3GPP TSG-RAN WG2 Meeting #109-e R2-200xxxx

Elbonia, Online, 24 February – 6 March 2020

**Agenda item: 7.3.2.3**

**Source: LG Electronics Inc. (summary rapporteur)**

**Title: Closing UP issues (PDCP/RLC/MAC) and discussing remaining open items for DAPS**

**WID/SID: NR\_Mob\_enh-Core/** **LTE\_feMob-Core - Release 16**

**Document for: Discussion and Decision**

# 1 Brief scope

The scope of this document is as follows.

* Agreeing on the proposals as per R2-2001532 and R2-2002099.
* Discuss open items as per R2-2001532 and R2-2002099 to seek companies feedback on open issues of UP for DAPS.

# 2 Summary

## 2.1 Is PDCP status report for UM DRB needed?

As stated in [1], it was indicated whether the PDCP status report for UM DRB should be introduced to minimize the number of the duplicated PDCP PDU. For this issue, we would like to ask the RAN2 companies to answer the following question:

Q1. Do you think the PDCP status report for UM DRBs is needed for DAPS HO?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| LG | Yes | Considering that the purpose of the PDCP status report is to minimize the number of duplicated PDCP PDUs, PDCP status report UM DRBs should be considered for DAPS HO. |
| Samsung | Yes | For UM DRBs, the PDCP status report can avoid unnecessary retransmission from the target. |
| MediaTek | No | In UM case, only PDCP PDUs not sent by source gNB are forwarded to target gNB. PDCP status report simply causes delay in sending/receiving new data, and this has negative effect for real-time application, which is the main use case of UM. |
| OPPO | No | UM DRBs are usually configured for real-time services and do not work with feedback/acknowledgement and we think PDCP status report will cause additional delay for target node to send packets, |
| Ericsson | Yes | Agree with comments from LG and Samsung. |
| Intel | No | Agree with comments from MediaTek and OPPO. |
| Nokia | Yes | It can help to reduce unnecessary transmissions from target cell. However, one thing to confirm is: we consider only UE to NW status reporting (and not the other way round)? Just checking as based on the description and some of the answers this may not be so clear. We should not specify anything for network side here as we have not done that in other cases. |
| Apple | No | Agree with comments from MediaTek and OPPO. |
| NEC | Yes | The PDCP status report can be used to avoid duplicated transmission. |
| ZTE | Yes | Yes, but no strong view. The PDCP status report for downlink transmission (status report from UE to NW) is beneficial to avoid unnecessary transmission of duplicated PDCP PDUs. However, since the NW may initiate the transmission for UM DRB without waiting for the PDCP status report, and there is no RLC retransmission in source link for the UM DRB, the status report for UM DRB seems not so necessary as PDCP status report for AM DRB. |
| Huawei, HiSilicon | No | Agree with comments from MediaTek and OPPO. |
| Sharp | No | Agree with MediaTek and OPPO.  However, as long as supporting PDCP status reporting for UM DRB is optional, i.e., PDCP status reporting is configurable by the network, we don’t have strong objection for “supporting” PDCP status reporting for UM DRB. |

The text proposal will be provided based on the submitted CR/contribution if needed.

Conclusion: To be updated

Text proposal: To be updated

## 2.2 Is the PDCP status report triggered when releasing the source link?

As stated in [1], it was addressed whether the PDCP status report is triggered when releasing the source link (let’s call it the second PDCP status report). For this issue, we would like to ask the RAN2 companies to answer the following question:

Q2. Do you think the second PDCP status report is needed?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| LG | No | Since the time between the first PDCP status report (i.e. at the UL data switching) and the second PDCP status report (i.e. at the source cell release) may be very short, there will only be a few DL packets sent from the source cell to the UE and therefore there is no strong need for the second PDCP status report. |
| Samsung | Yes | No strong opinion. However, the time scale depends on network implementation. From UE side, the PDCP status report would be a small byte of payload and thus the second PDCP status report could be beneficial without a big overhead. |
| MediaTek | Yes | A final status report needs to be sent to the target node. It is used to trigger retransmission of the DL PDCP SDUs which are not successfully delivered by the source Node. |
| OPPO | No | We also think the time interval between UL switching and source release is short and not many DL packets are received in the source. We don’t think optimization through second PDCP status report is needed. |
| Ericsson | No | Agree with comments from LG and Oppo. |
| Intel | Yes | Same view as Samsung and Mediatek. |
| Nokia | No | In our opinion PDCP status report sent at source link release makes more sense than the status report at UL switching. However, if the latter is already agreed then we are OK not to have the second reporting in addition. |
| Apple | No | Since the period between the UL switching and source link release is short, and the target node is possible to receive the final SN status transfer from the source Node upon the source link release to understand the next missing DL/UL PDCP SDU, UE does not need to trigger PDCP status report. |
| NEC | Yes | As there are still data transmitted by the source node, a final PDCP status report should be supported. |
| ZTE | No | Since no new PDCP PDU can be generated in source side after the transmission of “SNStatusTransfer” over X2/Xn, the PDCP PDU transmitted in the source link after the first PDCP status report will be quite limited. Also considering the NW will not wait for the second PDCP status PDU before the transmission of PDCP PDU on the target link, it is very much likely the concerned duplicated PDCP PDU will be transmitted before the reception of the second PDCP status report, thus it seems not so useful. |
| Huawei, HiSilicon | Yes | Same view as Samsung and Mediatek. |
| Sharp | Yes | Agree with Samsung and MediaTek |

Conclusion: To be updated

If the answer for Q2 is yes, we would like to ask company view on that the second PDCP status report is applied to only AM DRBs or AM and UM DRBs.

Q3. Do you think the second PDCP status report is triggered only for AM DRB or AM and UM DRBs?

|  |  |  |
| --- | --- | --- |
| Company | AM DRBs/ AM and UM DRBs | Comments |
| LG |  | The second PDCP status report should not be introduced. |
| Samsung | Both | If the second PDCP status report is agreed, then there seems no need to have different behaviour for UM DRBs and AM DRBs. |
| MediaTek | AM DRB only | For UM DRBs, it may be too late to retransmit them. |
| Intel | AM DRB only. | Retransmission is not supported for UM DRB. |
| NEC | Both | The purpose of the two PDCP status report are the same, if the first PDCP status report are supported for both RLC AM and RLC UM, then the second should also be supported for both cases. |
| ZTE | AM DRB only | If the second PDCP status report is adopted, based on the comments to Q2, we think it is sufficient to support the second PDCP status report for AM DRB only. |
| Huawei, HiSilicon | AM DRB only. | Same comments as for Q1. |
| Sharp | AM DRB only | Same comments as for Q1. |

The text proposal will be provided based on the submitted CR/contribution if needed.

Conclusion: To be updated

Text proposal: To be updated

## 2.3 How to handle the stored PDCP PDUs received from the source cell when releasing the source cell

As stated in [1], it is addressed how to handle the stored PDCP PDUs received from the source cell when releasing the source cell. However, in the 108#66 email discussion, many companies thought that this issue can be resolved by UE implementation. For this issue, we would like to ask the RAN2 companies to answer the following question:

Q4: Do you think the stored PDCP PDUs received from the source cell can be handled by the UE implementation?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| LG | No | According to the current specification, the PDCP entity decompresses the stored PDCP PDU at PDCP re-establishment. In other words, how to handle the stored PDCP PDU is already defined in the specification. Considering this, we think that how to handle the stored PDCP PDUs received from the source cell when releasing the source cell should be specified in the spec. |
| Samsung | No | In Rel-15, we already have similar behaviour for AM DRBs at PDCP re-establishment due to RLC out-of-order delivery as follows:  - for AM DRBs, perform header decompression for all stored PDCP SDUs if *drb-ContinueROHC* is not configured in TS 38.331 [3];  We have some concern about whether UE implementation can catch this issue easily. At least, NOTE would be needed if the majority don’t want to have this in normative text. |
| MediaTek | Yes | The PDCP PDUs should be decompressed using source RoHC and security functions, instead of being discarded. This can be handled by UE implementation, e.g., UE keeps the RoHC profile for a while until all PDUs received from the source cell are decompressed, before releasing the RoHC and security functions associated with source gNB.  However, If companies think this is unclear, we are fine to have a NOTE. |
| OPPO | Yes | As a compromise, we are also ok to have a NOTE saying that UE should decompress those stored PDCP PDUs before releasing source cell. |
| Ericsson | No | Agree with comments from LG and Samsung. We don’t see why we should leave the decompression of stored PDCP SDUs at source cell release to UE implementation when we define it for e.g. PDPC re-establishment. We also recall that there were some text proposals submitted to this meeting showing how this can be specified, |
| Intel | Yes | Ok to clarify in the Note. |
| Nokia | No | Agree with LG and Samsung. That shall be a specified behaviour, especially when it has been already described for other cases. |
| Apple | No | We are fine to make the UE behaviour clear in the spec. |
| NEC | Yes | Same view as MediaTek |
| ZTE | Yes | We think it can be left to UE implementation. |
| Huawei, HiSilicon | Yes | It doesn’t impact NW side, so it can be implemented by UE itself. |
| Sharp | Yes |  |

The text proposal will be provided based on the submitted CR/contribution if needed.

Conclusion: To be updated

Text proposal: To be updated

## 2.4 Should the consecutive ROHC decompression failure be resolved?

As stated in [1], it is addressed how to prevent the consecutive ROHC decompression failure. However, in the 108#66 email discussion, companies thought that this issue can be resolved by UE/NW implementation. For this issue, we would like to ask the RAN2 companies to answer the following question:

Q5. Which option do you prefer to solve this issue?

* Option 1. The target cell always transmits the PDCP PDUs containing IR packet until releasing the source cell.
* Option 2. The PDCP entity in UE decompresses the PDCP PDUs received from the target cell even if the PDCP PDUs are discarded due to duplication detection and out-of-window.
* Option 3. It is leave up to UE implementation.

|  |  |  |
| --- | --- | --- |
| Company | Option | Comments |
| LG | Option 2 | In LTE, in order to prevent the consecutive ROHC decompression, the PDCP entity for none split bearer decompresses a PDCP PDU even if the PDCP PDU will be discarded due to out-of-window and duplication reception. We think that the same principle can be applied to the NR and LTE. |
| Samsung | Option 2. | Both Option 1 and Option 2 will work to resolve this issue. If the majority want to specify anything in PDCP specification, then Option 2 would be better. |
| MediaTek | Option 3 | The DL duplication is performed by network implementation. From UE aspect, UE doesn’t know whether DL duplication is enabled or not beforehand. Therefore, UE can only perform duplication discarding as usual. If DL duplication is enabled by network implementation, the target node can generate/transmit IR packets the PDCP status report is received from the UE. This can be realized by network implementation and nothing needs to be specified in for the air interface.  Note: We would support Option 1 if this cannot be left for NW/UE implementation. |
| OPPO | Option 3 | We think both option 1 and 2 can work and we prefer not to mandate NW and UE behaviour and prefer to leave it to UE implementation. |
| Ericsson | Option 1 | We prefer to address this issue by network implementation. Note that the same problem exist also for the source link. If the source ROHC compressor sends important context updates and the UE ROHC decompressor misses these, the decompression may fail.  Don’t really see how Option 2 will work since the discarded packets must be decompressed in order. For example, say that packet N+1 is received from target before packet N is received from target. If packet N+1 has already been received from the source, packet N+1 received from target will be discarded, and according to option 2 it will be sent for decompression. But since packet N has not yet been received from the target the decompression of packet N+1 may fail since it is decompressed out of order. To properly address this issue we may need two PDCP reordering functions, one for decompression and one for re-ordering, as discussed in Q6. |
| Intel | Option 1/3 | Option 1 is network implementation, option 3 is UE implementation. So option 1 and 3 are aligned with proposal in 108#66  Proposal 15. Leave it to UE/network implementation (without specification impact) on the issue caused by duplicate discarding if duplication is enabled. |
| Nokia | Option 1 or Option 3 | We believe it can be handled by the IR packets sent from source and target during DAPS HO. But leaving that to the UE without specified actions is also acceptable. |
| Apple | Option 1 | It can be up to NW implementation. |
| NEC | Option 1 or 3 | Agree with MediaTek. |
| ZTE | Option 2 or 3 | Considering option 1 will increase the packet size and may lead to negative impact on the performance, especially in HO case which usually happen on the edge of cell, we think option 1 should be excluded. For option 2 and option 3, which are both acceptable to us, considering the limited time budget, we have slight preference on the option 3 and leave this to UE implementation. |
| Huawei, HiSilicon | Option 1 | We hope to specify a deterministic behaviour to avoid ROHC failure in downlink transmission. And option 1 is an easy way without changing UE behaviour and with only minor impact on NW. |
| Sharp | Option 1 and/or 3 | Agree with MediaTek and Intel |

If either option 1 or option 2 is agreed, the text proposal will be provided based on the submitted CR/contribution.

Conclusion: To be updated.

Text proposal: To be updated.

## 2.5 Are two PDCP reordering functions needed?

As stated in [1], it was addressed whether the two reordering functions should be specified or not, i.e., one is for decompression and another is for in-order delivery. For this issue, we would like to ask the RAN2 companies to answer the following question:

Q6: Do you think two PDCP reordering functions are needed, i.e., one is for decompression and another is for in-order delivery?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| LG | No | In the current specification, when the PDCP entity receives the PDCP PDUs from the lower layers, the PDCP entity performs the security, i.e., deciphering and integrity verification to the received PDCP PDUs. After that, the PDCP entity decompresses the received PDCP PDUs when the received PDCP PDUs are delivered to the upper layer. Considering this, even if the one ordering function is used, i.e., current specification for LTE and NR, there is no problem to support in-order delivery and decompression. Thus, we do not think two reordering functions are needed. |
| Samsung | No | Our understanding is that having two PDCP reordering is just for clarification. We think that there would be no ambiguity only with one PDCP reordering. |
| MediaTek | Yes? | We need to clearly describe the re-ordering behaviour in the spec, either modelled as a single re-ordering function or two re-ordering functions. |
| OPPO | Yes | We think two PDCP re-ordering functions would be clearer. |
| Ericsson | No | See our response to Q5. If other companies don’t agree that the decompression issue can be handled by sending IR packets (i.e. option 1 in Q5) then two PDCP re-ordering functions may be needed. |
| Intel | Yes? | The proposal in 108#66 is  there are two purposes for reordering, one for decompression, another for in order delivery. .  We agree, we do not need to have two reordering functions, but we should make it clear in spec, before decompression/in order delivery, reordering should be performed. |
| Nokia | No | One PDCP reordering should serve both purposes. |
| Apple | No | Agree with Samsung. There is no ambiguity with one PDCP ordering functionality. |
| NEC | No | If there are two reordering functions, the reordering window of the first re-ordering function can only be pushed forward by timer due to SN gap, which introduced additional latency. Single re-ordering function is enough support in-order delivery. |
| ZTE | No | Share the same view with LG and Samsung that one reordering function is sufficient. |
| Huawei, HiSilicon | No | Current spec is already clear enough. |

The text proposal will be provided based on the submitted CR/contribution if needed.

Conclusion: To be updated.

Text proposal: To be updated.

## 2.6 How to support the UDC for DAPS HO (only for LTE)?

As stated in [1], it was addressed whether and what will specify UDC for DAPS HO. However, RAN2 did not spend much time to discuss how to specify the UDC for DAPS HO. For this issue, we would like to ask the RAN2 companies to answer the following question:

Q7: What should be considered to support the UDC for DAPS?

|  |  |
| --- | --- |
| Company | Comments |
| LG | In our view, RAN2 should discuss many things to support the UDC for DAPS HO, e.g., are two UDC function needed, when the UDC function should be reset and so on. However, we think that RAN2 may not have enough time to discuss them. Thus, even if there is an agreement “support UDC”, we suggest that the UDC should not be considered for DAPS HO in Rel-16. |
| Samsung | In LTE, the features of UDC have been well-specified, e.g. it can be configured only for AM DRB, cannot be configured with ROHC and so on. Hence, for now, we don’t see a critical problem to apply UDC during DAPS handover. However, to consolidate the UP handling of DAPS handover, it would be better to avoid possible issues from UDC considering the meeting time. |
| MediaTek | UDC may be applied in DAPS. However, considering limited meeting time, we prefer to avoid UDC topics this time. |
| OPPO | We suggest not to support UDC for DAPS due to lack of time. |
| Ericsson | Is the question for LTE only or also for NR?  For LTE the changes required to support UDC seems quite small so we are fine with adding it. |
| Intel | The question is only for LTE since UDC is not supported in NR. We are afraid that we do not have time on this. |
| Nokia | We believe UDC is not necessary for DAPS. Thus, we suggest not to address it in Rel-16. |
| Apple | We suggest not to support UDC for DAPS due to lack of time. |
| NEC | Due to time limit, we prefer to not considering UDC in Rel-16. |
| ZTE | Considering the limited time budget, we think the support of UDC in DAPS can be postponed to later release. |
| Huawei, HiSilicon | Considering it is not an essential function and limited time, we suggest not to consider UDC for DAPS. |

The text proposal will be provided based on the submitted CR/contribution if needed.

Conclusion: To be updated.

Text proposal: To be updated.

## 2.7 How to prevent the transmission of the packet generated by the non-DAPS DRBs?

As stated in [3], it was addressed that the LCHs corresponding to non-DAPS DRBs should not be considered for LCP procedure of the source MAC entity during DAPS handover, not to allow the uplink resource to LCHs corresponding to non-DAPS DRBs, which should not perform data transmission. Thus, it is proposed that during DAPS handover, the source MAC entity selects only the logical channels corresponding to DAPS DRBs when the LCP procedure is applied.

For this issue, the summary rapporteur supposes that current running RRC CR [4] implies that the previous *LogicalChannelConfig* of non-DAPS DRBs from the source MAC entity has been already replaced. With this understanding, the summary rapporteur suggests that RAN2 confirm the understanding that whether the *LogicalChannelConfig* of non-DAPS DRBs from the source MAC entity should be released during DAPS HO. For this issue, we would like to ask the RAN2 companies to answer the following question:

Q8. Do you think the *LogicalChannelConfig* of non-DAPS DRBs from the source MAC entity should be released during DAPS HO?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| LG | No | If the UE performs the DAPS HO, the RLC entity associated with non-DAPS HO performs the re-establishment procedure. In other words, there is no stored RLC PDUs in the transmission buffer. Thus, even if the previous LCH config is applied, the RLC PDUs associated with non-DAPS HO are not transmitted to the source cell. Thus, we do not need to specify anything to prevent the transmission of the packet generated by non-DAPS DRBs. |
| Samsung | No (Yes if possible) | Regardless of RLC re-establishment and stored data, in principle, the source MAC entity performs LCP procedure for the LCHs of non-DAPS DRBs during DAPS handover, which would not be the intention. That’s the problem. The source MAC entity doesn’t have to apply LCP procedure to the LCHs of non-DAPS DRBs. |
| MediaTek | No | Agree with LG. |
| OPPO | No | We share the same view as LG. RLC entity has been re-established during HO and therefore the RLC PDUs generated by this RLC entity would be transmitted only to the target cell. |
| Ericsson | No (?) | Agree with the Samsung’s comment that it’s not the intention to consider the LCH of non-DAPS DRBs in the LCP procedure. But if we understand LG’s comment correctly, the non-DAPS LCGs will anyway not affect the outcome of the LCP (since the RLC transmission buffer is empty). If this is true then we are fine with not releasing the non-DAPS LCHs from the source MAC entity. |
| Intel | No | Agree with LG. RLC and PDCP for non-DAPS DRB have been reestablished, and no data can be delivered to MAC even if LogicalChannelConfig is still there for source. |
| Nokia | No | We agree LCHs for non-DAPS shall not be served during DAPS by not considering those in LCP. We share what LG pointed out – due to no RLC PDUs for non-DAPS bearers, there should be no issue at MAC level. |
| Apple | No | Agree with LG. There will be no data from non-DAPS LCHs for data transmission/reception during the DAPS HO, so it’s unnecessary to release it. |
| NEC | No | We understand there are three options. The first is to release the *LogicalChannelConfig*, the second is to keep the *LogicalChannelConfig* but do not perform LCP for LCH of non-DAPS DRB, the third is to do nothing. As LG commented, even we do nothing, there is no impact to the outcome of the LCP. We are ok to keep the LC configuration as most companies prefers. |
| ZTE | No | Considering the UE may need to revert back to old configuration in some failure case, we think the LCH for non-DAPS DRB shall be kept and suspended during the DAPS, and will be released when the source link is released. Otherwise, we may need to establish a new LCH in case the UE need to revert back to old configuration, and it is not clear how to align he RLC state variables between UE and source gNB in that case. |
| Huawei, HiSilicon | No | As non DAPS DRB follows legacy procedures, i.e. RLC re-establishment, so there is no PDU to be transmit. No need to specify specific behaviour for LCP. |

Conclusion: To be updated.

Q9. If the answer for Q8 is yes, do you think that the further clarification in RRC is needed?

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| LG |  | We do not need to specify anything for this issue. |
| Samsung | No (Yes if possible) | Clarification is needed but, as mentioned in [3], we think it may not be easy to clarify this in RRC. |
| Intel |  | Same view as LG. |

Conclusion: To be updated.

Q10. If the answer for Q8 is no, do you agree that “the source MAC entity selects only the logical channels corresponding to DAPS DRBs when the LCP procedure is applied, and the LCHs corresponding to non-DAPS DRBs should not be considered for LCP procedure of the source MAC entity during DAPS HO”

|  |  |  |
| --- | --- | --- |
| Company | Yes/No | Comments |
| LG |  | We do not need to specify anything for this issue. |
| Samsung | Yes | The source MAC entity doesn’t have to apply LCP procedure to the LCHs of non-DAPS DRBs. |
| OPPO | No | No need to specify anything. |
| Ericsson | Yes | This is the intention. Whether we need to make any specification changes to ensure this we don’t know. |
| Intel | No | Anyway, there is no data available in MAC for non DAPS DRB, we do not see the need to specify anything. |
| Nokia | Yes | That shall be the desired behaviour, but we agree nothing needs to be specified. |
| Apple | No | It has no spec impact. |
| NEC |  | We do not have to specify, this can be based on UE implementation, |
| ZTE | Yes | We agree the intention, and it seems we can simply capture in MAC that the MAC entity shall not transmit data for a suspended logical channel, and capture in RRC the LCH for non-DAPS DRB in source link shall be suspended. |
| Huawei, HiSilicon | No | No need to specify as there is no data for transmission in non DAPS DRB. |

The text proposal will be provided based on the submitted CR/contribution if needed.

Conclusion: To be updated.

Text proposal: To be updated.

# 3 Conclusions

Based on the above discussion, we propose the followings.

**To be updated.**

# 4 List of referenced documents

[1] R2-2001532 “Summary on PDCP/RLC aspects of DAPS HO in AI 7.3.2.1.1” LG Electronics Inc.

[2] R2-2000461 “Report of [108#66][LTE NR Mob] Open issues for LTE and NR mobility” Intel.

[3] R2-2002099 “Summary of DAPS MAC” vivo.

[4] R2-2000462 “RRC running CR for introduction of NR mobility enhancement [108#34]” Intel.