**Nokia3GPP TSG RAN WG2 Meeting #116-e R2-2111429
Electronic Meeting, 1st - 12th Nov 2021**

**Agenda item: 6.2.3**

**Source: CATT**

**Title: Summary [AT116-e][709][V2X/SL] PDCP/RLC Entity Maintenance for SL-SRBs (CATT)**

**Document for: Discussion and Decision**

# Introduction

This is the email discussion for below offline discussion:

* [AT116-e][709][V2X/SL] PDCP/RLC Entity Maintenance for SL-SRBs (CATT)

 **Scope:** Discuss the issue raised in R2-2110610 and also discuss the possible solutions if the problem is agreed.

 **Intended outcome:** Discussion summary in R2-2111429

**Deadline:** 11/9, 10:00am UTC

The above email discussion is divided in two phases:

* **Phase I:** Companies are invited to provide feedback on the questions of this email discussion by 11/5, 10:00am UTC. The intention for this phase is to confirm the issue and collect possible solution.
* **Phase II:** Rapporteur submits a phased summary and possible solution based on phase I’s feedback, further discussion is planned to carry out during this phase by 11/9, 10:00am UTC.

|  |  |  |
| --- | --- | --- |
| Company | Name | E-mail |
| MediaTek Inc. | Ming-Yuan Cheng | ming-yuan.cheng@mediatek.com |
| OPPO | Qianxi Lu | Qianxi.lu@oppo.com |
| Ericsson | Antonino Orsino | antonino.orsino@ericsson.com |
| Qualcomm | Dan Vassilovski | dvassilo@qti.qualcomm.com |
| Apple | Zhibin Wu | Zhibin\_wu@apple.com |
| CATT | Hao Xu | xuhao@catt.cn |
| vivo | Jing Liang | liangjing@vivo.com |
| Nokia | Jakob Buthler | Jakob.buthler@nokia.com |
| Lenovo | Jing HAN | Hanjing8@lenovo.com |

# Discussion

## Issue description

According to the TS 33.536, for sidelink unicast, the high-level flow of connection establishment is as below:



Figure-1 High-level flow of connection establishment

The cast type of each PC5-S message in the above Figure-1 is summarized in the following Table-1 based on the description of TS 23.287 or TS 24.587.

**Table-1 Cast type of each PC5-S signalling during PC5-S connection establishment procedure**

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| --- | --- | --- |
| PC5-S signaling | Cast type  | Reference |
| DIRECT LINK ESTABLISHMENT REQUEST | Unicast or broadcast | **TS23.287**UE-1 sends the Direct Communication Request message via PC5 broadcast or unicast using the source Layer-2 ID and the destination Layer-2 ID. |
| DIRECT LINK AUTHENTICATION REQUEST | Unicast | **TS24.587**After the DIRECT LINK AUTHENTICATION REQUEST message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication. |
| DIRECT LINK AUTHENTICATION RESPONSE | Unicast | **TS24.587**After the DIRECT LINK AUTHENTICATION RESPONSE message is generated, the target UE shall pass this message to the lower layers for transmission along with the target UE's layer-2 ID for unicast communication and the initiating UE's layer-2 ID for unicast communication. |
| DIRECT LINK SECURITY MODE COMMAND | Unicast | **TS24.587**After the DIRECT LINK SECURITY MODE COMMAND message is generated, the initiating UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication, …… |
| DIRECT LINK SECURITY MODE COMPLETE | Unicast | **TS24.587**After the DIRECT LINK SECURITY MODE COMPLETE message is generated, the target UE shall pass this message to the lower layers for transmission along with the target UE's layer-2 ID for unicast communication and the initiating UE's layer-2 ID for unicast communication, NRPIK, NRPEK if applicable, KNRP-sess ID,…… |
| DIRECT LINK ESTABLISHMENT ACCEPT  | Unicast | **TS24.587**After the DIRECT LINK ESTABLISHMENT ACCEPT message is generated, the target UE shall pass this message to the lower layers for transmission along with the initiating UE's layer-2 ID for unicast communication and the target UE's layer-2 ID for unicast communication, …... |

Based on the above table, it is observed:

* Based on the description in TS23.287 and TS24.587, for DIRECT LINK ESTABLISHMENT REQUEST (SL-SRB0), it can be transmitted by broadcast or unicast.
* Based on the description in TS23.287 and TS24.587, for the other PC5-S signaling (SL-SRB1, SL-SRB2) during PC5-S connection establishment procedure, only unicast is used.

**Question-1: Do companies agree that the upper layer will indicate the cast type of first feedback PC5-S signaling (e.g., DIRECT LINK AUTHENTICATION REQUEST if any or DIRECT LINK SECURITY MODE COMMAND) as unicast. If company choose no, please clarify on what basis can we determine the casttype of the above two messages.**

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| **Companies** | **Yes/No** | **Comments** |
| MediaTek | Yes |  |
| OPPO |  | Not sure the intention of this Q, I thought * At Tx side, yes it is upper layer to indicate it to lower layer
* At Rx side, it is lower layer who based on the cast type indicator in PSCCH to derive the associated cast type

Sorry if any misunderstanding[Rapp] Sorry for confusing. Our intention for this part is to confirm that for the first PC5-S feedback message, whether its cast type can be indicated as sidelink unicast by upper layer based on the SA2/CT1 spec. |
| Ericsson |  | Agree with OPPO |
| Qualcomm | Yes |  |
| Huawei, HiSilicon | Yes |  |
| Apple | Yes |  |
| CATT | Yes | Proponent |
| vivo | Yes |  |
| Nokia | Yes |  |
| Lenovo | Yes |  |
| Samsung | Yes |  |

**Rapporteur summary**:

Regarding Q1, 11 companies replied:

* Yes: 9
* Not sure the intention of this Q: 2

The majority companies (7/9) agreed that the first PC5-S feedback message (e.g., DIRECT LINK AUTHENTICATION REQUEST if any or DIRECT LINK SECURITY MODE COMMAND) would be indicated as unicast.

As to the establishment of PDCP/RLC entity. The detailed description is as below. Regarding to the PDCP/RLC entities maintenance, the corresponding description is in TS38.331, TS 38.323 and TS38.322 are as below:

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| --- |
| TS38.3315.8.9.1a.4 Sidelink SRB additionThe UE shall:1> if transmission of PC5-S message for a specific destination is requested by upper layers for sidelink SRB:2> establish PDCP entity, RLC entity and the logical channel of a sidelink SRB for PC5-S message, as specified in sub-clause 9.1.1.4;1> if a PC5-RRC connection establishment for a specific destination is indicated by upper layers:2> establish PDCP entity, RLC entity and the logical channel of a sidelink SRB for PC5-RRC message of the specific destination, as specified in sub-clause 9.1.1.4;2> consider the PC5-RRC connection is established for the destination. |

|  |
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| TS38.3235.1.1 PDCP entity establishmentWhen upper layers request a PDCP entity establishment for a radio bearer for Uu or PC5 interface; or for NR sidelink communication for groupcast and broadcast, when receiving the first PDCP PDU, and there is not yet a corresponding PDCP entity, the UE shall:- establish a PDCP entity for the radio bearer;- set the state variables of the PDCP entity to initial values;- follow the procedures in clause 5.2. |

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| TS38.3225.1.1 RLC entity establishmentWhen upper layers request an RLC entity establishment, the UE shall:- establish a RLC entity;- set the state variables of the RLC entity to initial values;- follow the procedures in clause 5.2.For NR sidelink groupcast and broadcast, when receiving the first UMD PDU from a Source Layer 2 ID and Destination Layer 2 ID pair for an LCID, and there is not yet a corresponding receiving RLC entity for a radio bearer, the UE shall:- establish a receiving RLC entity;- set the state variables of the RLC entity to initial values;- follow the procedures in clause 5.2. |

Based on the description in TS 38.331, TS 38.323 and TS 38.322, the transmitting and receiving PDCP/RLC establishment rule is as below:

* For groupcast and broadcast, the PDCP and RLC entity may be established with the below conditions:
* Tx side: requested by upper layer;
* Rx side: receiving a new PDU which is not yet corresponding to the existing RLC/PDCP entity.
* For unicast there is only one condition to establish the transmitting/receiving RLC/PDCP entity:
* Both Tx and Rx side: Requested by upper layer.

Since the upper layer of Rx UE doesn’t know that unicast messages from special Layer-2 ID are coming before the first PC5-S messages are transmitted. So, high layer cannot request to establish the associate Rx unicast entity to handle the receiving PDU before it coming.

Hence, it is obvious that for the first feedbackPC5-S message using unicast during PC5-S connection setup procedure, the receiving PDCP/RLC entities establishment procedures have not been captured in spec.

**Question-2: For the first feedback PC5-S message using unicast (e.g., DIRECT LINK AUTHENTICATION REQUEST if any or DIRECT LINK SECURITY MODE COMMAND) during PC5-S connection setup procedure, do companies agree that Rx UE cannot establishment the receiving PDCP/RLC entity for the corresponding to it?**

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| --- | --- | --- |
| **Companies** | **Yes/No** | **Comments** |
| MediaTek Inc. | Yes |  |
| OPPO | Yes the current spec needs some clarification | As proponent |
| Ericsson | No | We think that this issue is rather minor. Logically speaking, then the UE gets the first message via broadcast or unicast, it is implicit that the PDCP and RLC entities should be created (if not present), otherwise how the UE can communicate with its peer UE.Also, once that the first message is received, the upper layer of the RX side can trigger the creation of the PDCP and RLC entities, if these are not present.Not sure what is broken here.[Rapp]For the first PC5-S message using sidelink unicast, the Rx UE does not know the SRC ID used by the Tx UE.According to the section 5.22.2.2.2 of TS38.321:1> if the data for this TB was successfully decoded before:2> if this is the first successful decoding of the data for this TB:3> if this TB is associated to unicast, the DST field of the decoded MAC PDU subheader is equal to the 8 MSB of any of the Source Layer-2 ID(s) of the UE for which the 16 LSB are equal to the Destination ID in the corresponding SCI, and the SRC field of the decoded MAC PDU subheader is equal to the 16 MSB of any of the Destination Layer-2 ID(s) of the UE for which the 8 LSB are equal to the Source ID in the corresponding SCI; or3> if this TB is associated to groupcast or broadcast and the DST field of the decoded MAC PDU subheader is equal to the 8 MSB of any of the Destination Layer-2 ID(s) of the UE for which the 16 LSB are equal to the Destination ID in the corresponding SCI:4> deliver the decoded MAC PDU to the disassembly and demultiplexing entity;2> consider the Sidelink process as unoccupied. The Rx UE cannot pass the deliver the decoded MAC PDU to the disassembly and demultiplexing entity. Hence, it will not establish the corresponding PDCP/RLC entity. |
| Qualcomm | No | The Direct Communication Request (Direct Link Establishment Request) is sent over a specifically designated SRB (SRB-0). As such, UE behavior is based on receipt of the Direct Communication Request (DCR) over this SRB and is the same regardless of whether the Tx UE sent the DCR via broadcast or unicast. If no RLC/PDCP entities are established, the UE can proceed to establish them.[Rapp] Please see rapporteur’s reply above. |
| Huawei, HiSilicon | Yes | Also we think the change needed would be minor. |
| Apple | Yes | The current specification does not consider those cases. My understanding is that in SCI cast type of the MAC PDU containing the DCR will indicate it as “unicast”, So, the RX UE will not establishe RLC/PDCP entity. |
| CATT | Yes | Proponent |
| vivo | Yes | We agree this case may happen, and the concrete specification impact can be further discussed. We also don’t consider it would take much work to solve the case.  |
| Nokia | No | Agree with Qualcomm |
| Lenovo | No | Our understanding is that for PC5-S message, upper layer can always request to establish SL-SRB, e.g. transmit/receive DCR is known by upper layer, and then upper layer expects to transmit/receive following PC5-S message and indicate AS layer to add SL-SRBs e.g. SL-SRB1. If this is not possible, then followed PC5-S message are all have similar problem e.g. before SL-SRB2 added, if receive PC5-S message after PC5-S message on SL-SRB1 e.g. DCA, similar case happens  |
| Samsung | Not sure | We would like to understand the problem clearly. Assuming UE#1 sends Direct Communication REQ to UE#2 as the start, what is the case for problem? Q1: Is when Direct Communication REQ is sent via unicast or broadcast? Q2: The problematic Rx UE means UE#1 or UE#2?, Q3: why upper layer cannot configure it for the concerned case?  |

**Rapporteur summary**:

Regarding Q2, 11 companies replied.

* Yes: 6
* No: 4, their views is once that the first message is received, the upper layer of the RX side can trigger the creation of the PDCP and RLC entities, if these are not present.
* Not sure: 1

Since the time is limited and there is no majority view on this issue, it is proposed to further discuss this issue.

**Proposal 1: Suggest RAN2 to further discuss whether MAC layer can handle the first unicast PC5-S message correctly and whether the receiving PDCP/RLC entity can be established for SL-SRB0/1 using unicast.**

**Question-3: If companies confirm the problem and have a clear idea for a solution, please describe here. Please noted, this part is not mandatory.**

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| **Companies** | **Solutions** |
| OPPO | Solve this issue in RAN2, we are open to use CR (normative text, note) or meeting agreement. |
| Apple | I think this issue can be simply solved by mandating DCR message to be transmitted as SL broadcast (as shown in SCI) even if it use a Unicast L2 Destination ID. If companies not sure if this can be done, we can send a LS to SA2 to check if the upper layer can indicate “broadcast” cast type to DCR message. |
| CATT | In our understanding, there are three possible options:* Option 1: Solve this issue in upper layer.
* Option 2: Solve this issue in AS layer.
* Option 3: Leave it to UE implementation.
 |
| Lenovo | If need solution, we think upper layer solution is the simplest |

**Rapporteur summary**:

Regarding Q3, considering there is no consensus for Q2. Hence, no proposal is needed for this part.

# Conclusion

In conclusion, Rapporteur proposes the following recommendations as the outcome of this email discussion

**Proposal 1: Suggest RAN2 to further discuss whether MAC layer can handle the first unicast PC5-S message correctly and whether the receiving PDCP/RLC entity can be established for SL-SRB0/1 using unicast.**

# References

1. R2-2110610 PDCP/RLC Entity Maintenance for SL-SRBs CATT, APPLE, vivo, Huawei, HiSilicon, OPPO