**3GPP TSG-RAN WG2 Meeting #112 electronic *R2-200nnnn***

**Online, November 2 - 13, 2020**

Agenda Item: 8.7.3.1

Source: MediaTek Inc. (Email Discussion Rapporteur)

**Title: [Post111-e][627][Relay] Remaining issues on L2 architecture**

Document for: Discussion and decision

# Introduction

This document is to kick off the following email discussion:

* [Post111-e][627][Relay] Remaining issues on L2 architecture (MediaTek)

 Scope: Discuss the remaining issues from [AT111-e][605], including the functionality of the adaptation layer and control plane procedures.

 Intended outcome: Summary to next meeting

 Deadline: Long

This email discussion is a follow up discussion of “[AT111-e][605][Relay] L2 Relay Mechanism” with the aim to further discuss the needed functionality as required by L2 based Relay architecture.

# Issue list

## Uu Adaptation layer for L2 UE-to-Network Relay

It was agreed at the last RAN2 meeting to support an adaptation layer over Uu between Relay UE and gNB for L2 UE-to-Network Relay. Then it is important to clarify the required functionality for this adaptation layer.

From uplink perspective, it should be able to map ingress PC5 RLC channel for relaying into Uu RLC channel over the direct Uu path (i.e. Relay UE Uu path). The Uu adaptation layer between the Relay UE and gNB can be used to express such bearer mapping relation.

### **Question 1**

Do you agree that the Uu adaptation layer at Relay UE supports UL bearer mapping between ingress PC5 RLC channels for relaying and egress Uu RLC channels over the Relay UE Uu path?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | UL bearer mapping should be supported regardless of the support of N:1 mapping between ingress PC5 RLC channels for relaying and egress Uu RLC channels  |
| OPPO | Yes |  |
| Ericsson (Min) | Yes with comments | To be more accurate, the mapping should be between Uu RB and egress Uu RLC channels. It means that it should be Uu RB ID that is carried in adaptation header on relay UE Uu connection. |
| Qualcomm | Yes |  |
| Apple | Yes |  |
| CATT | Yes |  |
| Huawei | Yes |  |
| vivo | Yes |  |
| ZTE | Yes | Ingress PC5 RLC channels are mapped into egress Uu RLC channels for relaying by the Uu adaptation layer for UL transmission and vice versa. |
| Samsung | Yes | Did you mean to ask whether N:1 mapping should also (in addition) be supported? Otherwise in our view this question just confirms the definition. We agree with ZTE’s understanding and could not quite follow Ericsson’s reasoning. |
| Sony | Yes |  |
| Xiaomi | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Nokia | Yes |  |
| Convida | Yes |  |
| Philips | Yes |  |
| Lenovo&MM | Yes |  |
| InterDigital | Yes | The Uu adaptation layer at relay UE should map the ingress PC5 RLC channels to egress Uu RLC channels  |
| Futurewei | Yes |  |

**Rapporteur summary-1: All companies joining the email discussion agree that the Uu adaptation layer at Relay UE supports UL bearer mapping between ingress PC5 RLC channels for relaying and egress Uu RLC channels over the Relay UE Uu path. Then this description can be put into an easy proposal and a TP describing L2 UE-to-NW relay.**

**Proposal-1: [Easy] agree the following description for L2 UE-to-NW relay (also reflected by TP)**

* **For L2 UE-to-NW relay, the Uu adaptation layer at Relay UE supports UL bearer mapping between ingress PC5 RLC channels for relaying and egress Uu RLC channels over the Relay UE Uu path.**

RAN2#111e (based on email disc. 605) considered whether different traffics of the same Remote UE or different Remote UEs can be multiplexed in the same Uu RLC channel of the Relay UE (i.e. N-to-1 mapping). This issue can be discussed for uplink relaying traffic with N:1 mapping and data multiplexing.

### **Question 2**

Do you agree that the different traffics of the same Remote UE and/or different Remote UEs can be subject to N:1 mapping and data multiplexing over Uu RLC channel.

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | N:1 mapping is at least needed to support the relaying for multiple Remote UEs based traffic, since the number of e2e traffic may be larger than the max number of the Uu RLC channels |
| OPPO | Yes | It is up to network configuration on whether the N-to-1 mapping is applied to same and/or different remote UE(s). |
| Ericsson (Min) | Yes | Agree with OPPO. This is up to network configuration. In addition, it is ok to map multiple Uu RBs of remote UEs which have similar QoS requirements onto the same relay UE Uu RLC channel. |
| Qualcomm | Yes | It makes sense to support N-to-1 mapping from PC5 to Uu in relay as justified by MediaTek. And we have same understanding as OPPO that RRC configures the N-to-1 mapping from same and/or different remote UE(s) |
| Apple | Yes | N-to-1 mapping is a definitely needed option for U2N relay to work properly unless we assume only one remote UE is served by the relay UE.  |
| CATT | Yes | Agree with MTK and OPPO’s view. |
| Huawei | Yes | We can support the both N:1 the multiplexing of multiple remote UE and the multiplexing of multiple RB of one remote UE in Uu link. |
| vivo | Yes | Agree with above comments. Moreover, whether the remote UEs and corresponding relay UE data can be multiplexed over one Uu RLC channel can be considered. |
| ZTE | Yes | N-to-1 mapping shall be supported：-If the Relay UE services multiple Remote UEs, the number of Uu RLC channels may be smaller than the number of PC5 RLC channels , in other word, 1- to- 1 mapping dose not exist for this case. -Moreover, it is ok that multiple traffic of same Remote UE or different Remote UEs are mapped into a single Uu RLC channel(N-to-1 mapping) based on the similar QoS requirement.  |
| Samsung | Yes but… | Whether this is used is down to the network. But as MediaTek points out there are cases where it may be essential. Of course, we could look into extending the LCID space on the Uu even further than what was done in Rel-16 (if needed), in which case there may not be any need for N:1 mapping. |
| Sony | Yes |  |
| Xiaomi | Yes | This is the minimum function of adaptation layer. |
| Spreadtrum | Yes |  |
| Intel | Yes | Agree with OPPO |
| Nokia | Yes | We agree that the N:1 mapping is needed for this release. |
| Convida | Yes | N-to-1 mapping is needed |
| Philips | Yes | Agree with Huawei |
| Lenovo&MM | Yes | It is network implementation to multiplex them or not. |
| InterDigital | Yes | We agree. The adaptation layer at relay UE can be configured by network to support N:1 mapping, where N can include the PC5 RLC channels from the same remote UE or different remote UEs |
| Futurewei | Yes |  |

**Rapporteur summary-2: All companies joining the email discussion agree that the different traffics of the same Remote UE and/or different Remote UEs can be subject to N:1 mapping and data multiplexing over Uu RLC channel. Then this description can be put into an easy proposal and a TP describing L2 UE-to-NW relay. Some companies further indicated that the exact mapping is up to network configuration, which can be considered during normative phase.**

**Proposal-2: [Easy] agree the following description for L2 UE-to-NW relay (also reflected by TP)**

* **The different traffics of the same Remote UE and/or different Remote UEs can be subject to N:1 mapping and data multiplexing over Uu RLC channel**

From uplink perspective, the Relay UE always route the packets to the gNB. However, if multiple Remote UE traffic can be multiplexed, the Relay UE may need to tell the gNB the source of the traffic (i.e. comes from which Remote UE). In this case, Remote UE identification may needs be supported at Uu adaptation layer for UL packets.

### **Question 3**

Do you agree that Uu adaptation layer is used to support Remote UE identification for the UL traffic (multiplexing the data coming from multiple Remote UE)?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| Ericsson (Min) | Yes |  |
| OPPO | Yes |  |
| Qualcomm | Yes | If we support N-to-1 mapping between PC5 and Uu in relay, the adaptation layer should be able to identify remote UE for UL traffic. |
| Apple | Yes |  |
| CATT | Yes |  |
| Huawei | Yes |  |
| vivo | Yes |  |
| ZTE | Yes |  |
| Samsung | Yes but… | We need to be clear as to whether we need to identify just the Remote UE, or the specific bearers. It looks like the questions that follow try and answer that. |
| Sony | Yes |  |
| Xiaomi | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Nokia | Yes | We think it is also worth noting that the UE RB ID may not be the full UE ID and RB ID. As to reduce overhead, it makes sense to investigate the option of utilizing the adaptation layer to map a smaller, simpler adaptation layer ID between the full UE/RB IDs |
| Convida | Yes |  |
| Philips | Yes |  |
| Lenovo&MM | Yes |  |
| InterDigital | Yes | The adaptation layer at relay UE should identify the remote UE in some way  |
| Futurewei | Yes |  |

**Rapporteur summary-3: All companies joining the email discussion agree that Uu adaptation layer is used to support Remote UE identification for the UL traffic (multiplexing the data coming from multiple Remote UE). Then this description can be put into an easy proposal and a TP describing L2 UE-to-NW relay.**

**Proposal-3: [Easy] agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**For L2 UE-to-NW relay, Uu adaptation layer is used to support Remote UE identification for the UL traffic (multiplexing the data coming from multiple Remote UE).**

From uplink perspective, the Relay UE needs to indicate the exact Remote UE Uu Radio Bearer to gNB for the gNB to resolve the data packets at Uu adaptation layer and to deliver the received data packets to the specific PDCP entity associated with the right Remote UE Uu Radio Bearer. In this case, the identity information of Remote UE Uu Radio Bearer needs be put by Relay UE at Uu adaptation layer at UL. In case of multiple Remote UE based relaying, the identity information of Remote UE needs also be put by Relay UE at Uu adaptation layer at UL.

### **Question 4**

Do you agree that the identity information of Remote UE Uu Radio Bearer needs be put into the Uu adaptation layer by Relay UE at UL in order for the gNB to correlate the received data packets with the specific PDCP entity associated with the right Remote UE Uu Radio Bearer?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| OPPO | Yes with comment | Yet “needs be put into the Uu adaptation layer **by Relay UE** at UL” is a bit misleading, since it depends on the FFS point that whether the adaptation layer is applied to the PC5 hop – in that case the remote UE Uu-bearer ID can be put into adaptation layer **by remote UE** instead of **relay UE**, so to avoid misunderstanding, maybe the “by relay UE” can be removed. |
| Ericsson (Min) | Yes | Agree with OPPO. |
| Qualcomm | Yes | We are confused by OPPO’s comment. In our understanding, just because we have FFS on adaptation layer in PC5 of remote UE, rapporteur tried to avoid mixing the discussion of FFS here by adding “by relay UE”. We prefer to keep “by relay UE” here unless the FFS is resolved.  |
| Apple | Yes | Regarding the confusion about “by relay UE”, I think that Uplink Uu adaptataion header is always created by U2N relay UE even the relay UE reuses some information from PC5 adaptation header (FFS), so it is OK to keep it. The remote UE Uu bearer ID cannot be transparent to relay UE. |
| CATT | Yes |  |
| Huawei | Yes | We are fine with the current wording and also fine with following updates for OPPO comments.“identity information of Remote UE Uu Radio Bearer needs be included into the Uu adaptation layer at Relay UE at UL”. This is because, anyway, the egress adaption layer PDU should include this ID in the header. |
| vivo | Yes | We tend to agree with Qualcomm. If the remote UE Uu-bearer ID is put into adaptation layer by remote UE instead of relay UE, it brings more signaling overhead and consume more PC5 radio resources which is not preferred. |
| ZTE | Yes | Agree with Apple. Anyhow, the UL Uu adaptation header is always created by Relay UE. |
| Samsung | Not sure | Correlation at the gNB could also be done based on mapping between LCID (for case of 1:1 mapping) and Remote UE Radio Bearers. Even for N:1 mapping, in IAB we do not insert the bearer ID into the Adapt header – instead, through appropriate routing configuration, the packets are delivered to the right UE. Of course, some kind of destination identity is needed – but this is a very vague term, LCID being another example.Also, at RAN2#111-e, we agreed the following:“Working assumption: Agree to put the needed information within the header of adaptation layer to enable Bearer mapping for L2 UE-to-Network relay and **the details can be discussed at WI phase**”Therefore there is no need or point to discuss the details here&now. |
| Sony | Yes | It’s fine to keep “by relay UE” as it’s relay UE’s behavior, no matter where the identity information is from. |
| Xiaomi | Yes | We agree with original rapporteur suggestion, i.e. keeping ‘by relay UE’. |
| Spreadtrum | Yes |  |
| Intel | Yes | We are fine with the update from OPPO.  |
| Nokia | Yes | As in Q3 |
| Convida | Yes with comment | Both the remote UE identity as well as the bearer identity need to be put into the adaptation layer header in order for the gNB to correlate the received data packets with the specific PDCP entity associated with the right Remote UE Uu Radio Bearer. Also the entity that put into the adaptation layer header the bearer identity or the UE identity doesn’t need to be the Relay UE, as it can be the remote UE or the access U2U relay (for e.g. in the case of multi-hop relay i.e. the U2U relay the remote UE is connected to, if we account for forward compatibility). |
| Philips | Yes with comments | Agree with Convida although we understand the question only considers one remote UE |
| Lenovo&MM | Yes | For OPPO comments:Even if the adaptation layer is applied to the PC5 hop, the relay UE needs to decode/remove the header of the received PDU and add the new header to the new PDU as IAB. Therefore, there is no problem to keep ‘by relay’ |
| InterDigital | Yes | We agree with Apple. Since the Uu adaptation header is created by the relay UE and relay UE is aware of the Uu radio bearer of the remote UE, the information on the radio bearer of the remote UE can be included by the relay UE in the adaptation layer header.  |
| Futurewei | Yes | Either “by the relay UE” or “at the relay UE” is fine with us. |

**Rapporteur summary-4: Clear majority companies (19/20) joining the email discussion agree that the identity information of Remote UE Uu Radio Bearer needs be put into the Uu adaptation layer by Relay UE at UL in order for the gNB to correlate the received data packets with the specific PDCP entity associated with the right Remote UE Uu Radio Bearer. However, there is a little bit confusion for some companies to read the wording “by Relay UE”. Then the description with removal of “by Relay UE” can be put into a proposal and a TP describing L2 UE-to-NW relay.**

**Proposal-4: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

* **The identity information of Remote UE Uu Radio Bearer needs be put into the Uu adaptation layer by Relay UE at UL in order for the gNB to correlate the received data packets with the specific PDCP entity associated with the right Remote UE Uu Radio Bearer.**

### **Question 5**

Do you agree that the identity information of Remote UE Uu Radio Bearer and the identity information of Remote UE needs be put into the Uu adaptation layer by Relay UE at UL in order for gNB to correlate the received data packets for the specific PDCP entity associated with the right Remote UE Uu Radio Bearer of a particular Remote UE in case of multiple Remote UEs based relaying?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| OPPO | Yes | Similar to the response to Q4, the “by relay UE” maybe a bit misleading, and thus suggest to remove.Furthermore, “a particular Remote UE i**n case of multiple Remote UEs based relaying**” may be not necessary since the fields of the header of adaptation layer is designed regardless of # of remote UE, so also suggest to remove. |
| Ericsson (Min) | Yes | Agree with OPPO. |
| Qualcomm | See comments | We are a little confused by this question. Can’t company response to Q3 and Q4 derive their answer to Q5? In addition, we also prefer to keep “by relay UE” for this question similar to Q4. Furthermore, we agree with OPPO on the confusion of “in case of multiple remote UEs based relay”. It may be misunderstood as multiple remote UE diversity (i.e. multiple remote UEs send the same packet to improve robust). In our understanding, it can be replaced by “in case of multiplexing data coming from multiple Remote UEs”  |
| Apple | Yes |  |
| CATT | Yes |  |
| Huawei | Yes | For the OPPO’s 2nd comments, we have sympathy that the header presence is not conditional. So maybe the wording could be “…. of a particular Remote UE for supporting de-multiplexing of multiple Remote UEs”BTW, to reply QC’s first comment, we interpretation is that Q5 is Yes, if the answer to both Q3 and Q4 are Yes. |
| vivo |  | Q5 can be covered by Q3 and Q4. |
| ZTE | Yes | In our understanding, for multiple Remote UEs case, it is necessary to include the identity information of Remote UE and Remote UE RB ID in the adaptation layer over Uu.  |
| Samsung | Not sure | At RAN2#111-e, we agreed the following:“Working assumption: Agree to put the needed information within the header of adaptation layer to enable Bearer mapping for L2 UE-to-Network relay and **the details can be discussed at WI phase**”Therefore there is no need or point to discuss the details here&now. |
| Sony | Yes |  |
| Xiaomi | Yes | This seems to be sum of Q4 and Q3. |
| Spreadtrum | Yes |  |
| Intel | Yes | Agree with OPPO to remove “by relay UE”. Also, we understand that the identity information of Remote UE Uu Radio bearer refers to any information that can be used to determine the identity information of Remote UE Uu DRB by the gNB. |
| Nokia | Yes | To our understanding, this is covered by Q3 and Q4 |
| Convida | Yes | Agree with OPPO. Also see our feedback to Q4 |
| Philips | Yes | Agree with Convida |
| Lenovo&MM | Yes | As we have pointed out in the Q5, “by relay UE” should be kept. |
| InterDigital | Yes | The identity information of Uu radio bearers of remote UE and the identity information of remote UE can be included by the relay UE when performing N:1 mapping at the adaptation layer, where the N can include PC5 RLC links containing traffic from Uu radio bearers from the same or different remote UEs.  |
| Futurewei | Yes |  |

**Rapporteur summary-5: Clear majority companies (19/20) joining the email discussion agree that the identity information of Remote UE Uu Radio Bearer and the identity information of Remote UE needs be put into the Uu adaptation layer by Relay UE at UL in order for gNB to correlate the received data packets for the specific PDCP entity associated with the right Remote UE Uu Radio Bearer of a particular Remote UE in case of multiple Remote UEs based relaying. However, there is a little bit confusion for some companies to read the wording “by Relay UE”. Meanwhile the rapporteur acknowledged that the answer of Q5 may be derived by the answer of Q3 and Q4. One thing to clarify is that Q3 talks about the principle of Uu adaptation layer but Q5 talks about the header design of Uu adaptation layer. Then the description with removal of “by Relay UE” can be put into proposal and a TP describing L2 UE-to-NW relay.**

**Proposal-5: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

* **The identity information of Remote UE Uu Radio Bearer and the identity information of Remote UE needs be put into the Uu adaptation layer at UL in order for gNB to correlate the received data packets for the specific PDCP entity associated with the right Remote UE Uu Radio Bearer of a particular Remote UE in case of multiple Remote UEs based relaying.**

From downlink perspective, it should be able to map end-to-end Radio Bearer (SRB, DRB) of a Remote UE into one Uu RLC channel over the direct Uu path (i.e. Relay UE Uu path). The Uu adaptation layer can be used to express the bearer mapping relation.

### **Question 6**

Do you agree that the Uu adaptation layer can be used to support DL bearer mapping at gNB to map end-to-end Radio Bearer (SRB, DRB) of Remote UE into Uu RLC channel over Relay UE Uu path?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| OPPO | Yes |  |
| Ericsson (Min) | Yes with comments | The answer is yes for uni-directional RB. While for a bidirectional RB, it would also depend on the initial packets of the RB are uplink or downlink. If initial packets of the RB are transmitted in uplink, the bearer mapping is already determined based on UL packets. gNB can just use the same mapping for DL as in UL. If the initial packet of the RB are transmitted in DL, gNB can determine the mapping relation. in that case, remote/relay UE can apply the same mapping for UL as in DL. |
| Qualcomm  | Yes | We don’t agree with Ericsson’s comment on same mapping between DL and UL. We guess it is intended to save payload size of adaptation layer similar to reflective QoS. However, reflective QoS itself had a lot of issue, and it was precluded in Rel-16 NR V2X. We don’t think similar approach can be reused for adaptation. Meanwhile, it looks more like stage 3 issue. We would like to avoid such discussion in SI stage.  |
| Apple | Yes | Agree that reflective QoS issue can be discussed in WI stage. |
| CATT | Yes |  |
| Huawei | Yes | Not sure on the comment from Ericsson. In L2 relay, relay UE may be not aware of the direction of E2E RB. So, anyway the DL bearer mapping at relay UE requires this adaption layer and its header. We support the understanding from QC and Apple. |
| vivo | Yes, with comments | Regarding Ericsson’s comments, it is not something like reflective QoS, given that reflective QoS is to apply the DL mapping for UL. As for reflective QoS, we think it is not essential feature and can be deprioritized. |
| ZTE | Yes |  |
| Samsung | Yes |  |
| Sony | Yes |  |
| Xiaomi | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Nokia | Yes |  |
| Convida | Yes |  |
| Philips | Yes | Agree with Ericsson |
| Lenovo&MM | Yes |  |
| InterDigital | Yes | Our understanding is in DL the adaptation layer at gNB can map/multiplex the traffic from different E2E radio bearers (i.e. DRB, SRB) intended to a remote UEs in the same Uu RLC channel to relay UE |
| Futurewei | Yes |  |

**Rapporteur summary-6: All companies joining the email discussion agree that the Uu adaptation layer can be used to support DL bearer mapping at gNB to map end-to-end Radio Bearer (SRB, DRB) of Remote UE into Uu RLC channel over Relay UE Uu path. Then this description can be put into an easy proposal and a TP describing L2 UE-to-NW relay. Some companies further discussed the need to support reflective RB mapping between DL and UL, which may be visited during normative phase.**

**Proposal-6: [Easy] agree the following description for L2 UE-to-NW relay (also reflected by TP)**

* **The Uu adaptation layer can be used to support DL bearer mapping at gNB to map end-to-end Radio Bearer (SRB, DRB) of Remote UE into Uu RLC channel over Relay UE Uu path**

RAN2#111e (based on email disc. 605) considered whether different traffics of the same Remote UE or different Remote UEs can be multiplexed in the same Uu RLC channel of the Relay UE (i.e. N-to-1 mapping). This issue can be discussed for downlink relaying traffic with N:1 mapping and data multiplexing.

### **Question 7**

Do you agree that the Uu adaptation layer can be used to support DL N:1 bearer mapping and data multiplexing between multiple end-to-end Radio Bearers (SRBs, DRBs) of a particular Remote UE and/or different UEs and one Uu RLC channel over the Relay UE Uu path?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | With the same reason for the answer of Question 2.  |
| OPPO | Yes | As replied to Q2. |
| Ericsson (Min) | Yes |  |
| Qualcomm | Yes | Aligned with response to Q2.  |
| Apple | Yes |  |
| CATT | Yes |  |
| Huawei | Yes |  |
| vivo | Yes |  |
| ZTE | Yes | Same reason for the answer of Q2 |
| Samsung | Not sure | Nor sure this is needed, given the increased Uu LCID space – we are not convinced that we will need to multiplex bearers. How many Remote UEs do we envisage a single relay will support on average? How many bearers is each of these Remote UEs expected to establish on average? We need to answer those questions before we can answer Q7, and this should be done in WI phase (in our opinion, and in line with our previous responses). |
| Sony | Yes |  |
| Xiaomi | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes  |  |
| Nokia | Yes |  |
| Convida | Yes |  |
| Philips | Yes |  |
| Lenovo&MM | Yes |  |
| InterDigital | Yes | The same reasoning we applied in Q2 apply also to DL. |
| Futurewei | Yes |  |

**Rapporteur summary-7: Clear majority companies (19/20) joining the email discussion agree that the Uu adaptation layer can be used to support DL N:1 bearer mapping and data multiplexing between multiple end-to-end Radio Bearers (SRBs, DRBs) of a particular Remote UE and/or different UEs and one Uu RLC channel over the Relay UE Uu path. Then this description can be put into a proposal and a TP describing L2 UE-to-NW relay.**

**Proposal-7: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

* **The Uu adaptation layer can be used to support DL N:1 bearer mapping and data multiplexing between multiple end-to-end Radio Bearers (SRBs, DRBs) of a particular Remote UE and/or different UEs and one Uu RLC channel over the Relay UE Uu path**

From downlink perspective, the Relay UE needs to route the packets to the right Remote UE and then Uu adaptation layer needs to support Remote UE identification for Downlink traffic. Remote UE identification for relaying traffic can be seen as part of bearer mapping function or as a separate packet routing function.

### **Question 8**

Do you agree that the Uu adaptation layer needs to support Remote UE identification for Downlink traffic which can be done as part of bearer mapping function or as a separate packet routing function?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| OPPO | Yes | Regardless of “bearer mapping” or “packet routing” as a terminology issue, the remote UE ID is needed for relay UE to know which remote UE to further deliver the packet to. |
| Ericsson (Min) | Yes |  |
| Qualcomm | See comment | We still think “which can be done as a part of bear mapping function or as a separate packet routing function” is confusing before RAN2 agreed whether/how to define “packet routing function” for L2 relay. Hence, we would like to suggest remove the sentence beginning from “which…” |
| Apple | Yes | Note that similar function is also needed for the first hop of U2U relay to differentiate multiple receiving remote UEs. |
| CATT | Yes |  |
| Huawei | Yes | To address QC’s comment, maybe we can formulate the wording as below (But we see no big difference, since anyway the terminology of function is FFS)“… for Downlink traffic (this can be done as part of bearer mapping function or as a separate packet routing function, which can be decided in WI phase)” |
| vivo | Yes, with comments |  We agree that the Relay UE needs to support Remote UE identification to deliver downlink traffic to the right remote UE. But whether as part of bearer mapping function or as a separate packet routing function, we prefer it as part of bearer mapping function considering packet routing function is dynamic and more suitable for multiple-hops scenario.  |
| ZTE | Yes | We understand that this question is to address the information of Uu adaptation layer for DL, not the functionality of Uu adaptation layer. For DL traffic, it is necessary to find the correct destination (Remote UE) by Remote UE identification which is included in adaptation layer. Actually, “Bearer mapping” and “ packet routing” can be achieved simultaneously for one-hop case . |
| Samsung | Yes |  |
| Sony | Yes |  |
| Xiaomi | Yes | We also suggest to focus on the functionality of remote UE identification and remove the bearer mapping and packet routing part. |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Nokia | Yes |  |
| Convida | Yes | Share the same view as Huawei |
| Philips | Yes |  |
| Lenovo&MM | Yes |  |
| InterDigital | Yes | The adaptation layer should identify the intended remote UE by including some identity of the remote UE within the header of the adaptation layer. What function this is eventually part of can be further discussed in the WI phase when these functions are more clearly defined. |
| Futurewei | Yes | Destination UE information is needed when multiple UE’s traffic is multiplexed onto one RLC channel. |

**Rapporteur summary-8: Clear majority companies (19/20) joining the email discussion agree that the Uu adaptation layer needs to support Remote UE identification for Downlink traffic which can be done as part of bearer mapping function or as a separate packet routing function. However, as there is a reply on the definition of packet routing function, in order to simplify the discussion, Rapporteur suggests to remove the terminology to host the function. Then the revised description can be put into a proposal and a TP describing L2 UE-to-NW relay.**

**Proposal-8: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

* **The Uu adaptation layer needs to support Remote UE identification for Downlink traffic**

From downlink perspective, the gNB needs to indicate the exact Remote UE Uu Radio Bearer to the Relay UE for it to resolve the data packets at Uu adaptation layer and to deliver the received data packets to the specific PC5 RLC channel associated with the right Remote UE Uu Radio Bearer. In this case, the identity information of Remote UE Uu Radio Bearer needs be put by Relay UE at Uu adaptation layer at DL. In case of multiple Remote UEs based relaying, the identity information of Remote UE needs also be put by gNB at Uu adaptation layer at DL for Remote UE identification.

### **Question 9**

Do you agree that the identity information of Remote UE Uu Radio Bearer needs be put into the Uu adaptation layer by gNB at DL in order for Relay UE to correlate the received data packets with the specific PC5 RLC channel associated with the right Remote UE Uu Radio Bearer?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |   |
| Ericsson (Min) | Yes with comments | From the texts, the rapporteur hints that UE ID may be optional for adaptation layer. or? If so, it is unnecessary to make UE ID field to be optional in the header. UE ID should be always in the header. |
| OPPO | Yes |  |
| Qualcomm  | Yes | For Ericsson’s comment, if NW only configure 1:1 mapping, then UE ID is not useful to be included in adaptation layer, right?Also, it looks like stage 3 issue. We think we can leave it (whether one IE is optional) to WI stage. |
| Apple | Yes | Want to clarify that what we agreed here is the ID for “Remote UE Uu Radio Bearer”, not necessarily a UE ID. |
| CATT | Yes |  |
| Huawei | Yes | The optional presence issue is definitely a WI issue. |
| vivo | Yes |  |
| ZTE | Yes | For our understanding , the identity information of Remote UE in adaptation layer is not necessary for 1-to-1 mapping.  |
| Samsung | Not sure | Do not agree with comments from Ericsson and agree with Apple that clarity is needed on what the ID represents (please see also our response to Q4). Also, at RAN2#111-e, we agreed the following:“Working assumption: Agree to put the needed information within the header of adaptation layer to enable Bearer mapping for L2 UE-to-Network relay and **the details can be discussed at WI phase**”Therefore there is no need or point to discuss the details here&now. |
| Sony | Yes |  |
| Xiaomi | Yes | We understand the remote UE Uu Radio Bearer should be E-to-E Uu radio bearer. |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Nokia | Yes | Please see the related answer to Q3 also |
| Convida | Yes |  |
| Philips | Yes | Agree with Samsung |
| Lenovo&MM | Yes |  |
| InterDigital | Yes | Similar to our response to Q5, the adaptation layer at gNB UE should identify the E2E radio bearers when supporting N:1 mapping in DL, where N includes the E2E radio bearers associated with the same remote UE |
| Futurewei | Yes |  |

**Rapporteur summary-9: Clear majority companies (19/20) joining the email discussion agree that the identity information of Remote UE Uu Radio Bearer needs be put into the Uu adaptation layer by gNB at DL in order for Relay UE to correlate the received data packets with the specific PC5 RLC channel associated with the right Remote UE Uu Radio Bearer. However, as there is a confusion during the reply on the needed Remote UE identity and the optionality of it. It should be noted that** **Q9 discusses the identity information of Remote UE Uu Radio Bearer and it does not necessarily mean Remote UE identity.** **Meanwhile, the optional presence of a particular IE can be discussed at normative phase. Then the following easy proposal is made:**

**Proposal-9: [Easy] agree the following description for L2 UE-to-NW relay (also reflected by TP)**

* **the identity information of Remote UE Uu Radio Bearer needs be put into the Uu adaptation layer by gNB at DL in order for Relay UE to correlate the received data packets with the specific PC5 RLC channel associated with the right Remote UE Uu Radio Bearer**

### **Question 10**

Do you agree that the identity information of Remote UE Uu Radio Bearer and the identity information of Remote UE needs be put into the Uu adaptation layer by gNB UE at DL in order for Relay UE to correlate the received data packets with the specific PC5 RLC channel associated with the right Remote UE Uu Radio Bearer for the particular Remote UE in case of multiple Remote UEs based relaying?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| OPPO | Yes | It should be a straightforward result if one answer Yes to Q8/Q9. |
| Ericsson (Min) | Yes | Agree with OPPO, this question can be merged with Q8 and/or Q9. |
| Qualcomm | See comments | Same comment as Q5, i.e. company response to Q8 and Q9 can derive their answer to Q10. Furthermore, we suggest to replace “in case of multiple remote UEs based relay” with “in case of multiplexing data coming from multiple Remote UEs”  |
| Apple | Yes |  |
| CATT | Yes |  |
| Apple | Yes |  |
| vivo |  | Q10 can be covered by Q8 and Q9. |
| ZTE | Yes |  |
| Samsung | Not sure | For 1:1 mapping we do not need both the Remote UE ID and the Remote UE Bearer ID.Also, as you will no doubt remember, at RAN2#111-e, we agreed the following:“Working assumption: Agree to put the needed information within the header of adaptation layer to enable Bearer mapping for L2 UE-to-Network relay and **the details can be discussed at WI phase**”Therefore there is no need or point to discuss the details here&now. |
| Sony | Yes |  |
| Xiaomi | Yes | This seems to be sum of Q9 and Q8. |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Nokia | Yes |  |
| Convida | Yes |  |
| Philips | See comments | Agree with Qualcomm |
| Lenovo&MM | Yes |  |
| InterDigital | Yes |  |
| Futurewei | Yes |  |

**Rapporteur summary-10: Clear majority companies (19/20) joining the email discussion agree that the identity information of Remote UE Uu Radio Bearer and the identity information of Remote UE needs be put into the Uu adaptation layer by gNB UE at DL in order for Relay UE to correlate the received data packets with the specific PC5 RLC channel associated with the right Remote UE Uu Radio Bearer for the particular Remote UE in case of multiple Remote UEs based relaying. Meanwhile the rapporteur acknowledged that the answer of Q10 may be derived by the answer of Q8 and Q9. One thing to clarify is that Q8 talks about the principle of Uu adaptation layer but Q10 talks about the header design of Uu adaptation layer. Then the description with some rewording as suggested by the reply can be put into a proposal and a TP describing L2 UE-to-NW relay.**

**Proposal-10: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

* **The identity information of Remote UE Uu Radio Bearer and the identity information of Remote UE needs be put into the Uu adaptation layer by gNB UE at DL in order for Relay UE to correlate the received data packets with the specific PC5 RLC channel associated with the right Remote UE Uu Radio Bearer for the particular Remote UE in case of multiplexing data coming from multiple Remote UEs.**

### **Question 11**

What additional functions on the Uu interface would be needed from the adaptation layer?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | There may be additional functions like flow control as studied by Rel-16 IAB, which may also be supported for the Uu adaptation layer. The details can be considered at WI stage.  |
| OPPO |  | if any additional functions identified to discuss, it can be left to WI-phase. |
| Ericsson (Min) | Yes | For adaptation layer, there are some issues need to be studied 1. How to reflect PDCP buffer status of remote UE in a Uu BSR.
2. How other hops are informed in case a radio link failure is detected on a hop.
3. How other hops are informed in case a congestion is detected on a hop.
4. How to protect UE ID, and avoid it to be disclosed in adaptation layer header?

For the first three issues, it would be beneficial to use adaption layer (i.e., control PDUs) to distribute the above information/address the above issues. For the fourth issue, RAN2 may need to send LS to SA3, informing SA3 of the issue.  |
| Qualcomm | No (See comments) | From our perspective, we think it is sufficient to support only bearer mapping and 1-hop routing in Rel-17, according to scoping of SID of relay. We think it is quite risky and unrealistic to consider future-proof functions in such a tough SI. If RAN2 really need to consider it, these future-proof features should be treated as low priority.Meanwhile, we do not agree with MediaTek and OPPO to postpone support of new functions directly in WI stage. In our understanding, there shouldn’t be anything in the WI that is not properly studied and discussed and concluded in SI. If company really think additional function needs to be supported for adaptation layer in Rel-17, we are open for discussion. But we do think it is important to raise, discuss and conclude these new functions in SI phase, instead of postponing them to WI just because of limited TU in SI stage.  |
| Apple | No with comments | If any additoanl function is needed, I think we need to make it clear in SI. We are fine to have more detail solutions around "bearer mapping” and “compatible to multi-hop U2N scenario” feature in WI, but not fine to leave a blank check for any other optimizations, such as QoS, access control, etc. |
| Huawei | No | We see no further essential issue in SI pahse.For those flow control/RLF related issue, those are somehow enhancement. And we see no reason why this is only L2 specific issue if they are essential.For the “protection of UE ID in adaption layer”, this has been discussed in R16 IAB, and the conclusion is there is no security issue to carry some AS layer ID in adaptation layer. |
| vivo | No | All functions should be proposed and decided in SI phase. The WI phase should not introduce new solutions that have not been considered during SI phase. |
| ZTE | No | We think the mapping function of Uu adaptation layer is sufficient at current stage. Any additional functions can be left in the WI-phase  |
| Samsung | See comments | This would need to be discussed at the WI stage. |
| Sony | No | Bear mapping should be sufficient in SI phase. |
| Xiaomi | No | We don’t think any enhancement is critical to support sidelink relay. |
| Spreadtrum | No | For Rel-17 relay, we think it is sufficient to have N:1 mapping and 1-hop routing function. |
| Intel | See comment | Assuming single hop to the network, similar to Ericsson’s comment, the Remote UE ID to be utilized in the header needs to be discussed. In addition, we wonder if differentiation of SRB vs. DRB has to be considered. But it can also be left to WI phase.  |
| Nokia | See comment | Similar to what we understand from Ericssons comments, we see an advantage to inform the upper layers/other hops about the availability of the link, i.e. in case of pending RLF. |
| Convida | Yes | There might be additional functions if we take as a reference point, the Rel-16 IAB work (for e.g. flow control) but the detail of any such additional function if identified, can be discussed during the WI phase. |
| Philips | Yes | Agree with Ericsson |
| Lenovo&MM | Yes | The details can be discussed in WI phase. |
| InterDigital | Yes | We think at least flow control and RLF functions are needed (similar to IAB). However, the details could be discussed in the WI phase. |
| Futurewei | No | We don’t see there are more essential functions for SI. |

**Rapporteur summary-11: There is no majority view based on the answers to Q11. Some companies see the need to discuss RLF handling, flow control, etc. at Uu adaptation layer for L2 Relaying as supported by IAB during SI phase. Many companies suggest to discuss such details at WI stage but many other companies suggest to discuss the issues if needed at SI stage before WI stage. Some companies did not see the need to discuss additional functions at Rel-17 other than bearer mapping and Remote UE identification (i.e. one-hop routing). Then the following proposal is made:**

**Proposal-11: Any additional functions other than bearer mapping and Remote UE identification for L2 UE-to-NW Relay can be discussed at WI stage.**

## PC5 Adaptation layer for L2 UE-to-Network Relay

In practice, the end to end QoS for multiple different Radio Bearers may be met with the same SL RLC channel configuration. Then the support of N:1 mapping between Remote UE Uu Radio Bearer and PC5 RLC channel may have the benefit of better resource utilization efficiency. Such N:1 mapping from Remote UE Uu Radio Bearer to PC5 RLC channel can be supported by PC5 Adaptation layer for L2 UE-to-Network Relay. Meanwhile Uu may support more logical channels than sidelink, so the N:1 mapping from Uu Radio Bearers to SL RLC channel may be inevitable.

### **Question 12**

Do you agree to support the N:1 mapping by PC5 adaptation layer between Remote UE Uu Radio Bearer and PC5 RLC channel for relaying?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | There was a discussion on the overhead to add an adaptation layer over PC5. When we consider to support the many-to-one bearer mapping between the same Remote UE traffic to the PC5 RLC relaying channel, only the Bearer identity information is needed within the adaptation layer header (e.g. it can be assumed as four bits if we support 16 RBs as the maximum RBs over PC5 per Remote UE). The overhead to add an adaptation layer over PC5 is negligible. |
| OPPO | Yes | The LCID space for RLC channel between remote-relay UE would become a bottleneck, if always assume 1-to-1 mapping, considering the forwards compatibility for multi-hop relay, and the possibility of merging of traffic between UE-to-network and UE-to-UE. |
| Ericsson (Min) | Yes with comments | We think it is more reasonable to map N Uu bearers of different remote UEs to one PC5 RLC channel. We are also fine with a majority’s view. |
| Qualcomm | No | We are not convinced by the benefit of adaptation layer over PC5 (i.e. N-to-1 PC5 to PC5 mapping) for U2N relay:* **LCID space issue:** we do not agree the argument that LCID space is not enough because LCID space is per PC5 RRC instead of per UE. In Rel-16 NR V2X, we also have the scenario that one SL UE connects multiple peer UEs via multiple PC5-RRC links. Why LCID space issue was not raised in Rel-16?
* **Forward compatibility for multi-hop relay:** it is valid only for intermediate hop in a multi-hop scenario. According to scoping of SID, we only need to support 1 hop in this release. Thus, it is a future-proof enhancement. Isn’t it be treated as low priority?
* **More spec works:** As Ericsson mentioned, if adaptation layer over PC5 is agreed, RAN2 has to consider multiple further spec works like RLF propagation and congestion control support as they list in Q11. Do we really need to further complicate things in this tough SI?
* **Extra complexity in remote UE:** introducing adaptation layer in PC5 will also increase complexity in remote UE, either in spec work (may need a new spec) or remote UE implementation. We don’t think RAN2 have enough technique analysis of its pro and cos.

Based on above concern, we think it is quite risky to consider this future-proof function in such a tough SI. We fail to see why it is an essential issue in this release, and so suggest to treat it in low priority.  |
| Apple | Yes | We are fine with support both N-to-1 mapping and 1-to-1 mapping for PC5 adaption layer. Our view is that PC5 adaptation layer is always needed because the function of bearer mapping needs to be done even for 1-to-1 mapping. The only difference is that the PC5 adaptation header could be absent to reduce user plane overhead in case 1-to-1 mapping is used.  |
| CATT | No | In our understanding, in the scope of R17(considering just one hop scenario), the requirement of N:1 mapping for PC5 adaption layer is not so strong and due to time limitation, we prefer not to support it. |
| Huawei | No strong view | We need to clarify why gNB will configure more E2E DRB than PC5 RLC for a certain remote UE.  |
| vivo | No | We share similar view with Qualcomm. It is not essential to introduce PC5 adaptation layer in remote UE to achieve the N:1 mapping from Uu Radio Bearers to PC5 RLC channel. This can be smart implementation by combining mapping of QoS flows to DRB in remote UE SDAP entity, and mapping of PC5 RLC channel to Uu DRB/RLC channel in relay UE Adaptation layer. |
| ZTE | Yes | From our perspective, it is ok to put the PC5 adaptation layer :-It is fine to have the adaptation layer that can provide a flexible mapping for UE to NW relay-It is better to have a unified protocol stack with the UE-to-UE relay. - Moreover, the PC5 adaptation layer is also be supported for multi-hop relay case in a future release. |
| Samsung | No | We have not even agreed whether we will have an Adaptation layer on PC5 so we think this question is premature. Also we do not agree with the following reasoning from the rapporteur: “Meanwhile Uu may support more logical channels than sidelink, so the N:1 mapping from Uu Radio Bearers to SL RLC channel may be inevitable” – yes Uu may support more logical channels than SL, but it will also carry data for multiple Remote UEs. These discussions are all premature until we have a quantitative understanding of the basic parameters. |
| Sony | Yes | We think N:1 bearer mapping of the same remote UE have the benefits on resource utilization e.g. LCID and improve the mapping flexibility.On the multi-hop case, it’s true that it’s not listed as priority in SID. But if we can support it without much specification efforts, we should do it.  |
| Xiaomi | No | Relay UE could reuse LCID to different remote UEs. The argument of LCID lack is not valid. Regarding the sidelink and U2N relay traffic coexistence, current LCID space is enough to cover SLRB plus SRB/DRB on one sidelink connection. |
| Spreadtrum | No | We think there is no strong reason to introduce PC5 adaptation layer in L2 UE-to-Network Relay. We think the LCID space is not an issue. |
| Intel | Yes | We are ok to support N:1 mapping functionality at the PC5 adaption layer |
| Nokia | No | We don’t see the need for agreeing on the adaptation layer over PC5 (yet). Although we agree on it being needed to support future optimizations, not having it, will not disallow the operation of SL relay. As noted from the RAN2#111, this question is controversial, and we would prefer if this was at least discussed after all non-controversial topics are relieved.We would also like to echo the details on the solutions which are already provided by Qualcomm |
| Convida | Yes | We are fine with support both N-to-1 mapping and 1-to-1 mapping for PC5 adaption layer |
| Philips | Yes with comments | We think the adaption layer is required in the PC5 interface for forward compatibility with multi-hop scenarios. We do not agree with Qualcomm that this will trigger extra spec work since the adaptation layer for PC5 will have to be defined anyway for U2U scenarios at least in the 2nd hop (between Relay UE and Destination UE) (see question 15) |
| Lenovo&MM |  No | We don’t see the necessity to support it since the number of PC5 LCH is enough. |
| InterDigital | Yes | Having always a 1:1 mapping from Uu bearer to PC5 RLC channel seems overly restrictive, if a single RLC channel provide the needed QoS for multiple bearers. The additional overhead for a more flexible N:1 mapping is negligible, and if needed, can be avoided, as mentioned by MediaTek and Apple. |
| Futurewei |  | The function of mapping Uu DRB to PC5 RLC channel needs to be supported. We don’t have strong view on N:1, and can go with majority view for sake of progress. |

**Rapporteur summary-12: Based on the answers to Q12, there are many companies (10/20) that support the N:1 mapping by PC5 adaptation layer between Remote UE Uu Radio Bearer and PC5 RLC channel for relaying. Some companies (8/20) did not see the need. Two companies have no strong view. The key discussion is whether there is a LCID space bottleneck for RLC channel between Remote UE and Relay UE if always assuming 1:1 mapping between Remote UE Uu Radio Bearer and PC5 RLC channel. Rapporteur suggests to do online discussion for the issue:**

**Proposal-12: RAN2 discuss the support of N:1 mapping by PC5 adaptation layer between Remote UE Uu Radio Bearer and PC5 RLC channel for relaying.**

There was a discussion at the last RAN2 e-meeting on the traffic differentiation over PC5 by adaptation layer between the non-relaying traffic (i.e. traffic terminated at Relay UE) and the relaying traffic (i.e. traffic destined to gNB) for L2 UE-to-NW relay operation.

### **Question 13**

Do you agree to support traffic differentiation via PC5 adaptation layer between the non-relaying traffic and the relaying traffic for L2 UE-to-NW relay operation?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| OPPO | Yes | Besides the non-relay case, furthermore, the question can be extended to support the merging of traffic for UE-to-network and UE-to-UE on the same connection via adaptation layer, which can be also enabled by a unified design of adaptation layer for UE-to-network and UE-to-UE relay. |
| Ericsson (Min) | No | We don’t think adaptation layer header is needed for non-relaying traffic. Traffic termination is clear purely based on bearer mapping. Introduce adaptation layer for non relaying traffic would increase the overhead.Just to be clearer, adaptation layer should be only supported for relaying purposes. For normal PC5 operations there should be no adaptation layer to guarantee the backward compatibility with Rel-16. |
| Qualcomm | No | Agree with Ericsson. Note that even in IAB, there is no requirement of multiplexing non-relaying traffic and relaying traffic.We would like to suggest focusing on essential function first. |
| Apple | Yes | Agree with MTK and OPPO. |
| CATT | See comments | Depends on SA2, if the PC5-S connection is specific for relay(e.g., PC5-S connection setup signaling carrying relay indication), there is no need to identify it in adaption layer; otherwise, it is needed in AS. Hence, it had better send LS to SA2 to check whether relay PC5-S connection is separate from normal PC5-S connection. |
| Huawei | No strong view | Alternatives to not using adaption layer can be: 1. Specific LCH can be configured for relay UE’s direct traffic, which is different with the LCH for relayed traffic. This means the need of Uu LCID extension of more than 32
2. Specific L2 ID for relay UE’s traffic and relayed traffic, which is SA2’s decision.
 |
| vivo | No | From our view, adaption layer is only used when carrying relaying traffic for L2 UE-to-NW relay operation. For non-relaying traffic we can fallback to use R16 sidelink solution. |
| ZTE | Yes | It makes sense to support traffic differentiation via PC5 adaptation layer. If the number of RLC channels is not be extended, we can not preclude the case that relay traffic and non- relay traffic share the same PC5 RLC channel , which requires the PC5 adaptation layer to support traffic differentiation.  |
| Samsung | See comments | Please see our response to previous question. We first need to agree whether to support Adapt on the PC5 link. |
| Sony | Yes | Agree with OPPO |
| Xiaomi | No | Agree with Ericsson and Qualcomm. |
| Spreadtrum | No | The non-relaying traffic and the relaying traffic for L2 UE-to-NW relay operation can be distinguished by LCID or L2 ID. |
| Intel | Yes | We agree with OPPO that it can be useful to have this differentiation imparted by the adaptation layer |
| Nokia | No |  |
| Convida | Yes | It makes sense to support both non-relaying traffic and relaying traffic differentiation via PC5 adaptation layer. |
| Philips | Yes with comments | We agree that traffic differentiation is needed. Although we do not agree that adaptation layer is the only way to achieve it. There are also other alternatives as suggested by Spreadtrum or CATT . |
| Lenovo&MM | No | Agree with Ericsson and QC. The relaying traffic and non-relaying traffic is not multiplexed to one LCH as IAB. |
| InterDigital | No | We do not see the need for traffic differentiation between the relayed and non-relayed traffic at the PC5 adaptation layer of remote UE. The relay UE can identify which RLC bearers are relayed and which are terminated at the relay itself, since they will correspond to different PC5-RRC connections. |
| Futurewei | No | There doesn’t seem to be much need of multiplexing non-relaying traffic with relaying traffic on the same RLC channel. |

**Rapporteur summary-13: Based on the answers to Q13, there is no clear majority (8 supports among 20 replies) on the support of traffic differentiation via PC5 adaptation layer between the non-relaying traffic and the relaying traffic for L2 UE-to-NW relay operation. Some companies (9/20) did not see the need. One company has no strong view. One company prefers to discuss PC5 adaptation layer first. One company suggests to send LS to SA2 to clarify whether relaying PC5-S connection is separate from normal PC5-S connection. Rapporteur suggests to do online discussion for the issue:**

**Proposal-13: RAN2 discuss the support of traffic differentiation via PC5 adaptation layer between the non-relaying traffic and the relaying traffic for L2 UE-to-NW relay operation.**

**Proposal-13a: RAN2 discuss the need to send LS to SA2 to clarify whether relaying PC5-S connection is separate from normal PC5-S connection.**

### **Question 14**

What additional functions on the PC5 interface would be needed from the adaptation layer if PC5 adaptation layer is supported?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | There may be additional functions like flow control and RLF notification as studied by Rel-16 IAB, which may also be supported for the Uu adaptation layer. The details can be considered at WI stage.  |
| OPPO |  | One key aspect is the identification of remote UE considering the multi-hop relay, which means the remote UE ID is also motivated to be included in the adaptation layer header on PC5 hop.Other than it, as replied to Q11, other additional function can be put into WI-Phase. |
| Ericsson (Min) | Yes with comments | In case RAN2 has decided to adopt adaptation layer for PC5 link, see our comments for Q11. |
| Qualcomm | No | Same comment to Q11, if company really think additional function needs to be supported for adaptation layer in Rel-17, we are open for discussion. However, we think it is important to raise, discuss and conclude new functions in SI phase, instead of postponing new function support to WI. |
| Apple | No with comments | See comment in Q11, we need to limit the work in WI phase to focus on “bearer mapping” and “compatibility with multi-hop scenarios”. We do not forsee any other essential functions. |
| Huawei | No |  |
| vivo | No | All functions should be proposed and decided in SI phase. The WI phase should not introduce new solutions that have not been considered during SI phase. |
| ZTE | No | Agree with Qualcomm and Apple |
| Samsung | See comments | Please see our response to previous question. We first need to agree whether to support Adapt at the PC5 link. |
| Sony | No | We support adaptation layer but don’t see a need for new functions. |
| Xiaomi | No | We don’t think any enhancement is critical to support sidelink relay. |
| Spreadtrum | No |  |
| Intel | No | We think we should focus on the functionality discussed above |
| Nokia | No | As stated earlier, we are not convinced about the urgent need for the adaptation layer, and not at all any additional functions. |
| Convida | No | Same comment to Q11. Also we second the view captured by OPPO. |
| Philips | Yes | Agree with Ericsson |
| Lenovo&MM | Yes | When RLF of Uu interface happens, relay UE needs to inform the remote UE. therefore, if PC5 adaptation layer is supported, the RLF notification should be sent using adaptation layer. |
| InterDigital | Yes | We agree with MediaTek. The details of additional functions (flow control and RLF) can be discussed during WI stage |
| Futurewei | No | We don’t see there are more essential functions for SI. |

**Rapporteur summary-14: Based on the answers to Q14, The majority (13/19) did not see the need to discuss additional functions for PC5 Adaptation layer if supported other than bearer mapping, identification of remote UE, and traffic differentiation between the non-relaying traffic and the relaying traffic if supported. Meanwhile, 5 companies see the need. Rapporteur suggests to do online discussion for the issue:**

**Proposal-14: No additional functions is supported at PC5 Adaptation layer (if supported) other than bearer mapping, identification of remote UE, and traffic differentiation between the non-relaying traffic and the relaying traffic (if supported) for L2 UE-to-NW relay operation.**

## 2nd Hop PC5 Adaptation layer for L2 UE-to-UE Relay

It was agreed at the last RAN2 meeting to support an adaptation layer over second hop PC5 between Relay UE and Destination UE for L2 UE-to-UE Relay. Then it is important to clarify the required functionality for this adaptation layer.

From Relay UE perspective, it should be able to map the ingress PC5 RLC channel(s) for relaying into egress PC5 RLC channel(s) for relaying. The second hop PC5 adaptation layer between the Relay UE and Destination UE can be used to express such bearer (or RLC channel) mapping relation.

### **Question 15**

Do you agree that the second hop PC5 adaptation layer can be used to support bearer mapping between the ingress RLC channels over first PC5 hop and egress RLC channels over second PC5 hop at Relay UE?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| OPPO | Yes |  |
| Ericsson (Min) | Yes with comments. | To be more accurate, the mapping should be between E2E RB and egress RLC channels. It means that it should be E2E RB ID that is carried in adaptation header on relay UE egress connection. |
| Qualcomm | Yes |  |
| Apple | Yes |  |
| CATT | Yes |  |
| Huawei | Yes |  |
| vivo | Yes for the same transmitting UE, FFS for the multiple transmitting remote UEs | We are fine with the bearer mapping for the same transmitting Remote UE but have some concern on multiple transmitting remote UEs. See comments in Question 16. |
| ZTE | Yes |  |
| Samsung | Yes | By definition it does this (= mapping between ingress and egress channels). Not sure whether there was more behind this question? |
| Sony | Yes |  |
| Xiaomi | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Nokia | Yes |  |
| Convida | Yes |  |
| Philips | Yes |  |
| Lenovo&MM | Yes |  |
| InterDigital | Yes |  |
| Futurewei | Yes |  |

**Rapporteur summary-15: All companies joining the email discussion agree that the second hop PC5 adaptation layer can be used to support bearer mapping between the ingress RLC channels over first PC5 hop and egress RLC channels over second PC5 hop at Relay UE. Then this description can be put into an easy proposal and a TP describing L2 UE-to-UE relay.**

**Proposal-15: [Easy] agree the following description for L2 UE-to-UE relay (also reflected by TP)**

* **For L2 UE-to-UE relay, the second hop PC5 adaptation layer can be used to support bearer mapping between the ingress RLC channels over first PC5 hop and egress RLC channels over second PC5 hop at Relay UE.**

In draft TR38.836, there is an “Editor note” at section 5.5.1: *It is FFS on the details to support the N-to-1 mapping between the ingress RLC channels from multiple transmitting Remote UEs to egress RLC channels (going to the same Destination UE) at Relay UE.* Meanwhile, the discussion in RAN2#111e (based on email disc. 605) considered whether different traffics of the same Remote UE or different Remote UEs can be multiplexed in the second hop PC5 (i.e. N-to-1 mapping).

### **Question 16**

Do you agree that the adaptation layer over second PC5 hop can be used to support N:1 bearer mapping and data multiplexing between multiple ingress PC5 RLC channels over first PC5 hop and one egress PC5 RLC channel over second PC5 hop?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| OPPO | Yes |  |
| Ericsson (Min) | Yes with comments | See comments for Q15 |
| Qualcomm | Yes |  |
| Apple | Yes |  |
| CATT | Yes |  |
| Huawei | Yes |  |
| vivo | Pending SA2 | In case of multiple transmitting remote UEs scenario, e.g., UE1 and UE2 both need to communicate with UE3 via the same relay UE. According to L2-ID allocation mechanism by SA2, the discovery procedure between UE1 and UE3, and the discovery procedure between UE2 and UE3, may result in two different L2-ID pairs. However, in Rel-16 RAN2 have agreed that “For sidelink unicast, data of different destinations is not multiplexed into the same MAC PDU”, which means that the relay UE may not be able to map the data from UE1 and UE2 to a single bearer to UE3.In order to support N:1 bearer mapping, we suggest to consult SA2 if the same L2-ID pair can be ensured in multiple transmitting remote UEs scenario.  |
| ZTE | Yes |  |
| Samsung | Yes |  |
| Sony | Yes |  |
| Xiaomi | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Nokia | Pending SA2 | As stated by vivo, this is an SA2 matter |
| Convida | Yes |  |
| Philips | Yes |  |
| Lenovo&MM | Yes |  |
| InterDigital | Yes |  |
| Futurewei | Yes |  |

**Rapporteur summary-16: Clear majority (18/20) companies joining the email discussion agree that the adaptation layer over second PC5 hop can be used to support N:1 bearer mapping and data multiplexing between multiple ingress PC5 RLC channels over first PC5 hop and one egress PC5 RLC channel over second PC5 hop. However, two companies raised the issue on the multiple transmitting Remote UEs scenario and suggests to liaison SA2. The issue was raised at last meeting but in Rapporteur understanding this is a RAN2 issue and the details should be resolved at WI stage. It is suggested to agree the following proposal:**

**Proposal-16: agree the following description for L2 UE-to-UE relay (also reflected by TP)**

* **For L2 UE-to-UE relay, the adaptation layer over second PC5 hop can be used to support N:1 bearer mapping and data multiplexing between multiple ingress PC5 RLC channels over first PC5 hop and one egress PC5 RLC channel over second PC5 hop.**

In addition, the Relay UE needs to route the packets to the right Remote UE and then the second hop PC5 adaptation layer needs to support Remote UE identification for relaying traffic. Remote UE identification for relaying traffic can be seen as part of bearer mapping function or a separate packet routing function.

### **Question 17**

Do you agree that the second hop PC5 adaptation layer needs to support Remote UE identification for relaying traffic, which can be done as part of bearer mapping function or a separate packet routing function?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | Remote UE identification for relaying traffic is anyway needed regardless if it is seen as part of bearer mapping function or a separate packet routing function |
| OPPO | Yes  | We assume the “remote UE” in this question includes both source and destination UE. |
| Ericsson (Min) | Yes |  |
| Qualcomm | Yes with comments | Similar to Q8, we think “which can be done as a part of bear mapping function or as a separate packet routing function” is confusing before RAN2 agreed whether/how to define “packet routing function” for L2 relay. Hence, we would like to suggest remove the sentence beginning from “which…” |
| Apple | Yes (with comment) | We think packet routing is also used to serve the general bearer mapping purpose, so this is not a seprate function of adaption layer. |
| CATT | Yes | Remote UE identification for relaying traffic is anyway needed. |
| Huawei | Yes |  |
| vivo | Pending SA2 | Similar concern as in Question 16. it depends on whether to support N:1 bearer mapping and multiple transmitting remote UEs scenario.  |
| ZTE | Yes | Remote UE identification is the definitely needed information for the destination Remote UE to distinguish which source Remote UE the received packet belongs to |
| Samsung | Yes | Agree with Qualcomm. |
| Sony | Yes |  |
| Xiaomi | Yes | We suggest to focus on the functionality of remote UE identification and remove the bearer mapping and packet routing part. |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Nokia | Pending SA2 |  |
| Convida | Yes | Remote UE identification is needed for the destination Remote UE to distinguish which source Remote UE the received packet belongs to. |
| Philips | Yes | We agree that remote UE identification is required in the 2nd hop PC5 adaptation layer. How this is achieved should be for FFS |
| Lenovo&MM | Yes |  |
| InterDigital | Yes | The second hop PC5 adaptation layer should support the identification of the remote source UEs when traffic from different source UEs arrives at the same destination UE.  |
| Futurewei | Yes | Information is needed to identify remote UE. |

**Rapporteur summary-17: Clear majority (18/20) companies joining the email discussion agree that the second hop PC5 adaptation layer needs to support Remote UE identification for relaying traffic, which can be done as part of bearer mapping function or a separate packet routing function. Meanwhile some companies suggests to remove the wording “which can be done as part of bearer mapping function or a separate packet routing function”. Two companies raised the issue on the multiple transmitting Remote UEs scenario and suggested to contact SA2, but in Rapporteur understanding this is a RAN2 issue and the details should be resolved at WI stage. It is suggested to agree the following proposal:**

**Proposal-17: agree the following description for L2 UE-to-UE relay (also reflected by TP)**

* **For L2 UE-to-UE relay, the second hop PC5 adaptation layer needs to support Remote UE identification for relaying traffic.**

From UE-to-UE relay perspective, the Relay UE needs to indicate the exact Source Remote UE SL Radio Bearer to Destination Remote UE for Destination Remote UE to resolve the data packets at second PC5 hop adaptation layer and to deliver the received data packets to the specific PDCP entity associated with the right end-to-end SL Radio Bearer. In this case, the identity information of Source Remote UE SL Radio Bearer needs be put by Relay UE at second PC5 hop adaptation layer. In case of multiple Source Remote UEs based relaying, the identity information of source Remote UE needs also be put by Relay UE at second PC5 hop adaptation layer.

### **Question 18**

Do you agree that the identity information of Source Remote UE SL Radio Bearer needs be put into the second PC5 hop adaptation layer by Relay UE in order for Destination Remote UE to correlate the received data packets for the specific PDCP entity associated with the right end-to-end SL Radio Bearer?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| OPPO | Yes with comment | Yet “put into the second PC5 hop adaptation layer **by Relay UE**” is a bit misleading, since it depends on the FFS point that whether the adaptation layer is applied to the first PC5 hop – in that case the source UE PC5-bearer ID can be put into adaptation layer **by source UE** instead of **relay UE**, so to avoid misunderstanding, maybe the “by relay UE” can be removed.One small comment is on the terminology, in the current TR, we use source-UE or destination-UE instead of source-remote-UE or destination-remote-UE. |
| Ericsson (Min) | Yes with comment | From the texts, the rapporteur hints that UE ID may be optional for adaptation layer. or? If so, it is unnecessary to make UE ID field to be optional in the header. UE ID should be always in the header. |
| Qualcomm  |  | Same comment as Q10 |
| Apple | Yes |  |
| CATT | Yes |  |
| Huawei | Yes |  |
| vivo | Pending SA2  | Similar concern as in Question 16. it depends on whether to support N:1 bearer mapping and multiple transmitting remote UEs scenario.  |
| ZTE | Yes | Anyhow, the second hop PC5 adaptation header is always created by Relay UE. |
| Samsung | Not sure | At RAN2#111-e the following was agreed:“Working assumption: Agree to put the needed information within the header of adaptation layer (for the receiving remote UE in UE-to-UE) to enable Bearer mapping for L2 UE-to-UE relay and **the details can be discussed at WI phase**.” |
| Sony | Yes |  |
| Xiaomi | Yes | We agree with original rapporteur suggestion, i.e. keeping ‘by relay UE’. |
| Spreadtrum | Yes |  |
| Intel | Yes | Agree with OPPO on the comment regarding “by relay UE”.  |
| Nokia | Pending SA2 |  |
| Convida | No Sure | Share same view as Samsung.  |
| Philips | Yes | We understand that solely use the Source Remote UE SL Radio Bearer is not enough to uniquely identify the end-to-end SL radio bearer so it should be combined with the identity of Source remote UE (question 19) in case of more than one remote UE |
| Lenovo&MM | Yes | Need to keep ‘by relay UE’ as we have pointed out for the previous question. |
| InterDigital | Yes | The second hop PC5 adaptation layer at relay UE should identify the SL radio bearers when supporting N:1 mapping to the same destination UE. |
| Futurewei | Yes | Information is needed to identity the multiplexed bearer.  |

**Rapporteur summary-18: Clear majority (15/20) companies joining the email discussion agree that the identity information of Source Remote UE SL Radio Bearer needs be put into the second PC5 hop adaptation layer by Relay UE in order for Destination Remote UE to correlate the received data packets for the specific PDCP entity associated with the right end-to-end SL Radio Bearer. Among the comments within the reply, some companies suggest to remove “by Relay UE”, which did not change the mean of the sentence. Two companies did not see the need to discuss this details at SI. Two companies raised the issue on the multiple transmitting Remote UEs scenario and suggested to contact SA2. It is suggested to agree the following proposal:**

**Proposal-18: agree the following description for L2 UE-to-UE relay (also reflected by TP)**

* **The identity information of Source Remote UE SL Radio Bearer needs be put into the second PC5 hop adaptation layer in order for Destination Remote UE to correlate the received data packets for the specific PDCP entity associated with the right end-to-end SL Radio Bearer**

### **Question 19**

Do you agree that the identity information of Source Remote UE SL Radio Bearer and the identity information of Source Remote UE needs be put into the second PC5 hop adaptation layer by Relay UE in order for Destination Remote UE to correlate the received data packets for the specific PDCP entity associated with the right end-to-end SL Radio Bearer in case of multiple Source Remote UEs based relaying?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| OPPO | Yes | Similar to the response to Q18, the “by relay UE” maybe a bit misleading, and thus suggest to remove.Furthermore, “SL Radio Bearer i**n case of multiple Source Remote UEs based relaying**” may be not necessary since the fields of the header of adaptation layer is designed regardless of # of remote UE, so also suggest to remove. |
| Ericsson (Min) | Yes with comment | We think both UE ID and RB ID need to be included in adaptation layer header. The header format should be fixed. In other words, no field needs to be optional for simplifying design efforts perspective. |
| Qualcomm | See comments | Same comment as Q5, i.e. company response to Q17 and Q18 can derive their answer to Q19. Furthermore, we suggest to replace “in case of multiple remote UEs based relay” with “in case of multiplexing data coming from multiple Remote UEs”.  |
| Apple | Yes |  |
| CATT | Yes |  |
| Huawei | Yes |  |
| vivo |  | Q19 can be covered by Q17 and Q18. |
| ZTE | Yes | Agree that identity information for both remote UEs and their RBs should be included in adaptation layer, which is necessary for multiple remote UEs case |
| Samsung | Not sure | At RAN2#111-e the following was agreed:“Working assumption: Agree to put the needed information within the header of adaptation layer (for the receiving remote UE in UE-to-UE) to enable Bearer mapping for L2 UE-to-UE relay and **the details can be discussed at WI phase**.” |
| Sony | Yes |  |
| Xiaomi | Yes | This seems to be sum of Q17 and Q18. |
| Spreadtrum | Yes |  |
| Intel | Yes | Same as above |
| Nokia | Please see Q17 and 18 |  |
| Convida | Not Sure  | See feedback to Q18 |
| Philips | See comments | We agree that the identity information of Source Remote UE SL Radio Bearer and the identity information of Source Remote UE needs to be put into the second PC5 hop adaptation layer but we agree with the suggestion made by Qualcomm |
| Lenovo&MM | Yes |  |
| InterDigital | Yes | The second hop PC5 adaptation layer at relay UE should identify the SL radio bearers and identify the source UEs when supporting N:1 mapping to the same destination UE, where N includes the SL radio bearers associated with the same source UE or different remote/source UEs |
| Futurewei | Yes |  |

**Rapporteur summary-19: Majority (15/20) companies joining the email discussion agree that the identity information of Source Remote UE SL Radio Bearer and the identity information of Source Remote UE needs be put into the second PC5 hop adaptation layer by Relay UE in order for Destination Remote UE to correlate the received data packets for the specific PDCP entity associated with the right end-to-end SL Radio Bearer in case of multiple Source Remote UEs based relaying.**

**Meanwhile the rapporteur acknowledged that the answer of Q19 may be derived by the answer of Q17 and Q18. One thing to clarify is that Q17 talks about the principle of PC5 adaptation layer but Q19 talks about the header design of PC5 adaptation layer.**

**Among the comments within the reply, two companies did not see the need to discuss this details at SI. Two companies raised the issue on the multiple transmitting Remote UEs scenario and suggested to contact SA2. It is suggested to agree the following proposal:**

**Proposal-19: agree the following description for L2 UE-to-UE relay (also reflected by TP)**

* **The identity information of Source Remote UE SL Radio Bearer and the identity information of Source Remote UE needs be put into the second PC5 hop adaptation layer by Relay UE in order for Destination Remote UE to correlate the received data packets for the specific PDCP entity associated with the right end-to-end SL Radio Bearer in case of multiple Source Remote UEs based relaying.**

### **Question 20**

What additional functions on the second hop PC5 interface would be needed from the adaptation layer?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | There may be additional functions like flow control as studied by Rel-16 IAB, which may also be supported for the Uu adaptation layer. The details can be considered at WI stage.  |
| OPPO | Yes | Besides the bearer-ID and source-UE-ID discussed in Q18/19, the ID of destination-UE is also needed, considering * Otherwise, the first/second hop of UE-to-UE relay has to be differentiated in layers below adaptation layer, in order for adaptation layer to differentiate between the UE-ID included in the header is for source or destination UE
* the forwards compatibility to multi-hop relay, i.e., the destination-UE may need to further send the packet to next hop(s), and the differentiation mentioned in the bullet above has to be in 3 types, first/intermediate/last hops.

Other than that, the additional functions can be left to WI-phase. |
| Ericsson (Min) | Yes with comment | Echoing OPPO that destination ID is also needed, especially in case a UE may operate as relay UE for both U2N and U2U. In addition, there are some issues need to be studied * How other hops are informed in case a radio link failure is detected on a hop.
* How other hops are informed in case a congestion is detected on a hop.
* How to protect UE ID, and avoid it to be disclosed in adaptation layer header?

For the first two issues, same as in IAB, it would be beneficial to use adaption layer (i.e., control PDUs) to distribute the above information/address the above issues. However, it is worth noting that IAB mechanisms can not be directly reused here. We can base on the IAB control PDU format as a baseline to introduce changes for SL relay needs.For the third issue, RAN2 may need to send LS to SA3, informing SA3 of the issue. |
| Qualcomm | Yes | Agree with OPPO and Ericsson that destination ID is also needed. We don’t see need to introduce new functions besides it.Meanwhile, similar comment to Q11, if company really think additional function needs to be supported for adaptation layer in Rel-17, we are open for discussion. But we do think it is important to raise, discuss and conclude these new functions in SI phase, instead of postponing them to WI just because of limited TU in SI stage. |
| Apple | Yes | The destination L2 ID of the receiving remote UE may be needed for forwards compatibility to multi-hop scenario. |
| Huawei | No | We are fine to include both Destination and Source remote UE ID in the adaption header.Anyway, the destination UE ID does not have to be included. In SA2 TR, the L2 ID based routing solution has been captured, which has no adaption layer header impact. So, either way works. |
| vivo | No | All functions should be proposed and decided in SI phase. The WI phase should not introduce new solutions that have not been considered during SI phase. |
| ZTE | Yes | Agree with majority’s views, the destination L2 ID is needed in intermediate U2U relays for multi-hop scenario. |
| Samsung | See comments | Details can be considered at the WI stage. |
| Sony | Yes | Destination ID is needed. |
| Xiaomi | Yes | We think destination information of SLRB is needed but destination information of remote UE is not required. Traffic from one SLRB would be sent to the same sidelink UE by lower layer. Therefore, relay UE would not merge SLRBs to different remote UEs into the same SLRB on second hop PC5 interface. It’s useless to indicate destination information of remote UE in adaptation layer.There may be multiple source remote UEs connecting to the same destination remote UE via relay. Relay UE may merge multiple SLRBs from multiple source remote UEs to the same SLRB, in order to save LCID. In this case, the destination information of merged SLRB is needed for remote UE to deliver the SLRB to correct PDCP entity. |
| Spreadtrum | Yes | Destination UE ID is needed. |
| Intel | Yes with comment | We agree with the companies above that having the Destination UE ID can be useful, but we are ok with either way |
| Nokia | Yes | Similar to the question 11 |
| Convida | Yes | The destination ID of the receiving remote UE is needed for forwards compatibility to multi-hop scenario.There might be additional functions if we take as a reference point, the Rel-16 IAB work but the detail of any such additional function if identified, can be discussed during the WI phase. |
| Philips | Yes | Agree with Ericsson |
| Lenovo&MM | Yes | 1．Destination ID is needed. 2. Relay UE needs to indicate RLF using the 2nd hop adaptation layer when RLF in the first hop happens. |
| InterDigital | Yes | We agree with MediaTek about flow control and RLF. The details of these can be discussed during WI stage. Destination ID in the header should not be needed since the relay UE will determine the L2 ID of the destination from the upper layer routing information.  |
| Futurewei | No | Other than possible information to identify destination UE, no additional function is essential for this SI. |

**Rapporteur summary-20: According to the replies, the majority (16/20) companies see the need for second hop PC5 Adaptation layer to carry the Destination Remote UE identity. Some companies see the need to discuss RLF handling, flow control, etc. at second hop PC5 Adaptation layer for L2 Relaying as supported by IAB. Many companies suggest to discuss such details at WI stage but some companies suggest to discuss the issues if needed at SI stage before WI stage. Then the following proposal is made:**

**Proposal-20: The Destination Remote UE identity is carried by second hop PC5 Adaptation layer for L2 UE-to-UE Relay.**

## 1st Hop PC5 Adaptation layer for L2 UE-to-UE Relay

At first, the end to end QoS for multiple different SL Radio Bearers may be met with the same SL RLC channel configuration at the first hop PC5. Then the support of N:1 mapping between Remote UE Uu Radio Bearer and PC5 RLC channel at the first PC5 hop may have the benefit of better resource utilization efficiency.

### **Question 21**

Do you agree to support the N:1 mapping by first hop PC5 adaptation layer between Remote UE SL Radio Bearers and first hop PC5 RLC channels for relaying?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |   |
| OPPO | Yes | The LCID space for RLC channel between source-relay UE would become a bottleneck, if always assume 1-to-1 mapping, considering - the same first hop carries the data for different second hop data;- the scenario where the first-hop is also the second hop for another UE-to-UE connection.- the forwards compatibility for multi-hop relay. |
| Ericsson (Min) | Yes with comments | We think it is more reasonable to map N SL radio bearers of different remote UEs to one PC5 RLC channel. We are also fine with a majority’s view. |
| Qualcomm | Yes | Different from U2N relay, U2U relay needs adaptation layer in source / target remote UE to support bi-directional transmission. We think it makes sense, and so support it. |
| Apple | Yes | Despite the resource efficiency benefit given by the rapporteur, we think this PC5 adaptation layer is needed because the transmitting remote UE may need to reach multiple receiving remote UEs via the same relay UE, so the LCID space of the first PC5 hop would be insufficient. This is similar to the Downlink Uu adaptation layer case.  |
| CATT | Yes | For U2U case, bi-directional transmission is more normal and for reverse transmission, N:1 mapping should be supported.  |
| Huawei | Yes (No strong view) | We are fine to support this. |
| vivo | Pending SA2 | 1:1 mapping is enough with one remote UE. FFS support of multiple transmitting remote UE scenarios.  |
| ZTE | Yes | We are OK to put PC5 adaptation layer, Basically, the Source Remote UE is able to be a destination Remote UE at opposite direction. In addition, Relay UE may needs to forward the multiple traffic from source UE to different destination Remote UEs.   |
| Samsung | Yes |  |
| Sony | Yes |  |
| Xiaomi | Yes | Different from U2N, remote UE may connect multiple remote UEs via the same relay UE. LCID may not be enough. |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Nokia | Yes, with comments | We should be enough in 1:1 mapping in most cases. N:1 mapping is needed on 1st hop only if one transmitting remote UE needs to reach multiple receiving remote UEs via the same relay UE as Apple mentioned. |
| Convida | Yes |  |
| Philips | Yes | As pointed out by other companies and unlike U2N, the remote UE may connect with the same relay UE for multiple remote UEs so it may decide to do N to 1 mapping due to not having enough LCIDs |
| Lenovo&MM | Yes | The traffics for the different destination UEs can be multiplexed to one PDU in the first hop. |
| InterDigital | Yes | We are fine to support this. Motivation for this would be similar to the UE to NW relay case. |
| Futurewei | Yes |  |

**Rapporteur summary-21: According to the replies, clear majority (19/20) companies see the need to support the N:1 mapping by first hop PC5 adaptation layer between Remote UE SL Radio Bearers and first hop PC5 RLC channels for relaying. However one company did not see the need. Then the following proposal is made:**

**Proposal-21: agree the following description for L2 UE-to-UE relay (also reflected by TP)**

* **Support the N:1 mapping by first hop PC5 adaptation layer between Remote UE SL Radio Bearers and first hop PC5 RLC channels for relaying.**

Secondly, different from L2 UE-to-Network Relay, one Source Remote UE can establish multiple PC5 links with several Destination Remote UEs via Relay UE. In this case, the traffic transmitted by the Source Remote UE needs to identify the Destination Remote UE, in order for the Relay UE to forward the packets to the right destination. Then, the adaptation layer over first hop PC5 between Source Remote UE and Relay UE is needed to carry the necessary information (e.g. the Identity of the Destination Remote UE) for that purpose.

### **Question 22**

Do you agree to support the adaptation layer over first hop PC5 between Source Remote UE and Relay UE in order to identify the traffic destined to different Destination Remote UEs?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| OPPO | Yes |  |
| Ericsson (Min) | Yes |  |
| Qualcomm | Yes |  |
| Apple | Yes | As explained in Q21 |
| CATT | Yes |  |
| Huawei | Yes (No strong view) | Fine to go with majority. |
| vivo | Pending SA2 | Similar concern as in Question 16. it depends on whether can support multiple destination remote UEs scenario.  |
| ZTE | Yes | The reason was shown in Q21 |
| Samsung | Yes |  |
| Sony | Yes |  |
| Xiaomi | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes  |  |
| Nokia | Yes | But would prefer SA2s conclusions first |
| Convida | Yes |  |
| Philips | Yes |  |
| Lenovo&MM | Yes |  |
| InterDigital | Yes |  |
| Futurewei | Yes |  |

**Rapporteur summary-22: According to the replies, clear majority (19/20) companies see the need to support the adaptation layer over first hop PC5 between Source Remote UE and Relay UE in order to identify the traffic destined to different Destination Remote UEs. However one company did not see the need. Then the following proposal is made:**

**Proposal-22: agree the following description for L2 UE-to-UE relay (also reflected by TP)**

**Support the adaptation layer over first hop PC5 between Source Remote UE and Relay UE in order to identify the traffic destined to different Destination Remote UEs.**

RAN2 already agreed to support the adaptation layer over second hop PC5 interface. If an adaptation layer is only supported at the Destination Remote UE, a UE needs to be configured differently as a Source Remote UE or as a Destination Remote UE, which is suboptimal.

In addition, there was a discussion at the last RAN2 e-meeting on the traffic differentiation over first hop PC5 by adaptation layer between the non-relaying traffic (i.e. traffic terminated at Relay UE) and the relaying traffic (i.e. traffic destined to Destination Remote UE) for L2 UE-to-UE relay operation.

### **Question 23**

Do you agree to support traffic differentiation via first hop PC5 adaptation layer between the non-relaying traffic and the relaying traffic for L2 UE-to-UE relay operation?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| OPPO | Yes | Similar to the reply for Q13, besides the non-relay traffic, furthermore, the question can be extended to support the merging of traffic for first-hop of one UE-to-UE connection and the last hop of another UE-to-UE connection via adaptation layer, which can also be enabled by a unified design of adaptation layer. |
| Ericsson | No | It is unnecessary to apply adaptation layer for non relaying traffic. This would increase the overhead. It is sufficient to distinguish non-relaying traffic from relaying traffic based on bearer mapping. Just to be clear, adaptation layer should be only supported for relaying purposes. For normal PC5 operations there should be no adaptation layer to guarantee the backward compatibility with Rel-16. |
| Qualcomm | No | Agree with Ericsson. Note that even in IAB, there is no requirement of multiplexing non-relaying traffic and relaying traffic.Again, we would like to suggest focusing on essential function first. |
| Apple | Yes |  |
| CATT | See comments | Depends on SA2, if the PC5-S connection is specific for relay(e.g., PC5-S connection setup signaling carrying relay indication), there is no need to identify it in adaption layer; otherwise, it is needed in AS. Hence, it had better send LS to SA2 to check whether relay PC5-S connection is separate from normal PC5-S connection. |
| Huawei | No strong view | Fine to go with majority. |
| vivo | No | Similar comments as Q13. |
| ZTE | Yes |  |
| Samsung | No | Agree with Qualcomm. |
| Sony | Yes |  |
| Xiaomi | No | Agree with Ericsson and Qualcomm |
| Spreadtrum | No | The non-relaying traffic and the relaying traffic for L2 UE-to-UE relay operation can be distinguished by LCID or L2 ID. |
| Intel | Yes | Same reasoning as in Q13 |
| Nokia | No |  |
| Convida | Yes |  |
| Philips | Yes | Same reasoning as in Q13 |
| Lenovo&MM | No | Agree with Ericsson and QC. |
| InterDigital | No | Similar to our response to Q13, we do not see the need for traffic differentiation between the relayed and non-relayed traffic at the PC5 adaptation layer of source UE.  |
| Futurewei | No | It’d be better not to change non-relaying PC5 operation. |

**Rapporteur summary-23: Based on the answers to Q23, there is no majority (8 supports among 20 replies) on the support of traffic differentiation via first hop PC5 adaptation layer between the non-relaying traffic and the relaying traffic for L2 UE-to-UE relay operation. Half companies (10/20) did not see the need. One company has no strong view. One company suggests to send LS to SA2 to clarify whether relaying PC5-S connection is separate from normal PC5-S connection. Rapporteur suggests to do online discussion for the issue:**

**Proposal-23: RAN2 discuss the support of traffic differentiation via first hop PC5 adaptation layer between the non-relaying traffic and the relaying traffic for L2 UE-to-UE relay operation.**

### **Question 24**

What additional functions on the first hop PC5 interface would be needed from the adaptation layer if the first hop PC5 adaptation layer is supported?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | There may be additional functions like flow control and RLF notification as studied by Rel-16 IAB, which may also be supported for the Uu adaptation layer. The details can be considered at WI stage.  |
| OPPO | Yes | Besides the bearer-ID and destination-UE-ID discussed in Q21/22, the ID of source-UE is also needed, considering * Otherwise, the first/second hop of UE-to-UE relay has to be differentiated in layers below adaptation layer, in order for adaptation layer to differentiate between the UE-ID included in the header is for source or destination UE
* the forwards compatibility to multi-hop relay, i.e., the packet may come from the UEs relayed by the “source” UE, and the differentiation mentioned in the bullet above has to be in 3 types, first/intermediate/last hops.

Other than that, the additional functions can be left to WI-phase. |
| Ericsson (Min) | Yes with comments | In case RAN2 has decided to adopt adaptation layer for the first hop, then RAN2 shall further study issues as we commented for Q20 |
| Qualcomm | Yes with comments | We agree with OPPO that the ID of source-UE is also needed. We don’t see need to introduce new functions besides it.Meanwhile, similar comment to Q11, if company really think additional function needs to be supported for adaptation layer in Rel-17, we are open for discussion. But we do think it is important to raise, discuss and conclude these new functions in SI phase, instead of postponing them to WI just because of limited TU in SI stage. |
| Apple | Yes | The source L2 ID of the receiving remote UE may be needed for forwards compatibility to multi-hop scenario. |
| Huawei | No |  |
| vivo | No |  |
| ZTE | Yes | Agree with OPPO’s comment, source Remote UE ID is needed for multi-hop case. |
| Samsung | See comments | Details can be considered at the WI stage. |
| Sony | No |  |
| Xiaomi | Yes | Different from U2N, source remote UE may connect to multiple destination relay UE via relay. Source remote UE may merge multiple end to end SLRB into the same SLRB on 1st hop. Destination information of SLRB and destination remote UE is needed for relay UE to deliver the traffic to correct destination. |
| Spreadtrum | Yes | Source UE ID is needed |
| Intel | No |  |
| Nokia | No |  |
| Convida | See comments  | Details can be considered at the WI stage. |
| Philips | Yes | Agree with Ericsson |
| Lenovo&MM | Yes | RLF notification should be sent using adaptation layer when RLF in the 2nd-hop happens. |
| InterDigital | Yes | We agree with MediaTek. The details of the additional functions (e.g. flow control, RLF) can be discussed during WI stage |
| Futurewei | No | Other than SLRB to PC5 RLC channel mapping, no other function is essential in SI. |

**Rapporteur summary-24: Based on the answers to Q24, there is no clear majority (11/20) on any additional functionalities such, RLF, flow control, source UE identification, etc. Meanwhile, many companies prefers to discuss the issues at WI stage. Rapporteur suggests to do online discussion for the issue:**

**Proposal-24: RAN2 discusses the support of additional functionalities over first hop PC5 Adaptation layer at WI phase for L2 UE-to-UE relay operation.**

## QoS handling for L2 Relay

For L2-based L2 UE-to-Network Relay, the Remote UE data goes over its own PDU session, and the Remote UE can inform the network the required QoS parameters. The network can provide configuration information for both PC5 RLC channel(s) and Uu Radio Bearer(s) taking into consideration the provided QoS information [23].

[7] describes that gNB guarantees the end-to-end QoS requirement of Remote UE by dividing end-to-end QoS parameters received from CN into QoS requirement on each hop, and configuring appropriate Uu and PC5 configuration. [11] and [40] describes that gNB implementation can handle the QoS breakdown over Uu and PC5 for particular session established between Remote UE and network. It would be helpful to clarify the basic QoS handling for L2 based UE to Network relaying.

### **Question 25**

**Do you agree that gNB implementation can handle the QoS breakdown over Uu and PC5 for the end-to-end QoS enforcement of a particular session established between Remote UE and network in case of L2 based UE to Network relaying? If not, please give your alternative solution and the reason.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| OPPO | Yes |  |
| Ericsson (Min) | Yes |  |
| Qualcomm | Yes |  |
| Apple | Yes |  |
| CATT | Yes |  |
| Huawei | Yes |  |
| vivo | Yes |  |
| ZTE | Yes |  |
| Samsung | Yes, with comment | The implementation may be able to handle it depending on the configuration signaling and measurement reports we design. Was the question meant to be about whether we think any further work on these aspects is needed? |
| Sony | Yes |  |
| Xiaomi | Yes |  |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Nokia | Yes |  |
| Convida | Yes with comment | We assume the question is about the breakdown of each QoS end to end attribute for e.g. end to end latency between Uu interface and PC5 interface. |
| Philips | Yes |  |
| Lenovo&MM | Yes |  |
| InterDigital | Yes |  |
| Futurewei | Yes |  |

**Rapporteur summary-25: According to the replies to Q25, all companies agree that gNB implementation can handle the QoS breakdown over Uu and PC5 for the end-to-end QoS enforcement of a particular session established between Remote UE and network in case of L2 based UE to Network relaying. Then the following easy proposal is made:**

**Proposal-25 [Easy]: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

* **gNB implementation can handle the QoS breakdown over Uu and PC5 for the end-to-end QoS enforcement of a particular session established between Remote UE and network in case of L2 based UE to Network relaying.**

For L2-based UE-to-UE Relay, QoS parameters coordination of a particular end-to-end SLRB for both PC5 links can be managed by upper layer (SA/CT scope). The basic procedure is described by solution 31 within section 6.31 of SA2 draft TR 23.752. The detailed procedure is described in section 6.31.3 of draft TR 23.752. The principle can be summarized as below in RAN2 language:

* The QoS parameters coordination for L2-based UE-to-UE Relay is governed by upper layer.
* Source Remote UE decides the E2E QoS parameters between Source Remote UE and Destination Remote UE based on the application layer requirements. Then Source Remote UE provides the QoS parameters to Relay UE.
* Relay UE splits the E2E QoS parameters into two parts: one part is for the PC5 interface between Source Remote UE and Relay (source side PC5 QoS parameters), the other part is for the PC5 interface between Relay UE and Destination Remote UE (destination side PC5 QoS parameters). Then Relay UE provides the QoS parameters to both Source Remote UE and Destination Remote UE.
* After the PC5 QoS parameters splitting for two PC5 links, the AS layer configurations for PC5 QoS parameters in each of the PC5 links can be achieved according to legacy mechanisms in R16 V2X.

### **Question 26**

**Which alternative do you prefer to document QoS handling for L2 UE-to-UE Relay in RAN2 TR?**

**Alt1: Document the principles as listed above**

**Alt2: QoS handling for L2 UE-to-UE Relay is subject to upper layer, e.g. solution 31 within TR23.752 studied by SA2.**

|  |  |  |
| --- | --- | --- |
| Company | Alternatives | Comments |
| MediaTek | Alt1/Alt2 | Both alternatives works |
| OPPO | Alt2 is preferred (Alt1 is OK with rewording suggestion) | Alt2 is safer since it is more of SA2 scope to decide on QoS framework.Alt1 contains some uncertainty, e.g., “Then Relay UE provides the QoS parameters to both Source Remote UE and Destination Remote UE.”, it needs SA2 confirmation first. By rewording it to “How for relay UE to exchange the split QoS parameter with source and destination UE is up to SA2 decision”, Alt1 is also fine for us to be captured in TR. |
| Ericsson (Min) | Alt 2. With update | RAN2 TR can refer to 23.752 solution#31. In addition, RAN2 can highlight RAN2 aspects, such as how relay UE splits the E2E QoS is for FFS by RAN2. |
| Qualcomm | Alt-2 | Agree with suggestion of Ericsson. |
| Apple | Alt-2 |  |
| CATT | Alt2 |  |
| Huawei | Either way | We don’t see any R2 issue on e.g. “how relay UE splits the E2E QoS” from Ericsson comments. This is purely relay UE implementation or SA2 issue. |
| vivo | Alt-2 | QoS handling for L2 UE-to-UE Relay is up to SA2 decision. |
| ZTE | Alt-2 | It is better that RAN2 TR refers to SA2 TR 23.752 solution#31. |
| Samsung | Either way |  |
| Sony | Alt2 | Both options can work |
| Xiaomi | Alt-2 |  |
| Spreadtrum | Alt-2 | QoS handling for L2 UE-to-UE Relay should be decided by SA2. |
| Intel | Alt1/Alt2 | We think both can work. In addition, for Alt2, as Ericsson mentioned, we need to discuss how the UE splits the E2E QoS. |
| Nokia | Alt-2 |  |
| Convida | Alt1/Alt2 | Both Alts work |
| Philips | Alt2 | Agree with Ericsson |
| Lenovo&MM | Alt2 | It can be decided by SA2. |
| InterDigital | Alt-2 | We tend agree with Ericsson on this for referring to 23.752 solution#31. RAN2 impacts of the QoS splitting need to be further studied by RAN2. |
| Futurewei | Alt-1 and Alt-2 | It should be made clear that QoS handling is feasible, e.g., with high level principle of Alt-1, as studied in Alt-2. |

**Rapporteur summary-26: According to the replies to Q26, all companies agree with Alt2 i.e. QoS handling for L2 UE-to-UE Relay is subject to upper layer, e.g. solution 31 within TR23.752 studied by SA2. Meanwhile some companies thinks both Alt1 and Alt2 can work. Alt2 can be put into an easy proposal. Meanwhile, there is a discussion on whether RAN2 needs to discuss the RAN2 impacts of the end-to-end QoS splitting at Relay UE. Some companies see the need and some other companies see this as an SA2 issue or UE implementation issue.**

**Proposal-26 [Easy]: agree the following description for L2 UE-to-UE relay (also reflected by TP)**

* **QoS handling for L2 UE-to-UE Relay is subject to upper layer, e.g. solution 31 within TR23.752 studied by SA2.**

## Connection Establishment for L2 UE-to-Network Relay

Multiple documents submitted RAN2#111e discussed the high level procedure for L2 relay connection setup [7] [8] [15] [23]. In RAN2#111e, it was agreed that Remote UE initiates the first RRC message for its connection establishment with gNB, the PC5 L2 configuration for the transmission between the Remote UE and the UE-to-Network Relay UE can be based on the RLC/MAC configuration defined in specifications. It was also agreed that the establishment of Uu SRB1/SRB2 and DRB of the Remote UE is subject to legacy Uu configuration procedures for L2 UE-to-Network Relay.

Based on the agreement made at RAN2#111e meeting and the discussion in the relevant documents, the diagram in Figure 1 and the steps described below are to show a high-level summary of the process that needs to happen for connection establishment through the relay, which assumes the Remote UE does not first access on Uu to request a transfer to the relay link.



Figure 1: Connection Establishment for L2 UE-to-NW relay

Step 1. The Remote and Relay UE perform discovery procedure, and establish PC5-RRC connection according to the legacy Rel-16 procedure.

Step 2. The Remote UE sends the first RRC message (i.e. RRCSetupRequest) for its connection establishment with gNB via the Relay UE, using a default L2 configuration on PC5. The gNB responds with an RRCSetup message to Remote UE as legacy procedure. The RRCSetup delivery to the Remote UE uses the default configuration for L2 on PC5. If the relay UE had not started in RRC\_CONNECTED, it would need to do its own connection establishment as part of this step.

Step 3. The gNB and Relay UE perform relaying channel setup procedure over Uu. According to the configuration from gNB, the Relay UE establishes an RLC channel for relaying of SRB1 towards the Remote UE over PC5. This step prepares the relaying channel for SRB1.

Step 4. Remote UE SRB1 message (e.g. an RRCSetupComplete message) is sent to the gNB via the Relay UE using SRB1 relaying channel over PC5. Then the Remote UE enters into RRC\_Connected state.

Step 5. The Remote UE and gNB establish security following legacy procedure and the security messages are forwarded through the Relay UE.

Step 6. The gNB sets up additional RLC channels between the gNB and Relay UE for traffic relaying. According to the configuration from gNB, the Relay UE sets up additional RLC channels between the Remote UE and Relay UE for traffic relaying. This step prepares the relaying channels for SRB2/DRBs.

Step 7. The gNB sends an RRCReconfiguration to the Remote UE via the Relay UE, to set up the relaying SRB2/DRBs. The Remote UE sends an RRCReconfigurationComplete to the gNB via the Relay UE as a response.

### **Question 27**

**Do you agree to capture Figure 1 and the corresponding step description above into the TR to show the high level procedure for Connection Establishment of L2 UE-to-Network relay?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |
| OPPO | Yes with comment | We understand the intention of this question is to provides a high-level description of the procedure which is general enough to avoid debate on specific details, which can be left to WI phase, so we agree it would be benefit to capture this in TR.One comment is on step6/7: since the RRCReconfiguration is on SRB1 and used for configuration of SRB2/DRB, it is suggested to merge step6/7 as one, since there may be no clear boundary between the two, e.g., it can be the RRCReconfiguration itself to perform the RLC channel configuration for relay and remote UE. |
| Ericsson (Min) | Yes with comments | General we are fine with the step description. We also agree with OPPO to merge step 6 and 7. In addition, we would like the below things to be further clarified.1. Signalling transmission directions. Since this should be a flow diagram, better to change the “squares” with “arrows” since a procedure may involve two messages rather than only one, e.g., the security establishment.
2. In step 2, the default configuration means that the default L2 configurations for SL SRB0
3. Whether or not to use SL SRBs (even a new type of SL SRB) to carry these Uu RRC signalling? If so, what SL SRB will be used. Perhaps we can add an FFS for this issue in the TR.
 |
| Qualcomm | Yes with comments | We agree with OPPO that step 6 and 7 can be merged. |
| Apple | Yes | We agree with OPPO that step 6 and 7 can be merged. |
| CATT | See comments | Before we give the L2 U2N connection setup figure, it had better make clear the following questions first:1． It had better send LS to SA2 to check whether the legacy PC5-S connection setup procedure can be reused for relay connection setup? Whether any modification on the PC5-S signalling is needed, e.g., indicate the PC5-S is aiming for relay?2． How the relay UE can identify the PC5-RRC should be relayed while not terminated in itself if the PC5-S is not specified for relay as questioned in 1? Any AS enhancement is needed?3． Whether SRB0 or a separate Uu default BH bearer can be used to convey the remote UE’ RRCSetupRequest should be further studied. |
| Huawei | Yes | No need of FFS on “what SL SRB will be used”, since this is WI issue. There is no restriction from the rapporteur’s proposal.For the comment from CATT:1. This has no impact to the R2 procedure
2. This has been covered by the adaption layer function
3. Detailed configuration on Uu for the first RRC message can be discussed in WI phase, which has no impact to the high level procedure.
 |
| vivo | Yes, with comments | The initial RRC state of relay UE does not have to be RRC CONNECTED. It can be RRC IDLE/INACTIVE. And the RRC IDLE/INACTIVE to RRC CONNECTED state transition can be triggered during step 1 and accomplished before step 2 in the above Figure. |
| ZTE | Yes | Agree with OPPO that step 6 and 7 can be merged. In addition, for step 2, it is not clear when and how to establish the Uu BH bearer for forwarding the RRCSetupRequest/RRCSetup message for remote UE. We also need to address this issue. |
| Samsung | Yes |  |
| Sony | Yes |  |
| Xiaomi | Yes with comments | In step 2, the legacy RRC connection setup procedure may need changes. We suggest to remove ’as legacy procedure’ |
| Spreadtrum | Yes | General we are fine with the step description. |
| Intel | Yes | We are fine with the overall flow. |
| Nokia | Yes | Fine as a baseline, but details must be discussed |
| Convida | Yes |  |
| Philips | Yes | We agree to the general flow, but that we think further details will need to be added to step 1, since it is currently based on the assumption that the Remote UE has all the necessary information to make an informed decision as to which UE-to-NW relay to select, which may not be the case. |
| Lenovo&MM | Yes with comments | ‘RRC IDLE’ on top of step1 in remote UE side should be removed. ‘RRC connected’ on top of step1 in relay UE side should be removed. Before PC5 connection establishes, the relay UE could stay at idle mode.  |
| InterDigital | Yes, with some comments: | We agree that it makes sense to capture a high level description of the connection establishment procedure. Some additional comments:we are agree with Oppo that some aspects of steps 6 and 7 can be merged for configuring the RLC channels at the remote UE and relay UE Similarly, steps 3 and 4 can be merged to some extent – the creation of the SL RLC bearer for carrying SRB1 can be performed by the remote UE at the reception of the Uu RRCSetup message.We are not sure PC5-Connection establishment can be exactly as legacy.The figure should account for the relay UE being in RRC\_IDLE/INACTIVE. Connection establishment at the relay UE can be initiated immediately at step 1 (rather than waiting for step 2) |
| Futurewei | Yes, with comments | We are fine to have the figure and related description in the TR to show the feasibility of connection establishment.As commented by other companies already, the procedure and signaling details can be finalized/optimized in WI phase. For example, certain steps may be skipped or merged. |

**Rapporteur summary-27: According to the replies to Q27, clear majority companies (19/20) replied yes or yes with comments. One company suggests to send LS to SA2 to check whether the legacy PC5-S connection setup procedure can be reused for relay connection setup. However according to the discussion, rapporteur’s understanding is that RAN2 can discuss the procedure from AS perspective for connection establishment. Among the comments received, there is a proposal to merge step 6 and step 7. But rapporteur’s understanding is that step 6 (preparing relaying channel for SRB2 message transmission) should occur ahead of step 7 (SRB2 message). Among the comments received, there is a proposal to remove the RRC states for both Remote UE and Relay UE, this can be reflected by the proposal below. There is also some additional wording comments which can also be reflected by the proposal below. There is suggestion to discuss the Uu transmission for RRCSetupRequest/RRCSetup message, which is discussed by Q28. FFS can be put as an editor note following step 2.**

**Proposal-27: agree the following description for connection establishment procedure of L2 UE-to-NW relay (also reflected by TP)**



Figure 1: Connection Establishment for L2 UE-to-NW relay

Step 1. The Remote and Relay UE perform discovery procedure, and establish PC5-RRC connection using the legacy Rel-16 procedure as a baseline.

Step 2. The Remote UE sends the first RRC message (i.e. RRCSetupRequest) for its connection establishment with gNB via the Relay UE, using a default L2 configuration on PC5. The gNB responds with an RRCSetup message to Remote UE. The RRCSetup delivery to the Remote UE uses the default configuration for L2 on PC5. If the relay UE had not started in RRC\_CONNECTED, it would need to do its own connection establishment as part of this step.

*Editor notes: it is FFS how Relay UE forward the RRCSetupRequest/RRCSetup message for Remote UE at this step.*

Step 3. The gNB and Relay UE perform relaying channel setup procedure over Uu. According to the configuration from gNB, the Relay UE establishes an RLC channel for relaying of SRB1 towards the Remote UE over PC5. This step prepares the relaying channel for SRB1.

Step 4. Remote UE SRB1 message (e.g. an RRCSetupComplete message) is sent to the gNB via the Relay UE using SRB1 relaying channel over PC5. Then the Remote UE is RRC connected over Uu.

Step 5. The Remote UE and gNB establish security following legacy procedure and the security messages are forwarded through the Relay UE.

Step 6. The gNB sets up additional RLC channels between the gNB and Relay UE for traffic relaying. According to the configuration from gNB, the Relay UE sets up additional RLC channels between the Remote UE and Relay UE for traffic relaying. This step prepares the relaying channels for SRB2/DRBs.

Step 7. The gNB sends an RRCReconfiguration to the Remote UE via the Relay UE, to set up the relaying SRB2/DRBs. The Remote UE sends an RRCReconfigurationComplete to the gNB via the Relay UE as a response.

With regard to the transmission of the first RRC message (i.e. RRCSetupRequest) from the Remote UE to the gNB for connection establishment. The transmission of the message can go through Uu adaptation layer from Relay UE to gNB, which assumes Uu adaptation layer is always available and can be even used for the transmission of the first RRC message from Remote UE. Alternatively, the transmission of the message is not carried by Uu adaptation layer, which assumes the Uu adaptation layer is not established yet for the Remote UE at this stage.

### **Question 28**

Do you agree that the Uu adaptation layer is always available and can be used to carry the first RRC message (i.e. RRCSetupRequest) for connection establishment from Remote UE to the gNB when the first RRC message is forwarded by Relay UE?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes | We see that if Uu adaptation layer is always available, this will simplify the signaling transmission for the end-to-end Uu message between Remote UE and gNB.  |
| OPPO | Yes | Since the relaying of remote UE happens after relay UE establishing the Uu connection with network, it is easy that network provides a configuration on the bearer and the related adaption layer configuration to relay UE, before it sending the first SRB0 message of remote UE to network, i.e., there is no need to differentiate the forwarding of SRB0 and other SRB1/2/DRB message on Uu hop. |
| Ericsson (Min) | No | Adaptation layer is not configured yet for the first RRC signaling. in this case, it is enough to transmit the message without adaptation layer header. This will have an impact on Uu operation since it means that the gNB needs to configure the adaptation layer blindly for a relay connection that may never be established. We are totally against on this kind of unnecessary configuration/signaling/impact on Uu operations. |
| Qualcomm |  | We are a little confused by the question (what “always available” means?). In our understanding, it is up to gNB RRC configuration to relay whether to have bearer mapping (and adaptation layer is there if bearer mapping is configured).  |
| Apple | No | This is unreasonable. The gNB has no idea of the remote UE existence until it receivs the first RRC message in step 2, how the Uu adaptation layer is already available prior to that? |
| CATT | Yes | We think Uu adaption layer is always needed to perform the mapping between PC5 RLC channel to Uu BH RLC channel. |
| Huawei | Yes | The adaptation layer can be established and used with default configuration for first RRC message. |
| vivo | No | We think it is network configuration to have adaptation layer configured to relaying any remote UE RRC messages (i.e. RRCSetupRequest). |
| ZTE |  | We are confused about “the Uu adaptation layer is always available”. Does it mean that a default Uu BH RLC bearer is used to forward the Uu SRB0 of remote UE?For the “Alternatively, the transmission of the message is not carried by Uu adaptation layer, which assumes the Uu adaptation layer is not established yet for the Remote UE at this stage.”, in this case, how does the relay UE forwards the RRCSetupRequest for remote UE? |
| Samsung | No | We need more clarity of what ‘always available’ means? |
| Sony | Yes | gNB can configure the relay UE in advance. |
| Xiaomi | No | The adaptation is used to do N:1 mapping. There is no other end to end RBs between remote UE and gNB to be mapped to at this stage. |
| Spreadtrum | With comments | The adaptation layer should be established before the first RRC message for remote UE identification, in accordance with default configuration or using the configuration from the gNB. |
| Intel | Yes with comment | We are also a bit unsure of what ‘always available’ means. In any case, we also agree with Huawei that the first RRC message can use default configuration. We also think it is not unreasonable to have the adaption layer ‘setup’ since if the gNB provides the necessary configuration/authorization to a given UE to act as a relay, it should expect incoming RRCSetupRequest messages from interested remote UEs |
| Convida | Yes |  |
| Philips | No | Same as Samsung, further clarification is needed. The relay UE may not know anything about the remote UE, hence it is not possible to have an adaptation layer available |
| Lenovo&MM | No | The Uu adaptation layer for a certain remote UE should be established after end-to-end RRC connection has been established. |
| InterDigital | Yes | We think it would be simpler to unify transmission of SRB0 and other SRBs and DRBs if the adaptation layer exists prior to the transmission of the first RRC message. |
| Futurewei | No | The signaling and traffic of a remote UE shouldn’t be handled by the adaptation layer at a Relay UE before gNB accepts U2N relay for the remote UE. There is no corresponding demultiplexing function at gNB side’s adaptation layer for this remote UE anyway. |

**Rapporteur summary-28: According to the replies to Q28, there is no majority support on the transmission of the first RRC message (i.e. RRCSetupRequest) via Uu adaptation layer. Among the comments, there is a question on what ‘always available’ means. ‘Always available’ means the first RRC message needs to be packed by Uu adaptation layer with a header. If Uu adaptation layer is not available for the first RRC message transmission, it will skip the Uu adaptation layer. In rapporteur understanding (as also indicted by some of the replies), there is a benefit to unify transmission of SRB0 and other SRBs and DRBs if the adaptation layer exists prior to the transmission of the first RRC message, which also means there should be common RLC channel(s) between Relay UE and gNB used to forward all first RRC message(s) for the Remote UE (s). Those common RLC channels can be default configuration or be configured by gNB in advance.**

**Proposal-28: RAN2 further discuss the approach for the transmission of SRB0 message over Uu between Relay UE and gNB for L2 UE-to-NW Relay.**

## Connection Establishment for L2 UE-to-UE Relay

The connection establishment procedure for L2 UE-to-UE relay was studied by SA2 in solution 8 and solution 9 as captured within SA2 TR23.752. Both solution 8 and solution 9 assumes implicit relay discovery procedure during connection establishment procedure for UE-to-UE Relay, which is based on PC5-S signalling (e.g. Direct Communication Request). However, if the Mode A/Mode B based relay discovery procedure is performed before connection establishment procedure for L2 UE-to-UE Relay, there should be PC5-S signaling exchange for discovery purpose. In any case, the PC5-S signaling (Communication message or Discovery message) happens before PC5-RRC signaling.

The following steps and the diagram in figure 2 is to show a high-level summary of the process that needs to happen for connection establishment from AS perspective for L2 UE-to-UE Relay.



Figure 2: Connection Establishment for L2 UE-to-UE relay

Step 1. The PC5 RRC is established for both first PC5 hop between Remote UE1 and Relay UE and second PC5 hop between Remote UE2 and Relay UE after the PC5-S signalling procedure for PC5 discovery or PC5 communication.

Step 2. Remote UE1 and Remote UE2 establish end-to-end PC5 RRC connection and activate security for the end-to-end PC5 RRC connection.

Step 3. Remote UE1 and Remote UE2 exchange separate PC5-RRC signaling with the Relay UE to set up the PC5 RLC channels for traffic relaying at both hops (i.e. Remote UE1-Relay UE hop, and Relay UE-Remote UE2 hop).

Step 4. Based on the end-to-end PC5 RRC connection, Remote UE1 and Remote UE2 establish end-to-end SLRBs (including the configuration of PDCP/SDAP) which is subject to traffic relaying via Relay UE.

### **Question 29**

**Do you agree to capture Figure 2 and the corresponding step description above into the TR to show the high level procedure for Connection Establishment of L2 UE-to-UE relay?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes |  |

|  |  |  |
| --- | --- | --- |
| OPPO | Comment | We understand the intention of this question is to provides a high-level description of the procedure which is general enough to avoid debate on specific details, which can be left to WI phase, so we agree it would be benefit to capture this in TR.We assume that this procedure is for the steps except/excluding the PC5-S signaling exchange for connection establishment (i.e., step-0), which is left to SA2 decision.Comments for clarification - it is not clear on the difference between step1/2 and step3/4: now step-1/2 is for “establishment”, while step-3/4 is for SLRB “configuration” (including configuration of RLC/MAC/adaptation layer, and configuration of PDCP/SDAP) – but if relying on the R16 framework, there is no such differentiation for PC5-RRC between establishment and configuration, since there are only two PC5-RRC procedures specified, i.e., capability transfer and AS-layer configuration. So to further generalize the description for an agreeable shape to be captured in TR at the current stage, it is suggested to merge step-1/2 and step-3/4, i.e., one step for per-hop signaling, and another step for end-to-end signaling, both include at least the capability transfer and AS-layer configuration, and leave the necessity of additional PC5-RRC procedure to WI phase.Furthermore, for the time order of the steps, e.g., whether to do the per-hop signaling exchange first or the E2E signaling exchange first (for both PC5-S/-RRC), it may also depend on SA2 conclusion on the solution and detailed design in stage-3, which can be left as open and thus to be decided at WI-phase. |

|  |  |  |
| --- | --- | --- |
| Ericsson (Min) | No with comments | Generally we are fine with the intention. The proposed diagram needs to be improved to make it clearer.We agree with OPPO. In addition, we would like to clarify Step 0.In step 0, whether or not discovery protocol will be PC5-S identical or PC5-S like, is not decided yet. Therefore, better to remove PC5-S from step 0. Enough to say discovery message.Further, since this should be a flow diagram, better to change the “squares” with “arrows” and clearly show what is the message flow. |
| Qualcomm  | Yes in principle | We in general have the same understanding on the procedure of L2 U2U relay in Figure 2.Also we agree with Ericsson to just say “discovery message” for step 0. |
| Apple |  | The diagram looks confusiong, as we think the SLRB setup end-to-end is alreasy possible in step 2 because end-to-end security setup is in need of end-to-end Sidelink SRBs. Not sure the diagram is correct.  |
| CATT | See comments | Before we give the L2 U2U connection setup figure, it had better make clear the following questions first:1. How remote UE1 awares the UE identifier of remote UE 2?2. Who determines the mapping the two PC5 RLC channel? |
| Huawei | Yes | We agree to capture some high level and non-SA2-independent procedure. |
| vivo | Yes, with comments | Generally, we are fine to capture a Figure in the TR with the following changes:1. In step 0, to just say “discovery message”.
2. In step 1, PC5 RRC and PC5-S are setup together.
 |
| ZTE | Yes | For step 1/2, it is confused what the “PC5-RRC establishment” mean. As in NR V2X, the PC5-RRC is established when the corresponding PC5-S link is established and the specified SL SRBs are prepared. In addition, the order of step 3 and 4 may be further decided after the discovery procedure is determined. |
| Samsung | See comments | Agree with some of the issues raised by OPPO. In addition – and more generally – unlike in the preceding diagram (Figure 1), in Figure 2 we have no clear upstream/downstream directions and therefore the direction of the message flow is not always clear (actually, this may also be true for Figure 1). |
| Sony | With comments | We are fine to include this high level procedure but think step 2-4 need to be re-structured/explained. |
| Xiaomi | Yes with comments | Need to clarify the definition of PC5 RRC establishment. |
| Spreadtrum | Yes |  |
| Intel | Yes with comment | We agree some of the comments expressed above. It is better to follow RAN2 methodology to show the signaling flow rather than block diagrams (which apparently is SA2 methodology) |
| Nokia | Yes |  |
| Philips | Yes | Agreed with Ericsson and Intel  |
| Lenovo&MM | Yes | We agree with the general procedure. The details can be further discussed in WI. |
| InterDigital | See comments | Steps 1 and 2 seem more related to SA2 signaling, as there is no AS-layer signaling associated with PC5-RRC connection establishment. As for steps 3 and 4, they are related mostly to exchange of SLRB configuration. We are not sure why these need to be done separately and in that order, since the SLRB established at the source UE is anyway related to the RLC channel configurations at each hop.  |
| Futurewei | Yes, with comments | We are fine to have the figure and related description in the TR to show the feasibility of connection establishment.As commented by other companies already, the procedure and signaling details can be finalized/optimized in WI phase. For example, certain steps may be skipped or merged. |

**Rapporteur summary-29: According to the replies to Q29, there is no majority support and there is some confusion on the wording and the steps. One clarification is that step1/2 serves to prepare the signaling connection over PC5 but the configuration of SLRB serves to configure the relaying channel for SL DRBs. One thing to note is that these steps are revised based on the steps described within solution 8 and solution 9 as captured within SA2 TR23.752. Rapporteur acknowledges that step 0/1/2 does not have explicit AS layer impact and then there is quite some room to improve the wording. Given the comments received, rapporteur suggests to further discuss the connection establishment procedure for L2 UE-to-UE Relay.**

**Proposal-29: RAN2 further discuss the connection establishment procedure for L2 UE-to-UE Relay.**

## System information delivery for Remote UE (UE-to-NW relay)

As discussed within R2-2008266[43], the system information can be forwarded to Remote UE by Relay UE for L2 UE-to-NW relay.

The in-coverage Remote UE(s) can receive system information directly (via Uu link) or indirectly (via relay UE). However, if the Remote UE is out of coverage, it relies on the Relay UE to forward the system information. It assumes that the Relay UE doesn’t need to know whether the Remote UE is in coverage or out of coverage. The Relay UE can always forward the system information to the Remote UE without considering the remote UE is in coverage or out of coverage.

In any case, the Relay UE can support the relaying of the essential system information as required by the Remote UEs. Which system information is considered as essential for Remote UEs can be discussed at normative phase.

Relay UE can forward the received system information to Remote UE(s) via broadcast or groupcast. Relay UE can also forward the system information to Remote UE via dedicated PC5-RRC signaling. The detailed mechanisms of PC5-RRC signaling design can be discussed in WI stage.

### **Question 30**

**Do you agree that Relay UE can support the relaying of the essential system information as required to the Remote UE(s) and which system information is considered as essential for Remote UEs can be discussed at normative phase?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No  | Comments |
| MediaTek | Yes |  |
| OPPO | Yes with comment | “as required” may lead to further discussion on whether the forwarding is on-demand from remote UE, it is suggested to remove “as required” to avoid further debate at the current stage. |
| Ericsson (Min) | Yes with comment | Perhaps we can remove “essential”, “as required”, and also Reformulate “which system information is considered as essential for Remote UEs can be discussed at normative phase” to “what system information can be relayed to Remote UEs can be discussed at normative phase”. |
| Qualcomm  | Yes with comments | Agree with OPPO and Ericsson to remove “essential” and “as required”. |
| Apple | Yes |  |
| CATT | Yes |  |
| Huawei | Yes |  |
| vivo | Yes, with comments | In Uu, there is already definition of essential system information. At least it should be clarified whether Uu definition is the baseline or not. |
| ZTE | Yes | Agree with above comments to remove “essential” and “as required”. |
| Samsung | See comments | Agree that clarification is needed. Also, before making the agreement “that Relay UE can support the relaying of the essential system information as required to the Remote UE(s)”, we’d better study and clarify the need of SI relaying including on-demand SI. |
| Sony | Yes  |  Agree with OPPO. |
| Xiaomi | Yes | We understand this doesn’t include om-demand SI request procedure, which should be discussed separately. |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Nokia | Yes |  |
| Convida | Yes | Agree with above comments to remove “essential” and “as required”. |
| Philips | Yes |  |
| Lenovo&MM | Yes |  |
| InterDigital | Yes, with comments | We tend to agree with OPPO and Ericsson for removing “essential” and “as required”  |
| Futurewei | Yes |  |

**Rapporteur summary-30: According to the replies to Q30, clear majority companies (19/20) replied yes or yes with comments. There is clear support to reword the sentence in the question with removal of both “essential” and “as required”. Then the wording “Relay UE can support the relaying of the system information to the Remote UE(s) and what system information can be relayed to Remote UEs can be discussed at normative phase” can be put into a proposal as below.**

**Proposal-30: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

* **Relay UE can support the relaying of the system information to the Remote UE(s) and what system information can be relayed to Remote UEs can be discussed at normative phase.**

### **Question 31**

**Do you agree that Relay UE can forward the received system information to Remote UEs via broadcast or groupcast?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No  | Comments |
| MediaTek | Yes |  |
| OPPO | Yes | It is needed since the SI forwarding is needed before remote UE establish PC5 connection with relay UE, i.e., one cannot always rely on unicast for it.Between broadcast and groupcast, we believe only broadcast is feasible. But also fine to keep the wording as it is and leave the decision to WI phase. |
| Ericsson (Min) | Yes | this is only valid if the remote UEs are out of coverage. |
| Qualcomm | Yes with comments | We are wondering whether these system information is sent via discovery procedure or other messages ? |
| Apple | Yes | We can further discuss whether this is part of SL discvovery message or seprate SL broadcast/groupcast mechamism |
| CATT | Yes |  |
| Huawei | Yes, with comment | Agree with Apple and OPPO. |
| vivo | Yes, with comments | It makes sense to relay cell specific system information by broadcast or groupcast. But we think unicast is also possible if the remote UE and relay UE already have a PC5 RRC connection. |
| ZTE | Yes |  |
| Samsung | Not sure | In our understanding, the SI is needed when remote UE performs cell selection/reselection from RRC\_IDLE/INACTIVE. In this scenario, SI may also be transmitted via unicast between remote UE and relay UE. |
| Sony | Yes |  |
| Xiaomi | No | We think it’s possible to use unicast in case relay UE can identify which remote UE is interested in certain SIBs. |
| Spreadtrum | Yes |  |
| Intel | No | We think PC5-RRC connection should be established before relaying can occur, in which case unicast can be used |
| Nokia | Not sure |  |
| Convida | Yes, with comment | Agree with Apple and OPPO. |
| Philips | Yes | Agree with Apple |
| Lenovo&MM | Yes |  |
| InterDigital | Yes | Broadcast/groupcast of system information is required before the remote UE connects to the relay (in case the cell is not suitable). Once the remote UE is connected, the relay can use either unicast or groupcast (to each of the connected remote UEs). |
| Futurewei | Yes | System information update can also be delivered through unicast if there is already PC5 connection between remote UE and relay UE. |

**Rapporteur summary-31: According to the replies to Q30, majority companies (16/20) replied yes or yes with comments. About the exact signaling used by Relay UE to forward the received system information to Remote UEs via broadcast or groupcast, it can be is part of SL discovery message or separate SL broadcast/groupcast message, which can be further discussed later on.**

**Proposal-31: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

* **Relay UE can forward the received system information to Remote UEs via broadcast or groupcast.**

### **Question 32**

**Do you agree that Relay UE can forward the system information to Remote UE via dedicated PC5-RRC signaling and the detailed mechanisms of PC5-RRC signaling design can be discussed in WI stage?**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No  | Comments |
| MediaTek | Yes |  |
| OPPO | Yes | Since the current spec allows SI delivery via dedicated RRC, the forwarding of such dedicated RRC carrying SI to remote UE via relay UE has not difference compared to the normal DL RRC forwarding. |
| Ericsson (Min) | Yes  |  Agree with OPPO |
| Qualcomm | Yes | Agree with OPPO |
| Apple | Yes | Regarding OPPO comment, I think the question covers the case where SI forwarding happen befor end-to-end Uu connection is established. In this case, the relay UE can forward its (stored) SI information to remote UE via dedicated PC5-RRC signaling  |
| CATT | Yes |  |
| Huawei | Yes | For remote UE in connected state, agree with the understanding from OPPO. But, if we agree the need of SI delivery for remote UE in IDLE (other than the SI related delivery in discovery message), PC5-RRC is needed. |
| vivo | Yes | See comments in Q31. |
| ZTE | Yes | Agree with Apple. And in this case, the relay UE is aware of the forwarded SI information, which is different from the normal DL RRC forwarding that the relay UE is transparent of the RRC messages. |
| Samsung | Yes |  |
| Sony | Yes |  |
| Xiaomi | Yes | Regarding OPPO’s comment, we think this is not the same with existing SI delivery via dedicated signaling, which is controlled by gNB to include SI in RRC reconfiguration message. Here, relay UE may decide to transmit SI via PC5 RRC without gNB involvement. |
| Spreadtrum | Yes |  |
| Intel | Yes |  |
| Nokia | Yes |  |
| Convida | Yes | Agree with Apple |
| Philips | Yes | Agree with Apple |
| Lenovo&MM | Yes |  |
| InterDigital | Yes | Similar view as Apple. But also, a remote UE that is PC5-RRC connected to a relay while in IDLE with the network would need to receive SI by some forwarding by the relay. |
| Futurewei | Yes |  |

**Rapporteur summary-32: According to the replies to Q32, All companies agree that Relay UE can forward the system information to Remote UE via dedicated PC5-RRC signaling and the detailed mechanisms of PC5-RRC signaling design can be discussed in WI stage. With regard to the comments saying that Relay UE may decide to transmit SI via PC5 RRC without gNB involvement or Relay UE just perform transparent DL RRC message forwarding, which can be further discussed later on. Based on the comments received, rapporteur suggests the following easy proposal:**

**Proposal-32 [Easy]: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

* **Relay UE can forward the system information to Remote UE via dedicated PC5-RRC signaling and the detailed mechanisms of PC5-RRC signaling design can be discussed in WI stage.**

The support of on-demand SI delivery is proposed in some of the papers [7] [14] [29] [42]. Note that for Relay UE (in RRC Idle/Inactive/Connected state), which is in coverage, the legacy on-demand SI delivery mechanism is used.

From Remote UE perspective, for idle/Inactive Remote UE, Msg1-based on-demand SI request should not be used as Relay UE cannot simply forward this type of request. For idle/Inactive Remote UE, the Msg3-based on-demand SI request (i.e. RRCSystemInfoRequest) can be sent as normal Uu SRB0 message from Remote UE to gNB via Relay UE. For connected Remote UE, the on-demand SIB request (i.e. dedicatedSIBRequest) can be sent as normal Uu SRB1 message from Remote UE to gNB via Relay UE.

In summary, on-demand SI request is supported for Remote UE for all RRC states (Idle/Inactive/Connected state). only Msg3 based on-demand SI request is supported for Remote UE, and the legacy Uu RRC procedure is reused to support the Remote UE’s on-demand SI request, when the Remote UE is in RRC Idle/Inactive/Connected state. On-demand SI delivery is needed for the Remote UE regardless of out-of-coverage or in-coverage Remote UE(s).

### **Question 33**

**Do you agree the following on-demand SI delivery principles for Remote UE:**

**(a)** **on-demand SI request is supported for Remote UE for all RRC states (Idle/Inactive/Connected state).**

**(b)Only Msg3 based on-demand SI request is supported for Remote UE**

**(c) The legacy Uu RRC procedure is reused to support the Remote UE’s on-demand SI request.**

**(d) On-demand SI delivery is supported for the Remote UE(s) regardless of out-of-coverage or in-coverage,** **when connected with Relay UE.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No (with bullets) | Comments |
| MediaTek | Yes with a/b/c/d |  |
| OPPO | Yes with a-d |  |
| Ericsson (Min) | Yes with a, b, c and d but with comment | Regarding b), should be clarified that Msg3-based framework is only supported if the remote UE is in IDLE/INACTIVE but NOT in CONNECTED. If the remote UE is in CONNECTED the procedure is different (same principle for the relay UE). Better to clarify this aspect and align to what has been specified in Rel-15 and Rel-16. |
| Qualcomm | Yes with a-d with comments | Same comments as Ericsson. |
| Apple | a)b)c)d) |  |
| CATT | Yes with a/d | In our understanding, on-demand SI for remote UE should be supported. But how to implement the on-demand SI, we think there are two options:* Option 1: Remote UE requests the on-demand SI directly from gNB via relay.
* Option 2: Remote UE requests the on-demand SI or SIB from relay. If relay has this SI or SIB, it can directly forward it to the remote UE; otherwise, relay can request the SI from the gNB as legacy Uu procedure.

Option 2 is more attractive compared with option 1 from the following perspectives:* Option 2 has less specification efforts, since option 1 impacts both the SL and Uu, while option 2 only impacts the SL.
* Option 2 is more efficiency, because relay UE serves many remote UE, it may have stored the SI/SIB requested by remote UE. It can directly forward the SIB to the remote UE.

But considering this is SI, only a/d needs to be confirmed, the on-demand SI details can be left to WI. |
| Huawei | Yes with a/b/c/d | For b), R16 connected state on-demand SI is also supported. Maybe we can say “Msg1 based is not supported”, if that can address the concern from Ericsson. Since we do not call it Msg3 if UE is in connected. |
| vivo | Yes with a/b/c/d |  |
| ZTE | Yes with a) b) c) for RRC connectedremote UE | In legacy Uu, gNB broadcasts the requested SI after receiving the msg 3 based on-demand SI request from UE. However, for the msg 3 based on-demand SI request for RRC idle/inactive remote UEs, it is not clear how gNB/relay UE sends the requested SI to remote UE. |
| Samsung | Yes with a/b/c | For OOC UE, (d) is not needed. And generally (as mentioned before), we need to first study the need of delivery of on-demand SI. |
| Sony | Yes with a/c/d | For b), agree with Huawei’s proposal to exclude Msg1. |
| Xiaomi | No | The necessity of on demand SI is not clear to us. If remote UE is in coverage, it could acquire the SI directly from gNB. If remote UE is out of coverage, it’s not clear whether any other SI is needed for remote UE. For the SIBs which carries sidelink configuration, we think relay UE should always broadcast those SIBs. |
| Spreadtrum | Yes with a/b/c/d |  |
| Intel | Yes with a-d | Agree with Huawei |
| Convida | Yes with a/b/c/d |  |
| Philips | Yes with a/b/c/d | Agree with Ericsson |
| Lenovo&MM | Yes with a,b,c,d |  |
| InterDigital | Yes with a/b/c/d |  |
| Futurewei | Yes with a/b/c/d |  |

**Rapporteur summary-33: According to the replies to Q33, majority companies (14/20) agree a/b/c/d on the principle of on-demand SI delivery for Remote UE. And there are clear majority companies (16/20) that agree a/b/c on the principle of on-demand SI delivery for Remote UE. There is also clear support to reword b) to decouple** **IDLE/INACTIVE and CONNECTED state. A likely rewording for b) can be: “Only Msg3 based on-demand SI request is supported for Remote UE during Idle or Inactive mode; For connected Remote UE, only on-demand SIB request (i.e. dedicatedSIBRequest) is supported as Rel-16”.**

**Proposal-33: agree the following on-demand SI delivery principles for Remote UE for L2 UE-to-NW relay (also reflected by TP)**

* **On-demand SI request is supported for Remote UE for all RRC states (Idle/Inactive/Connected state).**
* **Only Msg3 based on-demand SI request is supported for Remote UE during Idle or Inactive mode; For connected Remote UE, only on-demand SIB request (i.e. dedicatedSIBRequest) is supported as Rel-16.**
* **The legacy Uu RRC procedure is reused to support the Remote UE’s on-demand SI request.**
* **On-demand SI delivery is supported for the Remote UE(s) regardless of out-of-coverage or in-coverage,** **when connected with Relay UE.**

After the Remote UE sends the on-demand SI request message to the gNB, the Relay UE doesn’t know that the SI request was made, since it just saw that an encrypted message went through on an SRB. If the network responds by unicast, there is no problem since the response will also go transparently through the Relay UE to the Remote UE. However, if the network responds by broadcasting the concerned SI, the Relay UE can see the new SI being transmitted but has no way to know that it should be delivered to the Remote UE. In this case, Remote UE may need to notify its requested SIB to the Relay UE via PC5-RRC message, in order to trigger the Relay UE to perform SIB forwarding.

### **Question 34**

**Do you agree that Remote UE needs to notify its requested SIB to the Relay UE via PC5-RRC message, in order to trigger the Relay UE to perform SIB forwarding.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| MediaTek | Yes  | We think this mechanism is needed in case the gNB can take broadcast manner as the response to the on-demand SI request from Remote UE |
| OPPO | No | This is more like an optimization, if considering the baseline scheme is relay UE forwarding all necessary broadcasted SIB by default, i.e., RAN2 define a set of SIBs that needs to be forwarded by relay UE, and relay UE would simply forward it to PC5 hop as long as it is broadcasted by network, regardless whether it is triggered by a specific remote UE or not. |
| Ericsson (Min) | No | Agree with OPPO. |
| Qualcomm | No | Agree with OPPO |
| Apple | No | I think this can be solved by NW implementation. L2 remote UE is visible to gNB and gNB knows that this is a remote UE. Then NW can always deliver the Layer 2 remote UE’s request for SI with “unicast” response. Hence, the whole on-demand SI procedure can be transparent to relay UE. |
| CATT | Yes | The remote UE requests SIB to the Relay UE via PC5-RRC message, how to acquire the SIB is relay UE behavior. |
| Huawei | Postpone to WI phase |  |
| vivo | Yes, with comments | The Relay UE to perform SIB forwarding triggered by remote UE requested SIB can save some signaling overhead and radio resource over PC5, compared to always doing SIB forwarding. |
| ZTE | Yes | For RRC connected remote UE with dedicated SIB request, network will response by sending dedicated RRC message for concerned SIBs. For RRC idle/inactive remote UE with msg 3 based on-demand SI request, network cannot respond the remote UE with a “dedicated/unicast” response. |
| Samsung | No | Same view as OPPO. |
| Sony | Yes | We think such information would be beneficial to improve the SI delivery performance and help relay UE to monitor the SI update on behalf of remote UE. |
| Xiaomi | No | We should first clarify the necessity of on-demand SI. |
| Spreadtrum | No | Agree with OPPO. |
| Intel | No | Agree with Apple |
| Nokia | No | Agree with the others |
| Convida | Postpone to WI Phase |  |
| Philips | Postpone to WI phase |  |
| Lenovo&MM | Yes | Remote UE needs to notify its requested SIB to the Relay UE via PC5-RRC message, otherwise it may need to blindly keep forwarding SIBs which may not be required by any remote (anymore). |
| InterDigital | Yes, with comments |  Since SI may need to be transmitted by multiple relays on sidelink, possibly in unicast to each remote UE, how to avoid overhead for SI forwarding should be further studied. This can also be done in the WI stage. |
| Futurewei | No for SI phase | Can be considered as signaling optimization in WI if benefit becomes more clear after more details emerge during normative works. |

**Rapporteur summary-34: According to the replies to Q34, there is no majority support for the PC5-RRC message based SIB notification from Remote UE to the Relay UE. The supporting companies see the benefit to improve the SI delivery performance. There is a proposal to require Relay UE to forward all necessary broadcasted SIB by default, (i.e., RAN2 define a set of SIBs that needs to be forwarded by relay UE), which needs standard support. Based on the comments received, there are many supports to postpone the related discussion to WI phase.**

**Proposal-34: RAN2 further discuss PC5-RRC message based SIB notification from Remote UE to the Relay UE for L2 UE-to-UE Relay at WI phase.**

## Access Control for L2 UE-to-Network Relay

Remote UE may perform access control. The Relay UE may provide UAC parameters to Remote UE during or after SL unicast connection is established. For example, it can be transmitted via the SL RRC message as dedicated parameters or included in forwarded SIB1 [7].

As studied by feD2D, upon reception of the UAC parameters, the access control check is performed at Remote UE using the parameters of the cell it intends to access. The UE-to-Network Relay UE does not perform access control check for the Remote UE's data. If the access is allowed, the Remote UE can trigger RRC Setup procedure towards the gNB via Relay UE.

### **Question 35**

**Do you agree the following access control check principles for L2 UE-to-Network Relay operation?**

**(a)The Relay UE may provide UAC parameters to Remote UE**

**(b)The access control check is performed at Remote UE using the parameters of the cell it intends to access.**

**(c)The UE-to-Network Relay UE does not perform access control check for the Remote UE's data.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No (with bullets) | Comments |
| MediaTek | Yes with a/b/c |  |
| OPPO | Yes with a-c |  |
| Ericsson (Min) | Yes with a, b, and c with comments | We are wondering whether different UAC parameters may be applied to the relay UE and remote UE. This could be particularly useful in certain use case. We propose to have an FFS on this and further study this. |
| Qualcomm | Yes with a-c |  |
| Apple  | a)b)c) |  |
| CATT | a)b)c) |  |
| Huawei | Yes with a/b/c | The different UAC parameters are optimization, which can be discussed in WI phase. No need of FFS on this, since everything else is for sure open. |
| vivo  | Yes with a/b/c |  |
| ZTE | Yes with a, b, c |  |
| Samsung | Yes with a/b/c |  |
| Sony | Yes with a/b/c |  |
| Xiaomi | Yes with a/b/c |  |
| Spreadtrum | Yes with a/b/c |  |
| Intel | Yes with a,b,c |  |
| Nokia | Yes a)b)c) |  |
| Convida | a/b/c |  |
| Philips | Yes with a/b/c with comments | Agree with Ericsson |
| Lenovo&MM | Yes with a,b,c |  |
| InterDigital | Yes with a/b/c, with comments | We agree with Ericsson. We also wonder whether access control should also depend on the sidelink characteristics, given that the network is also controlling the sidelink resources for the connected remote UE. We think this can be further studied. |
| Futurewei | Yes with a/b/c |  |

**Rapporteur summary-35: According to the replies to Q35, all companies replied yes or yes with comments. Among the comments, there is a proposal during the reply to study different UAC parameters to the relay UE and remote UE and to leave it as FFS. Rapporteur understanding is that this can be discussed later on or at WI phase.**

**Proposal-35 [Easy]: agree the following access control check principles for L2 UE-to-NW relay (also reflected by TP)**

* **The Relay UE may provide UAC parameters to Remote UE**
* **The access control check is performed at Remote UE using the parameters of the cell it intends to access.**
* **The UE-to-Network Relay UE does not perform access control check for the Remote UE's data.**

## Other issues

There may be additional issues that need to be discussed to describe the L2 relaying.

### **Question 36**

**Please give the explanation of any additional issues to describe the L2 relaying, which needs to be studied in SI phase.**

|  |  |
| --- | --- |
| Company | Comments |
| Ericsson (Min) | 1. **Exchanging of capability** In situations when the remote UE is out-of-coverage, the remote UE may not be able to exchange its capability with the gNB/UE.

In this case, the relay UE should do it.1. **RRC states of the relay UE and remote UE**

Our assumption is that the relay UE and remote UE may have different RRC states, but we should limit the combination of those because some of them may not be practical. In the following table to explain what our idea of the supported RRC state combinations is:

|  |  |  |
| --- | --- | --- |
| **RL UE state** | **RM UE state** | **Validity** |
| CONNECTED | CONNECTED | Valid |
| CONNECTED | INACTIVE | Valid |
| CONNECTED | IDLE | Valid |
| INACTIVE | CONNECTED | Invalid |
| INACTIVE | INACTIVE | Valid |
| INACTIVE | IDLE | Valid |
| IDLE | CONNECTED | Invalid |
| IDLE | INACTIVE | Valid |
| IDLE | IDLE | Valid  |

 |
| Lenovo&MM | The idle/inactive UE is expected to perform registration update and RAN based notification area update. For example, each of inactive remote UE needs to perform RNAU based on timer. It could be beneficial that relay UE periodically indicate to gNB for a group of the served inactive remote UEs. |

**Rapporteur summary-36: According to the replies to Q36, there are not so many input. One reply suggests to discuss capability exchange and RRC state combination between Relay UE and Remote UE. One reply suggests to discuss registration update and RAN based notification area update. All these aspects can be potentially discussed at WI phase. As such, no proposal needs to be made.**

# Rapporteur’s summary and Proposal

**Rapporteur summary-1: All companies joining the email discussion agree that the Uu adaptation layer at Relay UE supports UL bearer mapping between ingress PC5 RLC channels for relaying and egress Uu RLC channels over the Relay UE Uu path. Then this description can be put into an easy proposal and a TP describing L2 UE-to-NW relay.**

**Proposal-1: [Easy] agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**For L2 UE-to-NW relay, the Uu adaptation layer at Relay UE supports UL bearer mapping between ingress PC5 RLC channels for relaying and egress Uu RLC channels over the Relay UE Uu path.**

**Rapporteur summary-2: All companies joining the email discussion agree that the different traffics of the same Remote UE and/or different Remote UEs can be subject to N:1 mapping and data multiplexing over Uu RLC channel. Then this description can be put into an easy proposal and a TP describing L2 UE-to-NW relay. Some companies further indicated that the exact mapping is up to network configuration, which can be considered during normative phase.**

**Proposal-2: [Easy] agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**The different traffics of the same Remote UE and/or different Remote UEs can be subject to N:1 mapping and data multiplexing over Uu RLC channel**

**Rapporteur summary-3: All companies joining the email discussion agree that Uu adaptation layer is used to support Remote UE identification for the UL traffic (multiplexing the data coming from multiple Remote UE). Then this description can be put into an easy proposal and a TP describing L2 UE-to-NW relay.**

**Proposal-3: [Easy] agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**For L2 UE-to-NW relay, Uu adaptation layer is used to support Remote UE identification for the UL traffic (multiplexing the data coming from multiple Remote UE).**

**Rapporteur summary-4: Clear majority companies (19/20) joining the email discussion agree that the identity information of Remote UE Uu Radio Bearer needs be put into the Uu adaptation layer by Relay UE at UL in order for the gNB to correlate the received data packets with the specific PDCP entity associated with the right Remote UE Uu Radio Bearer. However, there is a little bit confusion for some companies to read the wording “by Relay UE”. Then the description with removal of “by Relay UE” can be put into a proposal and a TP describing L2 UE-to-NW relay.**

**Proposal-4: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**The identity information of Remote UE Uu Radio Bearer needs be put into the Uu adaptation layer by Relay UE at UL in order for the gNB to correlate the received data packets with the specific PDCP entity associated with the right Remote UE Uu Radio Bearer.**

**Rapporteur summary-5: Clear majority companies (19/20) joining the email discussion agree that the identity information of Remote UE Uu Radio Bearer and the identity information of Remote UE needs be put into the Uu adaptation layer by Relay UE at UL in order for gNB to correlate the received data packets for the specific PDCP entity associated with the right Remote UE Uu Radio Bearer of a particular Remote UE in case of multiple Remote UEs based relaying. However, there is a little bit confusion for some companies to read the wording “by Relay UE”. Meanwhile the rapporteur acknowledged that the answer of Q5 may be derived by the answer of Q3 and Q4. One thing to clarify is that Q3 talks about the principle of Uu adaptation layer but Q5 talks about the header design of Uu adaptation layer. Then the description with removal of “by Relay UE” can be put into a proposal and a TP describing L2 UE-to-NW relay.**

**Proposal-5: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**The identity information of Remote UE Uu Radio Bearer and the identity information of Remote UE needs be put into the Uu adaptation layer at UL in order for gNB to correlate the received data packets for the specific PDCP entity associated with the right Remote UE Uu Radio Bearer of a particular Remote UE in case of multiple Remote UEs based relaying.**

**Rapporteur summary-6: All companies joining the email discussion agree that the Uu adaptation layer can be used to support DL bearer mapping at gNB to map end-to-end Radio Bearer (SRB, DRB) of Remote UE into Uu RLC channel over Relay UE Uu path. Then this description can be put into an easy proposal and a TP describing L2 UE-to-NW relay. Some companies further discussed the need to support reflective RB mapping between DL and UL, which may be visited during normative phase.**

**Proposal-6: [Easy] agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**The Uu adaptation layer can be used to support DL bearer mapping at gNB to map end-to-end Radio Bearer (SRB, DRB) of Remote UE into Uu RLC channel over Relay UE Uu path**

**Rapporteur summary-7: Clear majority companies (19/20) joining the email discussion agree that the Uu adaptation layer can be used to support DL N:1 bearer mapping and data multiplexing between multiple end-to-end Radio Bearers (SRBs, DRBs) of a particular Remote UE and/or different UEs and one Uu RLC channel over the Relay UE Uu path. Then this description can be put into a proposal and a TP describing L2 UE-to-NW relay.**

**Proposal-7: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**The Uu adaptation layer can be used to support DL N:1 bearer mapping and data multiplexing between multiple end-to-end Radio Bearers (SRBs, DRBs) of a particular Remote UE and/or different UEs and one Uu RLC channel over the Relay UE Uu path**

**Rapporteur summary-8: Clear majority companies (19/20) joining the email discussion agree that the Uu adaptation layer needs to support Remote UE identification for Downlink traffic which can be done as part of bearer mapping function or as a separate packet routing function. However, as there is a reply on the definition of packet routing function, in order to simplify the discussion, Rapporteur suggests to remove the terminology to host the function. Then the revised description can be put into a proposal and a TP describing L2 UE-to-NW relay.**

**Proposal-8: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**The Uu adaptation layer needs to support Remote UE identification for Downlink traffic**

**Rapporteur summary-9: Clear majority companies (19/20) joining the email discussion agree that the identity information of Remote UE Uu Radio Bearer needs be put into the Uu adaptation layer by gNB at DL in order for Relay UE to correlate the received data packets with the specific PC5 RLC channel associated with the right Remote UE Uu Radio Bearer. However, as there is a confusion during the reply on the needed Remote UE identity and the optionality of it. It should be noted that** **Q9 discusses the identity information of Remote UE Uu Radio Bearer and it does not necessarily mean Remote UE identity.** **Meanwhile, the optional presence of a particular IE can be discussed at normative phase. Then the following proposal is made:**

**Proposal-9: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**the identity information of Remote UE Uu Radio Bearer needs be put into the Uu adaptation layer by gNB at DL in order for Relay UE to correlate the received data packets with the specific PC5 RLC channel associated with the right Remote UE Uu Radio Bearer**

**Rapporteur summary-10: Clear majority companies (19/20) joining the email discussion agree that the identity information of Remote UE Uu Radio Bearer and the identity information of Remote UE needs be put into the Uu adaptation layer by gNB UE at DL in order for Relay UE to correlate the received data packets with the specific PC5 RLC channel associated with the right Remote UE Uu Radio Bearer for the particular Remote UE in case of multiple Remote UEs based relaying. Meanwhile the rapporteur acknowledged that the answer of Q10 may be derived by the answer of Q8 and Q9. One thing to clarify is that Q8 talks about the principle of Uu adaptation layer but Q10 talks about the header design of Uu adaptation layer. Then the description with some rewording as suggested by the reply can be put into a proposal and a TP describing L2 UE-to-NW relay.**

**Proposal-10: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**The identity information of Remote UE Uu Radio Bearer and the identity information of Remote UE needs be put into the Uu adaptation layer by gNB UE at DL in order for Relay UE to correlate the received data packets with the specific PC5 RLC channel associated with the right Remote UE Uu Radio Bearer for the particular Remote UE in case of multiplexing data coming from multiple Remote UEs.**

**Rapporteur summary-11: There is no majority view based on the answers to Q11. Some companies see the need to discuss RLF handling, flow control, etc. at Uu adaptation layer for L2 Relaying as supported by IAB during SI phase. Many companies suggest to discuss such details at WI stage but many other companies suggest to discuss the issues if needed at SI stage before WI stage. Some companies did not see the need to discuss additional functions at Rel-17 other than bearer mapping and Remote UE identification (i.e. one-hop routing). Then the following proposal is made:**

**Proposal-11: Any additional functions other than bearer mapping and Remote UE identification for L2 UE-to-NW Relay can be discussed at WI stage.**

**Rapporteur summary-12: Based on the answers to Q12, there are many companies (10/20) that support the N:1 mapping by PC5 adaptation layer between Remote UE Uu Radio Bearer and PC5 RLC channel for relaying. Some companies (8/20) did not see the need. Two companies have no strong view. The key discussion is whether there is a LCID space bottleneck for RLC channel between Remote UE and Relay UE if always assuming 1:1 mapping between Remote UE Uu Radio Bearer and PC5 RLC channel. Rapporteur suggests to do online discussion for the issue:**

**Proposal-12: RAN2 discuss the support of N:1 mapping by PC5 adaptation layer between Remote UE Uu Radio Bearer and PC5 RLC channel for relaying.**

**Rapporteur summary-13: Based on the answers to Q13, there is no clear majority (8 supports among 20 replies) on the support of traffic differentiation via PC5 adaptation layer between the non-relaying traffic and the relaying traffic for L2 UE-to-NW relay operation. Some companies (9/20) did not see the need. One company has no strong view. One company prefers to discuss PC5 adaptation layer first. One company suggests to send LS to SA2 to clarify whether relaying PC5-S connection is separate from normal PC5-S connection. Rapporteur suggests to do online discussion for the issue:**

**Proposal-13: RAN2 discuss the support of traffic differentiation via PC5 adaptation layer between the non-relaying traffic and the relaying traffic for L2 UE-to-NW relay operation.**

**Proposal-13a: RAN2 discuss the need to send LS to SA2 to clarify whether relaying PC5-S connection is separate from normal PC5-S connection.**

**Rapporteur summary-14: Based on the answers to Q14, The majority (13/19) did not see the need to discuss additional functions for PC5 Adaptation layer if supported other than bearer mapping, identification of remote UE, and traffic differentiation between the non-relaying traffic and the relaying traffic if supported. Meanwhile, 5 companies see the need. Rapporteur suggests to do online discussion for the issue:**

**Proposal-14: No additional functions is supported at PC5 Adaptation layer (if supported) other than bearer mapping, identification of remote UE, and traffic differentiation between the non-relaying traffic and the relaying traffic (if supported) for L2 UE-to-NW relay operation.**

**Rapporteur summary-15: All companies joining the email discussion agree that the second hop PC5 adaptation layer can be used to support bearer mapping between the ingress RLC channels over first PC5 hop and egress RLC channels over second PC5 hop at Relay UE. Then this description can be put into an easy proposal and a TP describing L2 UE-to-UE relay.**

**Proposal-15: [Easy] agree the following description for L2 UE-to-UE relay (also reflected by TP)**

**For L2 UE-to-UE relay, the second hop PC5 adaptation layer can be used to support bearer mapping between the ingress RLC channels over first PC5 hop and egress RLC channels over second PC5 hop at Relay UE.**

**Rapporteur summary-16: Clear majority (18/20) companies joining the email discussion agree that the adaptation layer over second PC5 hop can be used to support N:1 bearer mapping and data multiplexing between multiple ingress PC5 RLC channels over first PC5 hop and one egress PC5 RLC channel over second PC5 hop. However, two companies raised the issue on the multiple transmitting Remote UEs scenario and suggests to liaison SA2. The issue was raised at last meeting but in Rapporteur understanding this is a RAN2 issue and the details should be resolved at WI stage. It is suggested to agree the following proposal:**

**Proposal-16: agree the following description for L2 UE-to-UE relay (also reflected by TP)**

**For L2 UE-to-UE relay, the adaptation layer over second PC5 hop can be used to support N:1 bearer mapping and data multiplexing between multiple ingress PC5 RLC channels over first PC5 hop and one egress PC5 RLC channel over second PC5 hop.**

**Rapporteur summary-17: Clear majority (18/20) companies joining the email discussion agree that the second hop PC5 adaptation layer needs to support Remote UE identification for relaying traffic, which can be done as part of bearer mapping function or a separate packet routing function. Meanwhile some companies suggests to remove the wording “which can be done as part of bearer mapping function or a separate packet routing function”. Two companies raised the issue on the multiple transmitting Remote UEs scenario and suggested to contact SA2, but in Rapporteur understanding this is a RAN2 issue and the details should be resolved at WI stage. It is suggested to agree the following proposal:**

**Proposal-17: agree the following description for L2 UE-to-UE relay (also reflected by TP)**

**For L2 UE-to-UE relay, the second hop PC5 adaptation layer needs to support Remote UE identification for relaying traffic.**

**Rapporteur summary-18: Clear majority (15/20) companies joining the email discussion agree that the identity information of Source Remote UE SL Radio Bearer needs be put into the second PC5 hop adaptation layer by Relay UE in order for Destination Remote UE to correlate the received data packets for the specific PDCP entity associated with the right end-to-end SL Radio Bearer. Among the comments within the reply, some companies suggest to remove “by Relay UE”, which did not change the mean of the sentence. Two companies did not see the need to discuss this details at SI. Two companies raised the issue on the multiple transmitting Remote UEs scenario and suggested to contact SA2. It is suggested to agree the following proposal:**

**Proposal-18: agree the following description for L2 UE-to-UE relay (also reflected by TP)**

**The identity information of Source Remote UE SL Radio Bearer needs be put into the second PC5 hop adaptation layer in order for Destination Remote UE to correlate the received data packets for the specific PDCP entity associated with the right end-to-end SL Radio Bearer**

**Rapporteur summary-19: Majority (15/20) companies joining the email discussion agree that the identity information of Source Remote UE SL Radio Bearer and the identity information of Source Remote UE needs be put into the second PC5 hop adaptation layer by Relay UE in order for Destination Remote UE to correlate the received data packets for the specific PDCP entity associated with the right end-to-end SL Radio Bearer in case of multiple Source Remote UEs based relaying.**

**Meanwhile the rapporteur acknowledged that the answer of Q19 may be derived by the answer of Q17 and Q18. One thing to clarify is that Q17 talks about the principle of PC5 adaptation layer but Q19 talks about the header design of PC5 adaptation layer.**

**Among the comments within the reply, two companies did not see the need to discuss this details at SI. Two companies raised the issue on the multiple transmitting Remote UEs scenario and suggested to contact SA2. It is suggested to agree the following proposal:**

**Proposal-19: agree the following description for L2 UE-to-UE relay (also reflected by TP)**

**The identity information of Source Remote UE SL Radio Bearer and the identity information of Source Remote UE needs be put into the second PC5 hop adaptation layer by Relay UE in order for Destination Remote UE to correlate the received data packets for the specific PDCP entity associated with the right end-to-end SL Radio Bearer in case of multiple Source Remote UEs based relaying.**

**Rapporteur summary-20: According to the replies, the majority (16/20) companies see the need for second hop PC5 Adaptation layer to carry the Destination Remote UE identity. Some companies see the need to discuss RLF handling, flow control, etc. at second hop PC5 Adaptation layer for L2 Relaying as supported by IAB. Many companies suggest to discuss such details at WI stage but some companies suggest to discuss the issues if needed at SI stage before WI stage. Then the following proposal is made:**

**Proposal-20: The Destination Remote UE identity is carried by second hop PC5 Adaptation layer for L2 UE-to-UE Relay.**

**Rapporteur summary-21: According to the replies, clear majority (19/20) companies see the need to support the N:1 mapping by first hop PC5 adaptation layer between Remote UE SL Radio Bearers and first hop PC5 RLC channels for relaying. However one company did not see the need. Then the following proposal is made:**

**Proposal-21: agree the following description for L2 UE-to-UE relay (also reflected by TP)**

**Support the N:1 mapping by first hop PC5 adaptation layer between Remote UE SL Radio Bearers and first hop PC5 RLC channels for relaying.**

**Rapporteur summary-22: According to the replies, clear majority (19/20) companies see the need to support the adaptation layer over first hop PC5 between Source Remote UE and Relay UE in order to identify the traffic destined to different Destination Remote UEs. However one company did not see the need. Then the following proposal is made:**

**Proposal-22: agree the following description for L2 UE-to-UE relay (also reflected by TP)**

**Support the adaptation layer over first hop PC5 between Source Remote UE and Relay UE in order to identify the traffic destined to different Destination Remote UEs.**

**Rapporteur summary-23: Based on the answers to Q23, there is no majority (8 supports among 20 replies) on the support of traffic differentiation via first hop PC5 adaptation layer between the non-relaying traffic and the relaying traffic for L2 UE-to-UE relay operation. Half companies (10/20) did not see the need. One company has no strong view. One company suggests to send LS to SA2 to clarify whether relaying PC5-S connection is separate from normal PC5-S connection. Rapporteur suggests to do online discussion for the issue:**

**Proposal-23: RAN2 discuss the support of traffic differentiation via first hop PC5 adaptation layer between the non-relaying traffic and the relaying traffic for L2 UE-to-UE relay operation.**

**Rapporteur summary-24: Based on the answers to Q24, there is no clear majority (11/20) on any additional functionalities such, RLF, flow control, source UE identification, etc. Meanwhile, many companies prefers to discuss the issues at WI stage. Rapporteur suggests to do online discussion for the issue:**

**Proposal-24: RAN2 discusses the support of additional functionalities over first hop PC5 Adaptation layer at WI phase for L2 UE-to-UE relay operation.**

**Rapporteur summary-25: According to the replies to Q25, all companies agree that gNB implementation can handle the QoS breakdown over Uu and PC5 for the end-to-end QoS enforcement of a particular session established between Remote UE and network in case of L2 based UE to Network relaying. Then the following easy proposal is made:**

**Proposal-25 [Easy]: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**gNB implementation can handle the QoS breakdown over Uu and PC5 for the end-to-end QoS enforcement of a particular session established between Remote UE and network in case of L2 based UE to Network relaying.**

**Rapporteur summary-26: According to the replies to Q26, all companies agree with Alt2 i.e. QoS handling for L2 UE-to-UE Relay is subject to upper layer, e.g. solution 31 within TR23.752 studied by SA2. Meanwhile some companies thinks both Alt1 and Alt2 can work. Alt2 can be put into an easy proposal. Meanwhile, there is a discussion on whether RAN2 needs to discuss the RAN2 impacts of the end-to-end QoS splitting at Relay UE. Some companies see the need and some other companies see this as an SA2 issue or UE implementation issue.**

**Proposal-26 [Easy]: agree the following description for L2 UE-to-UE relay (also reflected by TP)**

**QoS handling for L2 UE-to-UE Relay is subject to upper layer, e.g. solution 31 within TR23.752 studied by SA2.**

**Rapporteur summary-27: According to the replies to Q27, clear majority companies (19/20) replied yes or yes with comments. One company suggests to send LS to SA2 to check whether the legacy PC5-S connection setup procedure can be reused for relay connection setup. However according to the discussion, rapporteur’s understanding is that RAN2 can discuss the procedure from AS perspective for connection establishment. Among the comments received, there is a proposal to merge step 6 and step 7. But rapporteur’s understanding is that step 6 (preparing relaying channel for SRB2 message transmission) should occur ahead of step 7 (SRB2 message). Among the comments received, there is a proposal to remove the RRC states for both Remote UE and Relay UE, this can be reflected by the proposal below. There is also some additional wording comments which can also be reflected by the proposal below. There is suggestion to discuss the Uu transmission for RRCSetupRequest/RRCSetup message, which is discussed by Q28. FFS can be put as an editor note following step 2.**

**Proposal-27: agree the following description for connection establishment procedure of L2 UE-to-NW relay (also reflected by TP)**



Figure 1: Connection Establishment for L2 UE-to-NW relay

Step 1. The Remote and Relay UE perform discovery procedure, and establish PC5-RRC connection using the legacy Rel-16 procedure as a baseline.

Step 2. The Remote UE sends the first RRC message (i.e. RRCSetupRequest) for its connection establishment with gNB via the Relay UE, using a default L2 configuration on PC5. The gNB responds with an RRCSetup message to Remote UE. The RRCSetup delivery to the Remote UE uses the default configuration for L2 on PC5. If the relay UE had not started in RRC\_CONNECTED, it would need to do its own connection establishment as part of this step.

*Editor notes: it is FFS how Relay UE forward the RRCSetupRequest/RRCSetup message for Remote UE at this step.*

Step 3. The gNB and Relay UE perform relaying channel setup procedure over Uu. According to the configuration from gNB, the Relay UE establishes an RLC channel for relaying of SRB1 towards the Remote UE over PC5. This step prepares the relaying channel for SRB1.

Step 4. Remote UE SRB1 message (e.g. an RRCSetupComplete message) is sent to the gNB via the Relay UE using SRB1 relaying channel over PC5. Then the Remote UE is RRC connected over Uu.

Step 5. The Remote UE and gNB establish security following legacy procedure and the security messages are forwarded through the Relay UE.

Step 6. The gNB sets up additional RLC channels between the gNB and Relay UE for traffic relaying. According to the configuration from gNB, the Relay UE sets up additional RLC channels between the Remote UE and Relay UE for traffic relaying. This step prepares the relaying channels for SRB2/DRBs.

Step 7. The gNB sends an RRCReconfiguration to the Remote UE via the Relay UE, to set up the relaying SRB2/DRBs. The Remote UE sends an RRCReconfigurationComplete to the gNB via the Relay UE as a response.

**Rapporteur summary-28: According to the replies to Q28, there is no majority support on the transmission of the first RRC message (i.e. RRCSetupRequest) via Uu adaptation layer. Among the comments, there is a question on what ‘always available’ means. ‘Always available’ means the first RRC message needs to be packed by Uu adaptation layer with a header. If Uu adaptation layer is not available for the first RRC message transmission, it will skip the Uu adaptation layer. In rapporteur understanding (as also indicted by some of the replies), there is a benefit to unify transmission of SRB0 and other SRBs and DRBs if the adaptation layer exists prior to the transmission of the first RRC message, which also means there should be common RLC channel(s) between Relay UE and gNB used to forward all first RRC message(s) for the Remote UE (s). Those common RLC channels can be default configuration or be configured by gNB in advance.**

**Proposal-28: RAN2 further discuss the approach for the transmission of SRB0 message over Uu between Relay UE and gNB for L2 UE-to-NW Relay.**

**Rapporteur summary-29: According to the replies to Q29, there is no majority support and there is some confusion on the wording and the steps. One clarification is that step1/2 serves to prepare the signaling connection over PC5 but the configuration of SLRB serves to configure the relaying channel for SL DRBs. One thing to note is that these steps are revised based on the steps described within solution 8 and solution 9 as captured within SA2 TR23.752. Rapporteur acknowledges that step 0/1/2 does not have explicit AS layer impact and then there is quite some room to improve the wording. Given the comments received, rapporteur suggests to further discuss the connection establishment procedure for L2 UE-to-UE Relay.**

**Proposal-29: RAN2 further discuss the connection establishment procedure for L2 UE-to-UE Relay.**

**Rapporteur summary-30: According to the replies to Q30, clear majority companies (19/20) replied yes or yes with comments. There is clear support to reword the sentence in the question with removal of both “essential” and “as required”. Then the wording “Relay UE can support the relaying of the system information to the Remote UE(s) and what system information can be relayed to Remote UEs can be discussed at normative phase” can be put into a proposal as below.**

**Proposal-30: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**Relay UE can support the relaying of the system information to the Remote UE(s) and what system information can be relayed to Remote UEs can be discussed at normative phase.**

**Rapporteur summary-31: According to the replies to Q30, majority companies (16/20) replied yes or yes with comments. About the exact signaling used by Relay UE to forward the received system information to Remote UEs via broadcast or groupcast, it can be is part of SL discovery message or separate SL broadcast/groupcast message, which can be further discussed later on.**

**Proposal-31: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**Relay UE can forward the received system information to Remote UEs via broadcast or groupcast.**

**Rapporteur summary-32: According to the replies to Q32, All companies agree that Relay UE can forward the system information to Remote UE via dedicated PC5-RRC signaling and the detailed mechanisms of PC5-RRC signaling design can be discussed in WI stage. With regard to the comments saying that Relay UE may decide to transmit SI via PC5 RRC without gNB involvement or Relay UE just perform transparent DL RRC message forwarding, which can be further discussed later on. Based on the comments received, rapporteur suggests the following easy proposal:**

**Proposal-32 [Easy]: agree the following description for L2 UE-to-NW relay (also reflected by TP)**

**Relay UE can forward the system information to Remote UE via dedicated PC5-RRC signaling and the detailed mechanisms of PC5-RRC signaling design can be discussed in WI stage.**

**Rapporteur summary-33: According to the replies to Q33, majority companies (14/20) agree a/b/c/d on the principle of on-demand SI delivery for Remote UE. And there are clear majority companies (16/20) that agree a/b/c on the principle of on-demand SI delivery for Remote UE. There is also clear support to reword b) to decouple** **IDLE/INACTIVE and CONNECTED state. A likely rewording for b) can be: “Only Msg3 based on-demand SI request is supported for Remote UE during Idle or Inactive mode; For connected Remote UE, only on-demand SIB request (i.e. dedicatedSIBRequest) is supported as Rel-16”.**

**Proposal-33: agree the following on-demand SI delivery principles for Remote UE for L2 UE-to-NW relay (also reflected by TP)**

* **On-demand SI request is supported for Remote UE for all RRC states (Idle/Inactive/Connected state).**
* **Only Msg3 based on-demand SI request is supported for Remote UE during Idle or Inactive mode; For connected Remote UE, only on-demand SIB request (i.e. dedicatedSIBRequest) is supported as Rel-16.**
* **The legacy Uu RRC procedure is reused to support the Remote UE’s on-demand SI request.**
* **On-demand SI delivery is supported for the Remote UE(s) regardless of out-of-coverage or in-coverage,** **when connected with Relay UE.**

**Rapporteur summary-34: According to the replies to Q34, there is no majority support for the PC5-RRC message based SIB notification from Remote UE to the Relay UE. The supporting companies see the benefit to improve the SI delivery performance. There is a proposal to require Relay UE to forward all necessary broadcasted SIB by default, (i.e., RAN2 define a set of SIBs that needs to be forwarded by relay UE), which needs standard support. Based on the comments received, there are many supports to postpone the related discussion to WI phase.**

**Proposal-34: RAN2 further discuss PC5-RRC message based SIB notification from Remote UE to the Relay UE for L2 UE-to-UE Relay at WI phase.**

**Rapporteur summary-35: According to the replies to Q35, all companies replied yes or yes with comments. Among the comments, there is a proposal during the reply to study different UAC parameters to the relay UE and remote UE and to leave it as FFS. Rapporteur understanding is that this can be discussed later on or at WI phase.**

**Proposal-35 [Easy]: agree the following access control check principles for L2 UE-to-NW relay (also reflected by TP)**

* **The Relay UE may provide UAC parameters to Remote UE**
* **The access control check is performed at Remote UE using the parameters of the cell it intends to access.**
* **The UE-to-Network Relay UE does not perform access control check for the Remote UE's data.**

**Rapporteur summary-36: According to the replies to Q36, there are not so many input. One reply suggests to discuss capability exchange and RRC state combination between Relay UE and Remote UE. One reply suggests to discuss registration update and RAN based notification area update. All these aspects can be potentially discussed at WI phase. As such, no proposal needs to be made.**

# References

[1]R2-2006572 Architecture Options for Sidelink Relay, MediaTek Inc.

[2]R2-2006555 UE-to-network relay architecture and procedures, Qualcomm Incorporated

[3]R2-2007100 Discussion on User Plane mechanisms for Layer 2 Relay, Apple

[4]R2-2008019 Relaying mechanism for NR sidelink, LG Electronics Inc.

[5]R2-2007181 Overview of Layer-2 and Layer-3 sidelink relay mechanisms, Sony

[6]R2-2007460 Protocol stack design for L2 relay, Lenovo, Motorola Mobility

[7]R2-2008047 Study aspects of UE-to-Network relay and solutions for L2 relay, Huawei, HiSilicon

[8]R2-2006604 Protocol stack and CP procedure for SL relay, OPPO

[9]R2-2006867 Mechanisms and Characteristics in NR Sidelink Relaying ,Fujitsu

[10]R2-2006962 Mechanisms for supporting L2-based Sidelink Relays, AT&T

[11]R2-2007041 Protocol stack and service continuity for L2 and L3 relay, vivo

[12]R2-2007044 Discusssion on architecture for NR sidelink relay,Spreadtrum Communications

[13]R2-2007100 Discussion on User Plane mechanisms for Layer 2 Relay, Apple

[14]R2-2007101 Discussion on Control Plane mechanisms for Layer 2 Relay, Apple

[15]R2-2006722 Protocol Stack and Connection Setup Procedure of Sidelink Relay, Futurewei

[16]R2-2006737 Discussion on NR SL Relay Architecture, ZTE Corporation, Sanechips

[17]R2-2006759 Discussion and TP on UE to NW Relay Based on L2 Relay Architecture, InterDigital

[18]R2-2006760 Discussion and TP on UE to UE Relay Based on L2 Relay Architecture, InterDigital

[19]R2-2006855 Considerations for L3 UE-to-Network Relays, Nokia, Nokia Shanghai Bell

[20]R2-2007203 L3 vs L2 relaying, Samsung Electronics GmbH

[21]R2-2007292 Considerations on L2 and L3 SL relay protocol design, Ericsson

[22]R2-2006611 L2/L3 UE-to-NW Relay Comparison, CATT

[23]R2-2006718 Characteristics of L2 and L3 based Sidelink relaying, Intel Corporation

[24]R2-2006843 View on L2/L3 SL relay, ITL

[25]R2-2006557 Discussion on NR sidelink relay selection and reselection, Qualcomm Incorporated

[26]R2-2006770 Discussion on SL relay (re)selection and authorization, OPPO

[27]R2-2006861 NR Sidelink Relay (Re-)Selection Criterion and Procedure Fraunhofer IIS, Fraunhofer HH

[28]R2-2006639 L2 vs L3 - Relay (re-)Selection, Quality of Service (QoS) Fraunhofer HHI, Fraunhofer IIS

[29]R2-2006571 RRC States for Relaying, MediaTek Inc.

[30]R2-2007462 RRC state and CN registration of the remote UE, Lenovo, Motorola Mobility

[31]R2-2008048 Service continuity for L2 UE-to-Network relay, Huawei, HiSilicon

[32]R2-2008066 Discussion on service continuity from Uu to relay, Xiaomi communications

[33]R2-2006641 L2 vs L3 Relay/Remote UE Authorization, Service Continuity Fraunhofer HHI, Fraunhofer IIS

[34]R2-2006723 Service Continuity with Sidelink Relay, Futurewei

[35]R2-2007461 Relayed connection management Lenovo, Motorola Mobility

[36]R2-2007608 Impact on user plane protocol stack/control plane procedure for Sidelink Relay,Intel

[37]R2-2007816 Considerations on UE-to-NW Relay, ETRI

[38]R2-2008043 Consideration of Relay characteristics, LG Electronics Inc.

[39]R2-2007040 Selection/Authorization and Security for L2 and L3 relay, vivo

[40]R2-2006724 QoS Control with Sidelink Relay, Futurewei

[41]R2-2007099 Discussion on NR Sidelink Relay Scenarios, Apple, Convida Wireless

[42]R2-2006610 User and Control Plane Procedures for L2 UE-to-NW Relay, CATT

[43]R2-2008266 Summary of the email discussion on L2 Relaying Mechanism, MediaTek