3GPP TSG-RAN WG2 Meeting #113e R2-210xxxx

Electronic Meeting, 25th January – 5th February 2021

Agenda: 8.7.2.1

Source: InterDigital

Title: Summary of [AT113-e][605][Relay] Continuation of L2 architecture issues (InterDigital)

Document for: Discussion, Decision

# 1 Introduction

The following email discussion was triggered at RAN2#113:

* [AT113-e][605][Relay] Continuation of L2 architecture issues (InterDigital)

 Scope: Discuss the priority 2 proposals P6, P15-P19 from R2-2102091 and implement the agreements on the priority 1 proposals. Work towards conclusions if possible.

 Intended outcome: Endorsable TP

 Deadline: Tuesday 2021-02-02 1200 UTC (for TP availability)

The summary document summarizes the portion of the scope related to “work towards conclusions if possible”

# 2 Conclusion Section

## 2.1 Evaluation and Conclusion for L2 Sidelink based UE-to-Network Relay

Rapporteur suggests the following text for conclusion section for L2 UE to NW Relay, which was generated by considering input in the following contributions [3][25][26][27][28] while avoiding overlaps and discussion of L2/L3 comparison material.

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Relay/Remote UE Authorization

Both Relay and Remote UE separately follow Rel-16 V2X design (TS 23.287), and no RAN2 impact is expected.

Relay (Re)Selection

Relay (Re)selection was studied for both L2 and L3 UE-to-Network Relay and the baseline solution is applied to both. In addition, for RRC\_CONNECTED remote UE in L2 UE-to-Network Relay, gNB decision on relay (re)selection is considered.

Discovery

Discovery was studied for both L2 and L3 UE-to-Network Relay and the baseline solution is applied to both. For L2 U2N Relay, the Relay UE should always be connected to a SL capable gNB. Further details of discovery configuration for the remote UE may be discussed in the normative phase.

Protocol Stack Design

The protocol stack and Uu adaptation layer function were studied for L2 UE-to-Network Relay. Whether the adaptation layer is also supported at the PC5 interface between Remote UE and Relay UE may be discussed in the normative phase. In L2 U2N Relay architecture, the remote UE is visible to the gNB, and the remote UE has its own PDU sessions. It supports the gNB configured/controlled bearer mapping for relayed traffic, which could also save the RLC bearer number by supporting the N:1 mapping from E2E bearers.

QoS Management

The general QoS handling for L2 UE-to-Network Relay was studied. The gNB can handle the QoS breakdown over Uu and PC5 for end-to-end QoS enforcement. Details of handling in case PC5 RLC channels with different e2e QoS are mapped to the same Uu RLC channel can be discussed in the normative phase. The end-to-end QoS enforcement can be supported. The gNB is aware of AS conditions of sidelink and Uu link, based on which the QoS breakdown can be flexible and tailored to such conditions (e.g. can be used to adapt the QoS breakdown when there is congestion on sidelink). In case of OOC, remote UE operates using the configuration provided in SIB or dedicated RRC signaling with overall better QoS performance than using pre-configuration. QoS can be enforced for each bearer as the gNB can decide whether an E2E bearer is admitted or not depending on the current congestion.

Security

In case of L2 UE-to-Network Relay, at AS layer, the security (confidentiality and integrity protection) is already enforced end to end at the PDCP layer between the endpoints at the Remote UE and the gNB.

Control Plane Procedures

Both connection establishment procedure and path switching procedures were captured for L2 UE-to-Network Relay. The establishment of Uu SRB1/SRB2 and DRB of the remote UE is subject to legacy Uu configuration procedures. It supports the remote UE’s RRC connection management, which can provide dedicated RRC configuration to remote UE, reduce the interruption/avoid data loss due to RLF recovery, and speed up RRC connection and data resume, etc. Further details of the steps for path switch procedure (e.g. measurements, message content) and potential differences on the Uu interface for inter-gNB cases may be discussed in the normative phase.

The Option 2 as studied in TR36.746 for FeD2D paging is selected as the baseline paging relaying solution for L2 UE-to-Network Relay. By supporting paging, for remote UE in RRC\_IDLE/RRC\_INACTIVE, the DL data reachability can be supported during remote UE’s mobility.

The system information (i.e SI) request from remote UE and forwarding mechanism from Relay UE to Remote UE was studied L2 UE-to-Network Relay. Specifically, the relay UE can forward system information to the remote UE via broadcast, groupcast or unicast. On-demand SI request is supported for all RRC states. The detailed mechanism for such SI request and forwarding and the exact system information that can be relayed to Remote UEs can be discussed at normative phase. It supports the SI delivery in case remote UE is OCC, which supports remote UE using SIB provided configuration rather than only using pre-configuration.

For L2 UE-to- Network relay, 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. It supports the remote UE access control to achieve the RAN overload control. Remote UE access control can take into account SL congestion as the gNB is aware of the remote UE.

Service Continuity

L2 UE-to-Network Relay uses RAN2 aspects of Rel-15 NR handover procedure as a baseline. The AS layer service continuity (i.e. lossless and in-sequence delivery of PDCP PDU with similar performance like legacy HO) can be guaranteed during path switch in L2 U2N relay.

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**Q3.1 Do companies have any major concern with the above suggested text. If so, please provide the suggested changes in the comments section.**

|  |  |  |
| --- | --- | --- |
| Company | Response (Y/N) | Comments |
| MediaTek | No | We agree with the current wording. If we wish to polish the wording, the order of the bullets can be adjust to follow the order of the objectives as listed in SID of SL relay.  |
| Apple | No | We have no concern. |
| Huawei, HiSilicon | No | We agree with the current wording. |
| Orange | No | We have no concern. |
| LG | No | We have no concern. |
| Ericsson | Yes | 1. For control plane procedure, the wording ”speed up RRC connection and data resum” is not true, how outcomes this conclusion? Suggest to remove the wording.
2. For control plane procedure, the below text

“Remote UE access control can take into account SL congestion as the gNB is aware of the remote UE.“ needs to be removed, since it has not been discussed during the SI phase yet.1. For service continuity, the text

“The AS layer service continuity (i.e. lossless and in-sequence delivery of PDCP PDU with similar performance like legacy HO) can be guaranteed during path switch in L2 U2N relay“.It not fully true, since the packet forwarding procedure would not only require the gNBs to be involved, but also involve relay UEs, purely reusing legacy HO mechanism will not work. Therefore suggest to reword the text as“In order to achieve lossless and in-sequence delivery of PDCP PDU with similar performance like legacy HO during path switch in L2 U2N relay, the AS layer service continuity mechanisms need to be studied invoving serving and target gNBs, but also invoving relay UEs (e.g., PDCP PDUs packet forwarding between relay UE and gNB, and between serving and target relay UEs) during path switch in L2 U2N relay.“ |
| Qualcomm | Yes(we provides suggested change, please check in “No Markup“ view) | **Relay (Re)selection:** Wording suggestion:“In addition, for RRC\_CONNECTED remote UE in L2 UE-to-Network Relay, gNB decision on relay (re)selection is considered in WI phase.“**Protocol Stack Design:**The last sentence is confusing to us. It refers to Remote UE or relay UE? Using N:1 mapping from E2E bearers is not accurate, as we did not conclude on PC5 AL functions yet. N:1 mapping is only relevant for PC5 <->Uu CHs for Uu AL. We suggest to change it to:“It supports the gNB configured/controlled N:1 bearer mapping for relay UE between multiple E2E Bearers of a Remote UE and/or different Remote UEs and one Uu RLC channel over the Relay UE Uu path~~for relayed traffic, which could also save the RLC bearer number by supporting the N:1 mapping from E2E bearers.“~~**QoS management:**2nd sentence should be aligned with the wording in section 4.5.2, i.e.~~The gNB can handle the QoS breakdown over Uu and PC5 for end-to-end QoS enforcement.~~ 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 UE-to-Network Relay.*“The gNB is aware of* ***AS conditions of sidelink*** *and Uu link, based on which the QoS breakdown can be flexible and tailored to such conditions (e.g. can be used to adapt the QoS breakdown when there is congestion on sidelink).“*We are not sure how gNB is aware of AS conditions of sidelink because we has not discussed measurement enhancement for sidelink in relay. Note that in existing event S1/S2 of TS38.331, the measurement is reported to peer UE but NOT report to gNB. And how the “congestion“ can be used for QoS enforcement was not discussed in RAN2. Anyway, we request to remove this sentence because it has been covered by the 2nd sentence (i.e. gNB implementation break down)*“In case of OOC, remote UE operates using the configuration provided in SIB or dedicated RRC signaling with overall better QoS performance than using pre-configuration. QoS can be enforced for each bearer as the gNB can decide whether an E2E bearer is admitted or not depending on the current congestion.“*We didn’t discuss why config in SIB/RRC has better QoS performance than pre-configuration for L2 relay, and this issue had been extensively discussed in LTE/NR V2X. Thus, we request to remove it because it doesn’t provide new value. Finally, last sentence (“QoS can be..“) is not necessary as it adds no value and is default behavior on adminition control.**Security:**We are not sure what “already“ means. Suggest to remove it.**Control Plane Procedures**For the last sentence of SIB paragraph, we don’t think it needs to emphasize “rather than only using pre-configuraiton“ which is obvious given the 1st half sentence. We don’t think conclusion needs to capture in detail to this level and we have removed the comparison section. So, we request Rapporteur to remove it (“rather than only using pre-configuration“).For UAC parapragh, we request to remove last two sentences: * for last 2nd sentence, it adds no value and is default behavior
* for last 1st sentence, we agree with Ericsson. What does “SL congestion“ mean? Who takes the SL Congestion into account? The Remote UE or the gNB? And, how is the SL Congestion detected. Anyway, we think it should be removed.

**Service Continuity**We agree with Ericsson suggested change, which is more accurately reflected what RAN2 discussion status |
| Samsung | Yes | Relay (Re)SelectionRelay (Re)selection was studied for both L2 and L3 UE-to-Network Relay and the baseline solution is applied to both. In addition, for RRC\_CONNECTED remote UE in L2 UE-to-Network Relay, gNB decision on relay (re)selection **is consideredmay be considered in the normative phase**.DiscoveryDiscovery was studied for both L2 and L3 UE-to-Network Relay and the baseline solution is applied to both. For L2 U2N Relay, the Relay UE should always be connected to a SL capable gNB. Further details of discovery configuration for the remote UE **mayneeds to** be discussed in the normative phase. *[‚may‘ does not give a realistic picture as it implies further details need not be studied and the L2 design would still be complete, which is incorrect]*Protocol Stack DesignThe protocol stack and Uu adaptation layer function were studied for L2 UE-to-Network Relay. Whether the adaptation layer is also supported at the PC5 interface between Remote UE and Relay UE **mayneeds to** be discussed in the normative phase. In L2 U2N Relay architecture, the remote UE is visible to the gNB, and the remote UE has its own PDU sessions. It supports the gNB configured/controlled bearer mapping for relayed traffic, which could also save the RLC bearer number by supporting the N:1 mapping from E2E bearers *[this is superfluous, unless further work is also mentioned that needs to be done to make this happen]*.QoS ManagementThe general QoS handling for L2 UE-to-Network Relay was studied. The gNB can handle the QoS breakdown over Uu and PC5 for end-to-end QoS enforcement. Details of handling in case PC5 RLC channels with different e2e QoS are mapped to the same Uu RLC channel **canneeds to be** be discussed in the normative phase. The end-to-end QoS enforcement can be supported. The gNB is aware of AS conditions of sidelink and Uu link, based on which the QoS breakdown can be flexible and tailored to such conditions (e.g. can be used to adapt the QoS breakdown when there is congestion on sidelink). *[This is superfluous/too much detail.]* In case of OOC, remote UE operates using the configuration provided in SIB or dedicated RRC signaling *[It is not clear how this part is related to QoS management.]* with overall better QoS performance than using pre-configuration *[This last statement needs verification/reference.].* QoS can be enforced for each bearer as the gNB can decide whether an E2E bearer is admitted or not depending on the current congestion....Further details of the steps for path switch procedure (e.g. measurements, message content) and potential differences on the Uu interface for inter-gNB cases **mayneed to** be discussed in the normative phase....The detailed mechanism for such SI request and forwarding and the exact system information that can be relayed to Remote UEs **canneeds to be** be discussed at normative phase. |

## 2.2 Evaluation and Conclusion for L2 Sidelink based UE-to-UE Relay

Rapporteur suggests the following text for conclusion section for L2 UE to UE Relay, which was generated by taking text directly from the following contributions [3][25][26][27][28] while avoiding overlaps and discussion of L2/L3 comparison material.

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Relay/Remote UE Authorization

Both Relay and Remote UE separately follow Rel-16 V2X design (TS 23.287), and no RAN2 impact is expected.

Relay (Re)Selection

Relay (Re)selection was studied for both L2 and L3 UE-to-UE Relay and the baseline solution is applied to both.

Discovery

Discovery was studied for both L2 and L3 UE-to-UE Relay and the baseline solution is applied to both.

Protocol stack design

The protocol stack and PC5 adaptation layer function (both first hop PC5 and second hop PC5) were studied for L2 UE-to-UE Relay.

QoS management

The design of QoS support for both L2 and L3 UE-to-UE relay are in the scope of SA2. No RAN2 impact of the solution captured in SA2 is identified thus far.

Security

In case of L2 UE-to-UE Relay, the security is established at PDCP layer in an end to end manner between source remote UE and destination remote UE. The end-to-end security can be supported.

CP procedures

The connection establishment procedure was studied for L2 UE-to-UE Relay. RAN2 consider the SA2 solution in TR 23.752 as baseline. Further RAN2 impacts can be discussed in WI phase, if any.

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**Q3.2 Do companies have any major concern with the above suggested text. If so, please provide the suggested changes in the comments section.**

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| --- | --- | --- |
| Company | Response (Y/N) | Comments |
| MediaTek | No | We agree with the current wording. If we wish to polish the wording, the order of the bullets can be adjust to follow the order of the objectives as listed in SID of SL relay.  |
| OPPO | See comment | For the QoS part, there is one NOTE in SA2 TR conclusion (and similarly in Solution#31) that „NOTE 2: It is left to RAN WG2 to support the QoS enforcement in AS layer.“, so it is suggested to add „Further RAN2 impacts can be discussed in WI phase, if any.“ into that for alignment.For the CP procedure part, although we see the point of „RAN2 consider the SA2 solution in TR 23.752 as baseline“ since that comes directly from the TR, but so far SA2 is still working on the solution (e.g., #9), and no conclusion yet. Considering SA2 meeting is after RAN2 meeting #113 as the last one for SI @ RAN, maybe one way to clarify is to say that „RAN2 consider the SA2 solution in TR 23.752 as baseline**, pending final SA2 conclusion**. Further RAN2 impacts..“ |
| Apple | No with commment | Regarding OPPO comments, for U2U relay solution 31, it is not clear to us what AS layer mechanisms need to be done for end-to-end QoS for Layer 2 U2U relay, because the L3 and L2 apporaches are quite similar in Solution 31. RAN2 can consider QoS enforcements in WI for L2 U2U if the QoS solution for U2U relay is not limited to Solution 31. But for Soluiton 31 itself, it is OK to say QoS support is in SA2 scope.  |
| Huawei, HiSilicon | No concern | We agree with the current wording. Regarding OPPO’s comment on QoS, we share the same view as Apple the SA2 solution #31 is taken as baseline for both L2 U2U and L3 U2U, and it seems no further enhancement is needed to enfore the QoS from RAN2‘s perspective so far. But considering the SA2/RAN2 discussion on U2U is not as thorough as U2N, we are open to discuss in WI if further requirement is identified.Regarding OPPO’s comment on CP procedure, we understand the solution of link establishment in high layer is in SA2’s scope but not RAN2, so it is of course up to SA2. From RAN2’s perspective, there is no issue identified to support either SA2 solution (e.g. solution #9). We do not see the need to mention this in TR, but maybe we can capture something in chairman notes if needed.  |
| Orange | No major concern | Any further requirements in regards to SA2 specs can be discussed in WI phase.  |
| LG | No | We have no concern. |
| Ericsson | Yes | Regarding discovery, for U2U relay, SA2 has concluded that Integrated PC5 unicast link establishment procedure (sol#8 in TR23.752) is also supported, which should be included.Regarding Qos, in sol#31 of TR 23.752, one EN is capturedHow to ensure the PC5 QoS over the two PC5 links by the Adaptation Layer, and the functionalities of the Adaptation Layer will be confirmed by RAN WG2.Suggest to add a sentence as the belowFurther **RAN2 impacts for QoS management are also captured in the clause 6.31 of SA2 TR.** |
| Qualcomm | Yes | We agree with OPPO’s suggestion. We think they are indeed misalignments with current SA2 TR. Thus, we think some clarifications are needed from RAN2 side. Please note that the intention is just to avoid misunderstanding in upcoming RAN Plenary discussion: SA2 somehow had some notes require RAN2 to resolve, although we think they should be resolved by SA2. RAN2 anyway should make further clarification on these SA2 notes.  |
| Samsung | Yes | Some sub-sections present a conclusion, while others (‚Protocol stack design‘) just state what’s been studied which makes it sound like an FYI.We additionally share OPPO and Qualcomm‘s concerns. |

## 2.3 RAN2 Recommendation

**Q3.3 Do companies agree that for L2 relay:**

* **RAN2 has determined L2 relay solution to be feasible**
* **L2 relay meets all of the objectives of the SID**
* **Mechanisms for layer-2 relay with minimum specification impact have been studied and identified by RAN2**
* **RAN2 recommends L2 UE to NW and UE to UE relay can proceed to normative work**

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| --- | --- | --- |
| Company | Response (Y/N) | Comments |
| MediaTek | Yes | We agree with the current wording. For the last bullet (bullet 4), one alternative is to capture the recommendation for normative work in a seperate subsection within conclusion section, which applies to both L2 and L3 solution. With this saying, the first three bullets can be kept within the conclusion for L2.  |
| OPPO |  | We are generally fine with the wording.But would also assume that bullet-4 may come with similar sugggestion on L3 relay as well.. |
| Apple | Yes | We agree with all 4 bullets listed above. |
| Huawei, HiSilicon | Yes | We agree with all 4 bullets listed above. |
| Orange | Yes | We agree with the current wording. |
| LG | No | We agree with the current wording. |
| Ericsson | No | 1. As highlighted by papers [8][14][28], intensive design complexity has been identified. Therefore, we don’t agree with the wording

**Mechanisms for layer-2 relay ~~with minimum specification impact~~ have been studied and identified by RAN2**“With minimum specification impact” shall be removed. |
| Qualcomm | No | For 3rd bullet, we don’t think the conclusion wth “minimum spec impact“ can be made for now. Maybe we can discuss it with L3 conclusion togother.For 4th bullet, given the current situation, we agree with MediaTek’s suggested alternative.  |
| Samsung | No | Regarding third bullet point, we do not think it captures the whole story and agree with Ericsson that „minimum specification impact“ should be removed. As a compromise, we could also consider the following change:* Mechanisms for layer-2 relay with minimum specification impact have been studied and identified by RAN2; **the full extent of the specification impact of identified mechanisms will only become clear in the normative phase**
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# 4 References

1. R2-2100111 Left issues on L2 Relay OPPO discussion Rel-17 FS\_NR\_SL\_relay
2. R2-2100124 Remaining issues on L2 U2N relay Qualcomm Incorporated discussion Rel-17
3. R2-2100169 Evaluation and Conclusion for L2 UE-to-Network Relay and L2 UE-to-UE Relay MediaTek Inc., Apple, Interdigital, Futurewei, Huawei, Hisilicon, Convida discussion Rel-17 FS\_NR\_SL\_relay
4. R2-2100202 Feasibility for Layer2 Relay CATT discussion Rel-17 FS\_NR\_SL\_relay
5. R2-2100300 Discussion on remaining issues on L2 UE-to-Network Relay ZTE Corporation discussion
6. R2-2100520 Remaining Control Plane Aspects for L2 Relays InterDigital discussion Rel-17 FS\_NR\_SL\_relay
7. R2-2100521 Discussion on L2 Relay Architecture and QoS InterDigital discussion Rel-17 FS\_NR\_SL\_relay
8. R2-2100535 Further discussions on L2 SL relay Ericsson discussion Rel-17 FS\_NR\_SL\_relay [R2-2009230](file:///C%3A%5CUsers%5Cfredamx%5CDesktop%5CLTE%5CRAN2%5C113%5CDocs%5CR2-2009230.zip)
9. R2-2100656 Remaining issues for L2 relay Spreadtrum Communications discussion Rel-17 FS\_NR\_SL\_relay[11]
10. R2-2100867 Discussion on Layer 2 Solutions for UE-to-NW relay and UE-to-UE relay Apple discussion Rel-17 FS\_NR\_SL\_relay
11. R2-2100910 Remaining issues on L2 relay Sony discussion Rel-17 FS\_NR\_SL\_relay
12. R2-2101107 Consideration on U2N relay and U2U relay Lenovo, Motorola Mobility discussion Rel-17
13. R2-2101179 Remaining issues on L2 U2N Relay vivo discussion Rel-17
14. R2-2101206 L3 vs L2 relaying Samsung, Ericsson, Nokia, Nokia Shanghai Bell discussion
15. R2-2101300 Inter-gNB Path Switching for L2 U2N Relay Intel Corporation discussion Rel-17 FS\_NR\_SL\_relay
16. R2-2101601 Open issues on L2 relay Xiaomi communications discussion
17. R2-2101623 Remaining issue on RRC state for L2 relay CMCC discussion Rel-17 FS\_NR\_SL\_relay
18. R2-2101754 Discussion on CP protocol stack for L2 U2U relay ASUSTeK discussion Rel-17 FS\_NR\_SL\_relay
19. R2-2101768 RRC status transition reporting procedure LG Electronics Inc discussion Rel-17 FS\_NR\_SL\_relay
20. R2-2101778 Further consideration of relay selection and reselection criteria LG Electronics Inc. discussion Rel-17 FS\_NR\_SL\_relay
21. R2-2101782 Clean-up of L2 sidelink relay Huawei, HiSilicon discussion Rel-17 FS\_NR\_SL\_relay
22. R2-2101785 Relay UE selection and reselection prioritization LG Electronics Inc. discussion Rel-17 FS\_NR\_SL\_relay
23. R2-2101788 Relay reselection using discovery message and sidelink unicast link LG Electronics Inc. discussion Rel-17 FS\_NR\_SL\_relay
24. R2-2101890 discussion on RRC procedures of L2 U2N relay ETRI discussion Rel-17 FS\_NR\_SL\_relay
25. R2-2100309 Comparison of L2 and L3 Relays ZTE Corporation
26. R2-2100616 Conclusion on the feasibility of L2 and L3 based Sidelink Relaying Intel
27. R2-2100123 Finalize the comparison and conclusion section of TR 38.836 Qualcomm
28. R2-2100980 Comparative Analysis of L2 and L3 SL Relay Architecture Ericsson, Samsung, Nokia, Nokia Shanghai Bell
29. R2-2102091 Summary Document for AI 8.7.2.1 InterDigital