cell change at the relay UE from the reception of the NotificationMessageSidelink. No additional specification to determine this at the remote UE (i.e. using the change of cell ID in SIB1) is needed.**

### 3.2 Stopping the Timers of Proposal 1 at the remote UE

The second issue is how to capture the remote UE behaviour in proposal 1 (i.e. stopping the relevant timers indicated in Proposal 1) following the detection of the cell change at the relay UE. There were two options presented as part of pre-meeting and online discussions:

Option 1: Add “cell change at the relay” as an additional condition for stopping the timers

This option was discussed in [4] and is repeated below (for the case of T300).

<begin>

5.3.3.6 Cell re-selection or cell selection while T390, T300 or T302 is running (UE in RRC\_IDLE)

The UE shall:

1> if cell reselection occurs while T300 or T302 is running; or

1> if relay reselection or cell change due to handover or cell reselection of the connected relay UE occurs while T300 is running; or

1> if cell changes due to relay reselection while T302 is running:

2> perform the actions upon going to RRC\_IDLE as specified in 5.3.11 with release cause 'RRC connection failure';

1> else if cell selection or reselection occurs while T390 is running, or cell change due to relay selection or reselection occurs while T390 is running:

2> stop T390 for all access categories;

2> perform the actions as specified in 5.3.14.4.

7.1.1 Timers (Informative)

| Timer | Start | Stop | At expiry |
| --- | --- | --- | --- |
| T300 | Upon transmission of *RRCSetupRequest.* | Upon reception of *RRCSetup* or *RRCReject* message, cell re-selection, cell change due to handover or cell reselection of the connected relay UE, the (re)selected L2 U2N Relay UE becomes unsuitable, and upon abortion of connection establishment by upper layers. | Perform the actions as specified in 5.3.3.7. |

<end>

During the pre-meeting discussion, there were concerns with this option that “cell change due to handover or cell reselection of the connected relay UE” may be error prone and a new/shorter terminology should be introduced in the specification. This can be addressed as a next step (e.g., in phase 2 of this email discussion), or handled by the specification rapporteur if we agree to this option.

Option 2: Consider “cell change at the relay” as a reselection at the remote UE.

Another option proposed in pre-meeting discussion is for the remote UE to consider a cell change at the relay UE (either HO at the relay, Uu RLF or a cell reselection of the relay) as a cell reselection at the remote UE. Although this option creates a new meaning/condition for “cell reselection” at a remote UE, it could significantly reduce the number of places where specification changes are needed. Specifically, changes to 5.3.3.6 and 7.1.1 to handle T300 (as shown in option 1) are not needed because the case is considered as a cell reselection. As a result, the changes can, for example, be localized to 5.8.9.10.4 as follows:

<begin>

##### 5.8.9.10.4 Actions related to reception of *NotificationMessageSidelink* message

Upon receiving the *NotificationMessageSidelink*, the U2N Remote UE shall:

1> if the *indicationType* is included:

2> if the UE is L2 U2N Remote UE in RRC\_CONNECTED:

3> initiate the RRC connection re-establishment procedure as specified in 5.3.7;

2> else (the UE is L3 U2N Remote UE, or L2 U2N Remote UE in RRC\_IDLE or RRC\_INACTIVE):

3> if the PC5-RRC connection with the U2N Relay UE is determined to be released:

4> perform the PC5-RRC connection release as specified in 5.8.9.5.

3> else:

4> maintain the PC5-RRC connection;

4> if the *indicationType* is *relayUE-HO or relayUE-CellReselection*

5> consider cell re-selection occurs;

NOTE: For L3 U2N Remote UE, or L2 U2N Remote UE in RRC\_IDLE or RRC\_INACTIVE, it is up to Remote UE implementation whether to release or keep the PC5 unicast link.

<end>

**Q3) Which option (option 1 or option 2) do you prefer for capturing proposal 1 following detection of “cell change by the relay UE”.**

1. **Option 1: Add “cell change at the relay” as an additional condition for stopping the relevant timers**
2. **Option 2: Consider “cell change at the relay” as a reselection at the remote UE, which already causes the relevant timers to be stopped**
3. **Option 3: (Added by Huawei) Add “reception of notification message” as an additional condition for stopping the relevant timers**

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| --- | --- | --- |
| Company | Response (Option 1 or option2) | Comments |
| Apple | Option 2 | For option 1, we think the concept of "cell change at relay" is not quite clear, and it is error-prone because multiple places in spec may have similar issue. If option 1 is adopted, we think it is better to have a definition of "cell change at the relay" in Section 3.1.  Compared with Option 1, we think Option 2 is a more clean solution. |
| MediaTek | Option 2 | We intend to avoid to introduce additional terms like cell change |
| Xiaomi | Option 1 | As discussed in Q2, remote UE can acknowledge relay UE’s cell change based on either SIB1 forwarding or notification message. Option 2 only covers the notification based method. Option 1 can cover all cases. But the wording of option 1 can be improved. Following modification is suggested,  1> if relay reselection or cell change of the connected relay UE occurs while T300 is running; or |
| OPPO | Option 2 | We tend to share the same view as Apple that if option 1 is chosen, then additional effort for the definition of “cell change at relay” would be caused. |
| Lenovo | Option 1 | The solution in Option 2 cannot be used to stop T301 because “cell reselection” is not a stop condition of T301.  Some companies don’t want to have the term of ‘cell change’. We would like to remind that the term of ‘cell change due to relay reselection’ has been used to stop timer in the current RRC specification already.  Option 1 is a unified solution to stop all timers. We prefer to have a unified solution. |
| vivo | Option 2 with comments | We think the cell reselection concept is only applicable to RRC\_IDLE or RRC\_INACTIVE but not for RRC\_CONNECTED. From this perspective, it is suggested to make it more clear “consider cell re-selection occurs” are only referring to L2 U2N Remote UEs in RRC\_IDLE or RRC\_INACTIVE. We should not extend this cell reselection concept more than that. |
| CATT | Option 2 | Agree with Apple and MediaTek. Option 2 can avoid to introduce additional term "cell change of the connected relay". |
| Ericsson | Option 1 with comments | If we agree that remote UE can figure out by himself that the cell of the relay UE has changed, we think that the change in section 7.1.1 would be enough to address this. |
| Sharp | Option 2 | General we are ok with both. However, if option 1 is adopted it has to apply to all the timers of T300, T302, T319 and T390 and it is not so clean than option 2. From this view, we think option 2 is better. |
| Samsung | Option 2 | No strong view but this option looks clearer. |
| InterDigital | Option 2 | We think this is cleaner. For the case of T301, we think this case can be handled on its own. |
| Intel | Option 2 | We are fine with both options, but we understand that this option impacts mostly only the Relay parts of the spec. Indeed T301 has to be also handled individually. |
| Kyocera | Option 2 | We think Option 2 is a simpler solution without large specification effort. We also agree that the case for T301 needs to be handled. |
| Qualcomm | Option 1 | It can address all timers and agree with Ericsson comments |
| Huawei, HiSilicon | Option 3 | We understand the current notification types (relay UE HO, reselection, RLF) all trigger the remote UE’s new behavior of stopping the timers. Therefore the simplest way is just adding reception of notification message as one of the timer stop conditions. |
| Futurewei | Option 2 |  |
| LG | Option 2 |  |
| ZTE | Option 2 | For the idle/inactive remote UE, the cell change can be regarded as cell reselection and the stop condition for the timers in P1 except T301 would then already be covered. As regard to T301, it is used in RRC reestablishment procedure for RRC connected (remote) UE, the change of the stop condition of T301 is not necessary to keep align with the timers for idle/inactive remote UE. |

Summary from Rapporteur:

* Rapporteur suggests we agree on the majority option to handle this in the specification, and proposes changes to be agreed to section ? in the appendix.

**Proposal 3 [13/17] – To implement the stopping of timers, update section 5.8.9.10.4 such that the relay UE considers a cell change at the relay UE as a cell reselection, and agree to the draft specification changes in the conclusion/summary section.**

### 3.3 Handling T301

It was noted in phase 1 that cell reselection is not a stop condition for T301. For this scenario, [5] proposes that T301 is stopped following a “cell change” at the relay UE and proposes the changes below:

<begin>

#### *5.3.7.7 T301 expiry or selected cell no longer suitable*

*The UE shall:*

*1> if timer T301 expires;*

1. *if the selected cell becomes no longer suitable according to the cell selection criteria as specified in TS 38.304 [20]; or*
2. *if cell change due to relay handover or cell reselection of relay UE:*

*2> perform the actions upon going to RRC\_IDLE as specified in 5.3.11, with release cause 'RRC connection failure'.*

## *7.1 Timers*

### *7.1.1 Timers (Informative)*

|  |  |  |  |
| --- | --- | --- | --- |
| *T301* | *Upon transmission of RRCReestabilshmentRequest* | *Upon reception of RRCReestablishment or RRCSetup message as well as when the selected cell becomes unsuitable, the (re)selected L2 U2N Relay UE becomes unsuitable or cell change due to relay handover or cell reselection of relay UE.* | *Go to RRC\_IDLE* |

<end>

Alternatively, one may consider that this case need not be handled based on the following considerations:

* If the cell change corresponds to HO at the relay UE, the network should be able to send the reestablishment message via the new relay, so T301 should not be stopped in this case
* Its not clear that a cell change corresponding to reselection at the relay UE needs to be handled the remote UE is attempting a reestablishment

If companies consider the above considerations to be true, then there is no need to stop T301 at the remote UE for this case.

**Q4) Which option do you prefer for handling T301 at the remote UE when a “cell change” occurs at the relay UE?**

1. **Stop T301 (changes in R2-2204961)**
2. **Do not stop T301**

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| --- | --- | --- |
| Company | Response | Comments |
| InterDigital | b | At least for the HO at the relay, we think stopping T301 at the remote UE is not the correct/preferred behaviour. |
|  |  |  |
|  |  |  |

### 3.4 Handling the timers for the case of Uu RLF and Uu RRC Failure

It was noted during phase 1 discussions from some companies that the cases of Uu RLF and Uu RRC failure, and how the remote UE handles the associated timers, need to be considered.

**Uu RLF**

In the case of Uu RLF, the relay UE should trigger re-establishment. One option would be for the remote UE to stop the timers at the reception of Uu RLF. However, the relay UE, when initiating re-establishment procedure, may select the same cell. In that case, it is not clear whether the timers should be stopped in the first place. Furthermore, if the relay UE selects a different cell during re-establishment, it should send the notification for cell selection to the remote UE, which will stop the timers based on proposals 1-3. It would therefore seem that there is no additional specification needed for this case.

**Q5) Do companies agree that the remote UE does not stop T301, T300, T302, T319, or T390, if running, upon reception of NotificationMessageSidelink with indicationType of relayUE-UuRLF?**

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| --- | --- | --- |
| Company | Response (Y/N) | Comments (If N, please elaborate) |
| InterDigital | Y |  |
|  |  |  |
|  |  |  |

**Uu RRC Failure**

How the case of RRC failure at the relay UE is handled should also be discussed separately. Similar to the other cases, the associated timers can be stopped at the remote UE. However, this should likely be captured differently than in P1-3, since relay UE RRC failure is not a “cell change at the remote UE”. Instead, a better way to address this is to explicitly stop the timers upon reception of this specific notification message.

Alternatively, since the relay UE RRC connection/resume failure is a rare occurrence compared to HO or reselection, it may be acceptable to leave the timers at the remote UE running and not introduce any additional specification change for this case.

**Q6) Which option to companies prefer for the case when the remote UE receives NotificationSidelinkMessage with indicationType of relayUE-UuRRCFailure?**

1. **Remote UE does not stop T301, T300, T302, T319, or T390, if running (no additional specification impact)**
2. **Remote UE stops T301, T300, T302, T319, or T390, if running**

|  |  |  |
| --- | --- | --- |
| Company | Response | Comments |
| InterDigital | b preferred, but we can accept a. | Given this scenario is a bit different than the cell change one, we suggest it is captured explicitly (i.e. timers are stopped) in 5.8.9.10.4, rather than considering this a cell reselection and relying on the behaviour in 5.3.3.6 |
|  |  |  |
|  |  |  |

# 4 Conclusion/Summary

Rapporteur suggests agreeing to the following proposals:

**Proposal 1 [17/17] – RAN2 agrees that the remote UE shall stop T301, T300, T302, T319, and T390, if running, when there is a cell change at the relay UE (i.e. caused by reception of reconfigurationWithSync at the relay, or cell (re)selection by the relay).**

**Proposal 2 [17/17] – The remote UE determines cell change at the relay UE from the reception of the NotificationMessageSidelink. No additional specification to determine this at the remote UE (i.e. using the change of cell ID in SIB1) is needed.**

**Proposal 3 [13/17] – To implement the stopping of timers, update section 5.8.9.10.4 such that the relay UE considers a cell change at the relay UE as a cell reselection, and agree to the draft specification changes in the conclusion/summary section.**

**Draft Changes to TS 38.331 for Phase 1 (P1, P2, P3)**

<begin>

##### 5.8.9.10.4 Actions related to reception of *NotificationMessageSidelink* message

Upon receiving the *NotificationMessageSidelink*, the U2N Remote UE shall:

1> if the *indicationType* is included:

2> if the UE is L2 U2N Remote UE in RRC\_CONNECTED:

3> initiate the RRC connection re-establishment procedure as specified in 5.3.7;

2> else (the UE is L3 U2N Remote UE, or L2 U2N Remote UE in RRC\_IDLE or RRC\_INACTIVE):

3> if the PC5-RRC connection with the U2N Relay UE is determined to be released:

4> perform the PC5-RRC connection release as specified in 5.8.9.5.

3> else:

4> maintain the PC5-RRC connection;

4> if the *indicationType* is *relayUE-HO or relayUE-CellReselection*

5> consider cell re-selection occurs;

NOTE: For L3 U2N Remote UE, or L2 U2N Remote UE in RRC\_IDLE or RRC\_INACTIVE, it is up to Remote UE implementation whether to release or keep the PC5 unicast link.

<end>

# 5 References

1. RAN2#118-e chairman notes – RAN2 chairman
2. R2-2206339 Summary of [Pre118-e][608][Relay] Summary of AI 6.7.2.1 on CP (Lenovo)
3. R2-2204551 Discussion on cell change of remote UE due to relay UE's cell change SHARP Corporation discussion NR\_SL\_relay-Core
4. R2-2204960 [B105] TP on setup request procedure Lenovo discussion Rel-17
5. R2-2204961 [B106] TP on re-establishment procedure Lenovo discussion Rel-17