**3GPP TSG-RAN WG2 Meeting #115e R2-21XXXX**

**E-Meeting, 9th - 27th Aug 2021**

**Source: Xiaomi**

**Title:****Report of [Offline-616]**

**Agenda Item:** **8.7.2.1**

**Document for:** **Discussion and Decision**

# Introduction

This contribution is to discuss following offline discussion.

* [AT115-e][616][Relay] Proposals from control plane summary (Xiaomi)

Scope: Briefly discuss P1/P4/P5 and P8/P9/P10 of R2-2108824 and attempt to reach consensus. Also confirm if P18 is agreeable.

Intended outcome: Report to comeback session, in R2-2108948

Deadline: Tuesday 2021-08-24 2000 UTC

# Discussion

## 2.1 Uu RLC configuration for remote UE’s SRB0/1

Regarding Uu RLC configuration for remote UE’s SRB0 message, companies’ views are observed as following,

Option 1, Fixed/specified [1], [6], [33], [36]

Option 2, Default [7], [9], [13]

Option 3, NW configured [4], [7], [9], [13], [15], [20], [26]

Proponents of option 1 prefer the same principle as PC-5 RLC configuration should be reused for Uu. Proponents of option 3 believes the NW is able to provide Uu RLC configuration since relay UE shall enter CONNECTED to relay remote UE’s SRB0 message. Meanwhile, [7], [9] and [13] also supports default configuration in case NW doesn’t provide dedicated configuration. There is no clear majority view. P1 in [39] propose RAN2 to discuss following question,

**Question 1: which Uu RLC configuration is used for remote UE’s SRB0 message.**

**Option 1, Fixed/specified.**

**Option 2, Default,**

**Option 3, NW configured.**

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| Apple | Option 1 | We think it is simple for relay UE implementation to just use fixed/specified option for SRB0 in both PC5 and Uu hop. |
| Qualcomm | Option 2 and Option 3 | Option 1 doesn’t make sense. Fixed/specified configuration is used for SRB0 delivery, but relay is CONNECTED state. As a principle in Uu, CONNECTED UE with security generally can’t use SRB0.  For Option 2 and Option 3, we actually see below 3 different solutions:   * **Alt-1:** Specify a default Uu RLC channel in spec, which can be reconfigured to a dedicated RLC channel by gNB later * **Alt-2:** gNB configures **one Uu RLC channel shared by all remote UEs for SRB0 delivery** after the relay UE enters CONNECTED state with its L2 Relay capability indicated/authorized * **Alt-3:** gNB configures **different Uu RLC channels for different remote UEs for SRB0 delivery**, which requires CONNECTED relay to send SUI first   We think Alt-3 should be precluded because it has extra latency of 2 RRC messages (for SUI and responded RRC Reconfiguration message with dedicated Uu RLC channel config).  For Alt-1 and Alt-2, we think there is not much difference. Both of them need to reserve a fixed LCID for SRB0. The only difference is that the fixed LCID is specified in spec in Alt-1 while the fixed LCID is configured by gNB after relay authorization in Alt-2. We think RAN2 can pick either one based on majority. |
| MediaTek | Option-2 |  |
| Lenovo | Option 3. | When the remote UE transmits SRB0 message, relay stays at RRC connected state. Therefore, option 3 is the best one. |
| OPPO | Option 3 | NW configured solution brings more flexibility.  w.r.t the 3 alternatives given by QC, we share the view, and there seems no need to separate alt-1 and alt-2 since the two cases can be combined, i.e., the Uu RLC channel can be shared by all remote UE and can be default but also reconfigurable by gNB.  We slightly prefer option-3 considering the point that “the whole procedure (configuration of Uu channel) happens after relay UE enters into RRC\_CONNECTED state”. |
| vivo | Option 3 | For Option 1 and Option 2, the potential advantage is the less CP latency for Remote UE’s RRC connection establishment, but with the cost of occupying one LCID value statically.  Meanwhile, for Option 3, it is flexible LCID value assignment like DRBs, but will bring the additional CP latency compared with Option 1/2.   1. However, we analyze the additional CP latency in our contribution R2-2107757. It is observed that if dedicated Uu RLC channel configuration is used, the potential CP latency of the Remote UE’s connection establishment procedure can be increased by **~10 ms** for the RRC non-segmented case and **~50 ms** for the RRC segmented case.   As above, we think the latency issue is not that urgent and in this release RAN2 can focus on the eMBB-type Remote UE first. Therefore, it is acceptable on the potential large latency due to the dedicated Uu RLC channel configuration. In such way, a common signalling solution for Remote UE’s SRB0/SRB1/SRB2/DRBs signalling delivery over Uu RLC channel can be achieved. |
| Spreadtrum | Option 3 | Remote UE’s SRB0 is relayed to the gNB after the RRC connection setup between the relay UE and the gNB. In such case, the gNB can do dedicated configuration for Uu RLC channels. |
| Sharp | Option 2 |  |

Regarding Uu RLC configuration for remote UE’s SRB1 message, companies’ views are observed as following,

Option 1, Fixed/specified [33]

Option 2, Default [1], [6], [7], [9], [13], [36]

Option 3, NW configured [4], [7], [9], [13], [15], [20], [26], [36]

Only one company prefers fixed/specified configuration. 6 companies prefer to use default configuration. 8 companies prefer to use NW configured configuration. RAN2 had agreed Uu RLC configuration for remote UE’s SRB1 message such as RRCResume and RRCReestablishment message could be (re-)configured by NW via dedicated signalling. It’s still FFS whether default configuration is supported. P4 in [39] propose RAN2 to discuss following question,

**Question 2: Do you agree default Uu RLC configuration for remote UE’s SRB1 message is supported.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Apple | Yes | It can be overridden by network configuration |
| Qualcomm | Yes | Because relay is in CONNECTED state, we prefer the same handling as SRB0 in Question 1, i.e. pick either one below Alt-1 or Alt-2:   * **Alt-1:** Specify a default Uu RLC channel, which can be reconfigured to a dedicated RLC channel by gNB later   **Alt-2:** gNB configures a **Uu RLC channel shared by all remote UEs for SRB0 delivery** after the relay UE enters CONNECTED state with its L2 Relay capability indicated/authorized |
| MediaTek | Yes |  |
| Lenovo | Yes | If the default configuration is alllowed, the default configuration can be overridden by the gNB configuration. |
| OPPO | No (prefer NW configuration as replied to Q1 above) | See our reply to Q1 above.  We wonder what’s the additional gain to support default configuration besides NW configured SRB1. SUI report from relay UE can always achieve the benefit of flexible configuration. |
| vivo | No with comments | For remote UE’s SRB1 message other than RRCResume and RRCReestablishment, it has already been agreed as following.  Agreements:  Proposal 6-2: [21/23, 22/23] [Easy] For the delivery of remote UE’s SRB1 RRC message other than RRCResume and RRCReestablishment message, network configuration via dedicated signalling is used for the configuration of PC5 RLC channel and Uu RLC channel.  Therefore, the delta part of Question 2 should be remote UE’s SRB1 message as RRCResume and RRCReestablishment. For the answer of Question 2, as commented in Question 1, we support that always relying on network configuration via dedicated signalling over Uu RLC channel. |
| Spreadtrum | No | The Uu RLC channel for remote UE’s SRB1can always rely on network dedicated configuration. |
| Sharp | Yes |  |

[7] further discuss which RLC configuration is used for RRCReconfigurationComplete in path switch to indirect path. P5 in [39] propose RAN2 to discuss following question,

**Question 3: Do you agree dedicated signalling is used for the PC5 RLC and Uu RLC configuration of remote UE SRB1 for RRCReconfigurationComplete in path switch to indirect path.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Apple | Yes | This can be part of RRCReconfiguration message to the remote UE. |
| Qualcomm | See comments | If target relay is in CONNECTED state, we think both RRC reconfiguration message towards remote UE (i.e. step 3) and reconfiguration message towards relay (i.e. step 2) can include remote UE dedicated PC5 RLC and Uu RLC configuration for delivery of remote UE’s *RRCReconfigurationComplete* message. So, it is “Yes”  If target relay is in IDLE/INACTIVE state, this question needs further study whether default/specified PC5/Uu RLC need to be used. Please note that gNB can’t configure dedicated RLC for IDLE/INACTIVE relay UE (i.e. there is no step 2). |
| MediaTek | Yes | We agree with Apple and the first part of the answer from Qualcomm. Meanwhile, we think that currently we should prioritize the discussion for connected Relay UE. |
| Lenovo | Yes with comments | If target relay UE is connected state, it is straightforward that dedicated signalling can be used to be transmitted to relay UE.  If idle/inactive state relay UE can be supported by path switching, the idle/inactive relay UE should transit to connected before remote UE transmits complete message. Specifically, if gNB indicates to idle/inactive relay UE, gNB can inform/page relay UE before step 3. If remote UE indicates to idle/inactive relay UE, the relay UE can response to the remote UE after transiting to connected state. Then, the remote UE transmits complete message after receiving response from relay UE. |
| OPPO | Yes for RRC\_CONNECTED relay UE | If Relay UE is in RRC\_INACTIVE/RRC\_IDLE  For Uu RLC configuration, see our reply to Q1 above, i.e., network configuration is still feasible.  For PC5 RLC configuration, we can follow the agreement for SRB1, i.e., use default configuration.  *Proposal 6-3: [23/23] [Easy] For the delivery of remote UE’s SRB1 RRC message such as RRCResume and RRCReestablishment message, default configuration is used for the configuration of PC5 RLC channel which can be reconfigured by network. FFS for Uu RLC channel.* |
| vivo | Yes | For the PC5 RLC configuration of remote UE SRB1 for RRCReconfigurationComplete, we agree with Apple that it can be included as part of the remote UE’s RRCReconfiguration message content.  For the Uu RLC configuration of remote UE SRB1 for RRCReconfigurationComplete, we think the following agreement to use network configuration via dedicated signalling has covered the path switch scenario.  Agreements:  Proposal 6-2: [21/23, 22/23] [Easy] For the delivery of remote UE’s SRB1 RRC message other than RRCResume and RRCReestablishment message, network configuration via dedicated signalling is used for the configuration of PC5 RLC channel and Uu RLC channel. |
| Spreadtrum | Yes for RRC\_CONNECTED relay UE | For IDLE/INACITVE relay UE, default configuration can be used for PC5 RLC channel and network configuration via dedicated signaling can be used for Uu RLC channel. |
| Sharp | Yes |  |

## 2.3 Sharing of ID/DRX information for paging forward

In RAN2 114 meeting, it’s agreed that When Relay UE in RRC IDLE/RRC INACTVE and Remote UE in RRC IDLE/RRC INACTIVE, the Relay UE monitors paging occasions of its PC5-RRC connected Remote UE(s). However, it’s FFS how relay UE obtain remote UE’s paging occasions. Many companies support remote UE provides UE ID, i.e. 5G-S-TMSI/I-RNTI to relay UE. Relay UE could decode paging message to derive the UE ID and forward the paging message accordingly. P8/P9 in [39] propose RAN2 to discuss following question,

**Question 4: Do you agree IDLE/INACTIVE remote UE provides 5G-S-TMSI/I-RNTI to IDLE/INACTIVE relay UE.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Apple | Yes | As SA3 has confirmed there is no security concern on exposing the 5G-S-TMSI/I-RNTI, it is OK to share those with relay UE. |
| Qualcomm | Yes | It is straight forward to follow SA3 reply LS:  **A**: SA3 made an assumption that the relay UE is a trusted entity. Under this assumption, exposing the 5G-S-TMSI/I-RNTI of the remote UE to relay UE is acceptable.  In addition, please note that SA3 didn’t mention any condition of this trust assumption. Thus, RAN2 can assume relay is always trusted. We prefer to add “**full**” before “**5G-S-TMSI/I-RNTI”,** to make the proposal more clearly |
| MediaTek | No | We understand that SA3 conclusion was that the Relay UE may know the 5G-S-TMSI in case the Relay UE is a trusted entity. However, as discussed in the SI phase in RAN2 and SA2, there are cases in which the Relay UE is not trusted, such as the case of a relay in a public place like a coffee shop.  In order to avoid the ID disclosure, we prefer that the Remote UE should inform Relay UE of its paging DRX parameters (i.e. to determine PO). Then Relay UE forwards the paging DRX parameters of Remote UE to the base station i.e. gNB [R2-2107045]. R2-2107045 describes the case for connected Relay UE but it can be easily expanded to IDLE/INACTIVE relay UE. |
| Lenovo | Yes | Based on LS from SA3, there is no security issues. |
| OPPO | No, only partial 5G-S-TMSI is needed. | We think partial 5G-S-TMSI/RNTI (UE\_ID=5G-S-TMSI mod 1024) is enough to let relay UE know the PO to monitor and mitigate the security concern considering the possibility of non-trusted relay, since SA3 only replied exposing the 5G-S-TMSI/I-RNTI of the remote UE to a trusted relay UE is acceptable. |
| vivo | Yes | They are used for Relay UE to derive Remote UE’s POs. |
| Spreadtrum | Yes | 5G-S-TMSI/RNTI can be provided to relay UE after PC-5 unicast connection is setup, where PC5 security has been established. Thus, the relay UE can be assumed as a trusted entity. |
| Sharp | Yes | Base on SA3’s input, it is applicable. |

**Question 5: Do you agree IDLE/INACTIVE Relay UE decodes received paging message to derive the 5G-S-TSMI/I-RNTI and forward the paging message accordingly.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Apple | Yes |  |
| Qualcomm | Yes | As replied in Q4, please note that SA3 didn’t mention any condition of this trust assumption. Thus, RAN2 can assume relay is always trusted, and full UE-ID can be shared between remote UE and relay.  Therefore, we think there is no security concern for relay to decode paging message of remote UE. Then, relay UE can know which specific remote UE to receive the paging. As consequence, unicast PC5-RRC transmission for paging forwarding is sufficient. |
| MediaTek | No | When the Relay UE monitors the PO of a particular Remote UE, the Relay UE can identify this is a message for a particular Remote UE according to the paging DRX parameters (i.e. to determine PO) he received from the Remote UE. |
| Lenovo | Yes |  |
| OPPO | No | We think partial 5G-S-TMSI/RNTI (UE\_ID=5G-S-TMSI mod 1024) is enough to let relay UE know the PO to monitor and mitigate the security concern. In this case, relay UE doesn’t need to decode the paging message for remote UE, but just forward the whole paging message received in the concerned PO to the concerned remote UE. |
| vivo | Yes | Instead of blindly forwarding the paging message, decoding received paging message to derive the 5G-S-TSMI/I-RNTI and forwarding the paging message accordingly are more accurate and save potential PC5 singnaling overhead. |
| Spreadtrum | Yes |  |
| Sharp | Yes |  |

Relay UE shall be aware of remote UE’s PO to perform monitoring. [2], [8], [12], [27] propose to provide remote UE’s DRX cycle to relay UE. [21] propose to provide remote UE’s PO to relay UE. [30] believes the PO of remote UE is configured via SIB. However, according to 38.304 specification, the PO is calculated in MAC and the essential parameters, e.g. DRX cycle, may come from SIB or upper layer. It’s unclear how SIB could configure remote UE’s PO. P10 in [39] propose RAN2 to discuss following question,

**Question 6: Do you agree IDLE/INACTIVE remote UE provide its Uu DRX cycle T to IDLE/INACTIVE relay UE.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Apple | Yes |  |
| Qualcomm | Yes (see comments) | We are not sure what T means. All the following understandings can work:   * IDLE UE   + Alt-1: T=min (default cycle, cycle in NAS)   + Alt-2: T=cycle in NAS. * INACTIVE UE   + Alt-1: T=min (RAN paging cycle, cycle in NAS)   + Alt-2: T= RAN paging cycle and cycle in NAS   The difference b/w IDLE and INACTIVE is that default cycle is common to relay and remote UE, so no need for remote to share with relay.  We don’t have strong opinion for above understanding. Suggest to make it clear in agreement. |
| MediaTek | Yes | See our reply in Q4/Q5.  We assume that Remote UE can inform Relay UE of its paging DRX parameters (i.e. to determine PO). For example, after deriving UE\_ID mode N and UE\_ID/N, Remote UE may report three parameters to Relay UE, i.e.  - T: paging cycle  - SFN start offset: e.g. the SFN with PO happens at SFN =3, 3+T, 3+ 2T, … 3+nT  - i\_s value |
| Lenovo | No | If IDLE/INACTIVE remote UE provide its Uu DRX cycle T to IDLE/INACTIVE relay UE, the remote UE is expected to calculate DRX cycle T based on the UE specific DRX cycle and default paging cycle. That means relay UE needs to transfer default paging cycle to remote UE. Actually, **the remote UE can only provide UE specific DRX cycle to relay UE**, **relay UE calculates Uu DRX cycle T which can save the step that relay UE transfers default cycle to remote UE.**  Based on the above analysis, the idle remote UE provides the UE specific cycle from NAS signalling to the relay UE. The inactive remote UE provides the minimum of UE specific cycle from NAS signalling and UE specific cycle via RRC signalling to the relay UE. |
| OPPO | Yes |  |
| vivo | Yes with comments | According to our understanding:  - For RRC\_IDLE UE, Uu DRX cycle T is the shortest of ‘UE specific cycle can be configured via NAS signalling’ and ‘a default cycle from SIB’.  - For RRC INCATIVE UE, Uu DRX cycle T is the shortest of ‘UE specific cycle via NAS signalling’, UE-specific cycle via RRC signalling, and ‘a default cycle from SIB’.  Based on above, providing remote UE’s UE specific DRX cycle to relay UE is necessary, but FFS for the default cycle from SIB. For the latter one, RAN2 may further discuss the necessity after the SI delivery design is more clear. For example, when direct Uu path reception of system information is allow for IC remote UE, but serving cell identity of remote UE is different from that of relay UE |
| Spreadtrum | Yes |  |
| Sharp | Yes |  |

## 2.4 Connection establishment for relay and remote UE

If both remote UE and relay UE are not in CONNECTED, both UEs need to enter CONNECTED for service transmission. [9] assumes remote UE and relay UE performs connection establishment/resume independently. [33] propose to discuss combined relay UE and remote UE’s RRC connection establishment/assumption. Rapporteur understands second option may require additional impact in RAN1, since current msg3 is not enough for two RRC messages. Furthermore, in TR, it’s agreed if the Relay UE had not started in RRC\_CONNECTED, it would need to do its own connection establishment upon reception of a message on the default L2 configuration on PC5. P10 in [39] propose RAN2 to discuss following question,

**Question 7: Do you agree, as baseline, Remote UE and relay UE performs connection establishment/resume independently, i.e. relay UE shall enter CONNECTED to be able to forward remote UE’s initial RRC messages.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| Apple | Yes |  |
| Qualcomm | Yes | We prefer to complete baseline procedure first. |
| MediaTek | Yes |  |
| Lenovo | Yes |  |
| OPPO | Yes |  |
| vivo | Yes | It just confirms SI conclusion and is already captured in TR. No need for new agreement as RAN2#113bis-e agreed as below.  Agreement:  Agreements from the SI phase are valid unless a decision is taken to revert them; RAN2 do not need to re-confirm each point individually. |
| Spreadtrum | Yes |  |
| Sharp | Yes |  |

# Report

Following proposals are made,

# Reference

[1] R2-2106989 Control Plane Procedures of L2 Relay CATT

[2] R2-2107039 Discussion on Control Plane Aspects for L2 Relay OPPO

[3] R2-2107044 Stage 2 level procedure for Connection Establishment MediaTek Inc.

[4] R2-2107103 Further discussion on RRC connection management of L2 U2N relay Qualcomm Incorporated

[5] R2-2107104 Further discussion on paging and SIB forwarding in L2 U2N relay Qualcomm Incorporated

[6] R2-2107176 Remaining issues on RRC connection management Samsung Electronics GmbH

[7] R2-2107231 Discussion on RRC connection management for L2 sidelink relay Huawei, HiSilicon

[8] R2-2107232 SI forwarding and paging for L2 sidelink relay Huawei, HiSilicon discussion

[9] R2-2107273 Connection Establishment Procedure for L2 UE to NW Relays InterDigital

[10] R2-2107274 Paging Procedures for L2 UE to NW Relays InterDigital discussion

[11] R2-2107275 SI Forwarding for L2 UE to NW Relays InterDigital discussion

[12] R2-2107304 Discussion on paging forwarding for a remote UE SHARP Corporation discussion

[13] R2-2107306 Remaining issues of L2 Relay connection management Intel Corporation

[14] R2-2107367 Discussion on control plane procedures for L2 U2N relay Spreadtrum Communications

[15] R2-2107541 Configuration of Uu Interface for Sidelink Relay Futurewei

[16] R2-2107622 Remaining issues on SIB forwarding for IDLE/INACTIVE remote UE Apple

[17] R2-2107623 Unified Access Control on Relay UE Apple

[18] R2-2107625 RNA Update via L2 UE-to-NW relay Apple

[19] R2-2107709 Paging delivery via L2 Relay in RRC\_CONNECTED Samsung

[20] R2-2107757 Way forward for L2 U2N Remote UE SRB0 SRB1 configuration vivo

[21] R2-2107966 Discussion on SI and paging delivery Xiaomi communications

[22] R2-2107967 Discussion on connection control Xiaomi communications

[23] R2-2108007 SI acquisition, CN Registration and RNAU Lenovo Mobile Com. Technology

[24] R2-2108008 Monitoring Paging by a U2N Relay Lenovo Mobile Com. Technology

[25] R2-2108060 L2 relay control plane procedures Sony discussion

[26] R2-2108145 Consideration on the connection management of SL relay ZTE, Sanechips

[27] R2-2108146 Consideration on the system information acquisition and paging in SL relay ZTE, Sanechips

[28] R2-2108153 SIB Delivery & Paging for Remote UE LG Electronics Inc

[29] R2-2108154 Connection Establishment LG Electronics Inc

[30] R2-2108192 Discussion on paging and SIB handling for L2 sidelink relay Ericsson

[31] R2-2108195 Discussion on RRC connection management procedures for L2 SL relay Ericsson

[32] R2-2108414 Discussion on SI and paging forwarding

[33] R2-2108458 Discussion on RRC connection establishment of remote UE in L2 U2N relay Nokia, Nokia Shanghai Bell

[34] R2-2108462 Support of idle mode mobility for remote-UE in SL UE-to-Nwk relay Nokia, Nokia Shanghai Bell

[35] R2-2108510 Control plane procedure CMCC

[36] R2-2108250 Sidelink Relay Uu RLC for Remote UE and Adaptation Layer Design Beijing Xiaomi Mobile Software

[37] R2-2108156 Relay reselection when Relay UE performs HO LG Electronics Inc

[38] R2-2108144 Further discussion on Relay selection ZTE, Sanechips

[39] R2-2108824 Summary of AI 8.7.2.1 Xiaomi Technology