**3GPP TSG-RAN WG2 Meeting #118 electronic R2-2206353**

**Online, May 9th – May 20th, 2022**

**Agenda item: 6.1.3.2**

**Source: Xiaomi**

**Title: Part 2 summary of [AT118-e][032][MBS] PDCP (Xiaomi)**

**Document for:**  **Discussion**

# 1. Introduction

This paper is to trigger the part 2 discussion of the following email discussion of MBS PDCP. The draft CR is also provided in the inbox for your information. You can also provide any comment for polishing the draft CR.

* [AT118-e][032][MBS] PDCP (Xiaomi)

Scope: part 1 Treat [R2-2204626](file:///C:\Users\mtk65284\Documents\3GPP\tsg_ran\WG2_RL2\TSGR2_118-e\Docs\R2-2204626.zip), [R2-2204683](file:///C:\Users\mtk65284\Documents\3GPP\tsg_ran\WG2_RL2\TSGR2_118-e\Docs\R2-2204683.zip), [R2-2204906](file:///C:\Users\mtk65284\Documents\3GPP\tsg_ran\WG2_RL2\TSGR2_118-e\Docs\R2-2204906.zip), [R2-2205714](file:///C:\Users\mtk65284\Documents\3GPP\tsg_ran\WG2_RL2\TSGR2_118-e\Docs\R2-2205714.zip), [R2-2205630](file:///C:\Users\mtk65284\Documents\3GPP\tsg_ran\WG2_RL2\TSGR2_118-e\Docs\R2-2205630.zip), [R2-2205479](file:///C:\Users\mtk65284\Documents\3GPP\tsg_ran\WG2_RL2\TSGR2_118-e\Docs\R2-2205479.zip), [R2-2205155](file:///C:\Users\mtk65284\Documents\3GPP\tsg_ran\WG2_RL2\TSGR2_118-e\Docs\R2-2205155.zip), [R2-2205454](file:///C:\Users\mtk65284\Documents\3GPP\tsg_ran\WG2_RL2\TSGR2_118-e\Docs\R2-2205454.zip), Collect one round of comments, pave the way for on-line agreement (identify agreeable points, discussion points), part 2 progress CR including Rapporteur Resolutions (R2-2205455), corrections and including agreements from current meeting (can be phased)

Intended outcome: part 1 Report, Part 2 CR

Deadline: part1 CB W1 Thu, part 2 Deadlines set by rapporteur, Final review can be by post meeting disc

Deadline (for companies' feedback): Wednesday 2022-05-18 12:00 UTC

## 1.1 Contacts

Contact person for each participating company:

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# 2. Discussion

## 2.1 List of changes from R2-2205455

According to the PDCP CR provided in R2-2205455, the changes are listed as follows:

* Change 1: MRB is clarified as not applicable for cyphering/deciphering and integrity protection/verification.
* Change 2: UDC is added for MRB
* Change 3: MRB is added for Window\_Size.

For Change 1, according to the current PDCP specification (e.g. section 5.1.2 and 5.2.2.1), there are several places mentioning “perform deciphering and integrity verification” or “apply the ciphering algorithm and key” also for MRB. However the MRB PDCP does not have the security configuration. Then it could be misunderstood that the MRB uses the uncast security key to “perform deciphering and integrity verification”, which would anyway fail. Then we could have some clarification similar to SL SRB4, as captured in section 5.8 and 5.9 of the PDCP specification.

For Change 2, althought MBS service is DL only and UDC is uplink only, the UE should also be able to provide uplink packets of voice for a multicast MRB of group call service. We could have the following two ways for the UE to provide the uplink data of the group call for the multicast MRB. If only Option 1 is allowed, then we do not need to add UDC support for MRB.

* Option 1: The UE uses a separate DRB to provide the uplink data for the multicast group call of MRB.
* Option 2: The UE uses the uplink channel of the same multicast MRB to provide the uplink data for the multicast group call of MRB.

For Change 3, Window\_Size is required for the receiving PDCP entity of the MRB .

#### Question 1: Which of the following changes are needed?

* Change 1: MRB is clarified as not applicable for cyphering/deciphering and integrity protection/verification.
* Change 2: UDC is added for MRB
* Change 3: MRB is added for Window\_Size.

(The rapporteur suggests that we firstly confirm whether the corresponding missing function/clarification is required, and then we can discuss further how to capture some required changes in the specification.)

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| **Company** | **Answer**  **(Change 1/2/3)** | **Comments** |
| Xiaomi | All | We think that Change 1 and 3 are required to avoid unnecessary misundertandings.  For Change 2, we think that both Option 1 and 2 are feasible solutions. It seems that there is no extra complexity of supporting UDC for multicast MRB. If companies consider that UDC is not applicable for MRB, we may need to add some clarification for the UDC configuration in 38.331. |
| LG | 1, 3 | For Change 2, we are not sure why the UDC is needed for MRB. The UDC is UPLINK data compression, and MRB is typically downlink. If there is UL data, it should be transmitted via separate DRB, not via MRB. |
| CATT | 1,3 | Agree with LG that UDC is for uplink data,it is not applicable to MRB |
| ZTE | 1, 3 | for one MRB, from service data perspective it is DL only.  - on session management, MRB QoS flow/ 5GC entities are only about DL  - on Uu, there is no flow to RB mapping at all (with the absence of SDAP entity functioning).  therefore, 1/ MRB is only for DL; 2/ if there is any UL service data, it will be the duty of other DRBs.  that being said, we have no strong view if companies want to apply UDC to PDCP Control PDU, if the spec impacts are acceptable, which however is not something we are so sure about. |
| MediaTek | 1,3 | For change 2, UL may be available if the MRB is configured with PTP or split-MRB (e.g. PDCP SR).So maybe option2 is right, The UE will uses the uplink channel of the same multicast MRB to provide the uplink data, if configured.  However, considering the UL data size, UDC may not be needed for MBS. |
| Lenovo | 1,3 | Not sure why UDC is needed for MRB since MRB has no uplink data. The motivation is not clear. |
| Qualcomm | 1,3 | UDC is for UL data, no need for MRB |
| Ericsson | 1, 3 | We agree with other companies that UDC is not relevant to MBS. |
| Samsung | 1,3 | UPLINK Data Compression (UDC) is not needed. |
| Huawei, HiSilicon | 1,3 |  |
| Nokia | Not 1  3 | We do not have to say “except for MRBs” since we already have the following statement : “*The ciphering function includes both ciphering and deciphering and is performed in PDCP, if configured.*” If we start doing it for MRB for ciphering and IP, we will have to adress other cases as well (e.g. UDC).  There are no UL data PDUs for MRB.  [Rapp] The first change is to add clarification text in section 5.8 and 5.9 of the PDCP specification, same as the SL SRB4. |
| OPPO | 3 | For 1, I think it is not necessary because it only express the PDCP function fenerally.  For 2, no such agreement and also wonder if MBS need UDC.  [Rapp] The first change is to add clarification text in section 5.8 and 5.9 of the PDCP specification, same as the SL SRB4. |
| Futurewei | 1, 3 | MRB is DL only. No additional specification for UDC is needed. |
| Intel | 1, 3 | For change 2, we agree with LG and others that UDC (for UL PDCP SDU) is not applicable for MRB (which is DL). Regarding applicability of UDC to PDCP control PDU (e.g. PDCP status report), our understanding is that UDC is not applicable to PDCP control PDU, e.g. as from TS 38.323 clause 5.14.4: “*The UDC protocol generates UDC packets, each associated with one PDCP SDU*”. |
| vivo | 1,3 | We agree with LG. |
| CMCC | 1,3 | For change 2, agree with other companies, UDC is for UL data, not needed for MBS. |
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| **Summary:**  16 companies provided feedbacks. 14 companies support Change 1. One company support Change 2. All companies support Change 3. From the rapporteur’s understanding, how to clarify that MRB is not applicable for cyphering/deciphering and integrity protection/verification can be discussed in the CR implementation. |

**Proposal 1: MRB is clarified as not applicable for cyphering/deciphering and integrity protection/verification. Details can be discussed at CR implementation. (14/16)**

**Proposal 2: UDC is not supported for MRB. (15/16)**

**Proposal 3: MRB is added for Window\_Size (16/16)**

## 2.2 Confirmation of the proposals from part 1 discussion

According to the part 1 discussion summary of [AT118-e][032][MBS] PDCP (Xiaomi), however due to the very short online discussion time, we have not been able to confirm some proposals as the RAN2 agreement. From the rapporteur’s understanding, we could try email approval for those proposals in the part 2 discussion, so as to avoid duplicated discussion in the future.

#### Question 2: Do you agree with the following proposals?

* Proposal 1: RX\_DELIV <= RX\_NEXT should be guaranteed for initial variable selection (12/16).
* Proposal 2: PDCP-SN-Size is updated to PDCP-SN-SizeDL. (16/16)
* Proposal 3: It is left to the network implementation for the prevention of the PDCP COUNT wrap-around of multicast MRB (15/16). No specification change is needed (12/16).

(Companies providing the answer “No” are also invited to indicate which Proposal is not agreed.)

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| **Company** | **Answer**  **(Yes/No)** | **Comments** |
| Xiaomi | Yes | We think that for both Proposal 1 and 3, no specification change is needed no matter if Proposal 1 or 3 is agreed or not, as the two proposals are more like a guidance for the network implementation. |
| LG | Yes | But, as Xiaomi indicated, no spec change is need for P1 and P3. |
| CATT | Yes | Agree with LG |
| ZTE | not P1 | for proposal one, we don't have to specify this if it does not break the system. see also question 3.  [Rapp] It is ok not to capture anything for P1 in the specification if the network vendor has some concerns on the restriction of the gNB implementation. |
| MediaTek | Yes | Agree with Xiaomi, NW should ensure COUNT not wrap-around. |
| Lenovo | Yes | We tend to agree with Xiaomi that no spec impact for P1&P3. |
| Qualcomm | Yes |  |
| Ericsson | Yes |  |
| Samsung | Yes | We are ok to not capture P1&P3 in the spec. But we need to have an agreement captured in the chairman note.  Anyway, there is no strong reason why network configures RX\_DELIV > RX\_NEXT. It’s true that RX\_DELIV > RX\_NEXT does not bring any benefit. So sensible way of initial setup should do that way. If NW wants to not start the reordering timer, RX\_DELIV = RX\_NEXT is sufficient. |
| Huawei, HiSilicon | Not P1 | This question should be discussed together with Q3.  The initial RX\_NEXT can be smaller than RX\_DELIV. It will be updated to a larger value than RX\_DELIV after the reception of the first PDCP packet within the receiving window. |
| Nokia | Not P1 | Agree with Huawei. |
| OPPO | Yes |  |
| Futurewei | Yes | No specification change is needed for proposals 1, 3. |
| Intel | Yes | Agree with Xiaomi that specification changes are not needed for Proposal 1 and 3. |
| vivo | Yes |  |
| CMCC | Yes | Agree with Xiaomi that no specification change is needed for Proposal 1 and 3. |
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| **Summary:**  16 companies provided feedbacks. All companies support Proposal 2 and 3 from the first phase of the email discussion. 3 companies considers that Proposal 1 is not needed, and 2 companies consider that P1 depends on the discussion of Question 3. From the rapporteur’s understanding, Proposal 1 is just an recommendation for the network implementation, which is normally not captured in the PDCP specification for such detailed configuration (i.e. RX\_DELIV <= RX\_NEXT). An observation could be provided for Proposal 1 in the discussion summary, and no more discussion is needed for Proposal 1. |

**Observation: RX\_DELIV <= RX\_NEXT should be guaranteed for initial variable selection (13/16).**

**Proposal 4: PDCP-SN-Size is updated to PDCP-SN-SizeDL. (16/16)**

**Proposal 5: It is left to the network implementation for the prevention of the PDCP COUNT wrap-around of multicast MRB. No specification change is needed. (16/16)**

## 2.3 Initial value of RX\_NEXT for multicast MRB

The followings are the RAN2 agreements related to to calculation of RX\_NEXT:

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| * The initial value of RX\_DELIV is set to a value before RX\_NEXT, e.g. the initial value of the SN part of RX\_DELIV is (x – 0.5 × 2[*PDCP-SN-Size*–1]) modulo (2[*PDCP-SN-Size*]), where x is the SN of the first received PDCP Data PDU. * For multicast MRB, the initial value of the SN part of RX\_NEXT is (x +1) modulo (2[*PDCP-SN-Size*]), where x is the SN of the first received PDCP Data PDU. * [027] If the initial value of HFN is indicated by the gNB, a reference SN corresponding to the initial value of HFN can be indicated to the UE. |
| RAN2#118-e meeting agreement:   * Go for Option 2   **Option 2: Initial RX\_DELIV is configured by RRC: SN(RX\_DELIV) = SN\_ref and HFN(RX\_DELIV) = HFN\_initial where HFN\_initial and SN\_ref are provided by RRC for multicast. (13/16)** |

According the latest RAN2 agreement, as the initial HFN is no longer left to the UE implementation, the initial HFN for the RX\_HFN should also be set to the HFN configured by RRC (i.e. *multicastHFN-AndRefSN*), same as the RX\_DELIV.

#### Question 3: Do you agree that the initial value of the HFN part of RX\_NEXT is set to the HFN configured by RRC, i.e. *multicastHFN-AndRefSN*?

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| **Company** | **Answer**  **(Yes/No)** | **Comments** |
| Xiaomi | Yes | We think that it is straight-forward that the initial value of the HFN part of RX\_DELIV and RX\_NEXT is set to the same value as configured by RRC. |
| LG | Yes |  |
| CATT | Yes |  |
| ZTE | probably yes | for RX\_NEXT initialisation, we have two options:  **A/as configured**, however, this will inevitably possibly result in RX\_NEXT < RX\_DELIV, although temporarily. this is against Proposal 1 in section 2.2.  **B/we follow previous agreement that the HFN of RX\_NEXT part shall be based on UE implementation**, such that we can still make sure RX\_DELIV <= RX\_NEXT. later RX\_NEXT will be updated based on RX\_DELIV and the received packets. however this might result in aggressive RX\_REORD setting, which could further result in packet loss. in a simplified example,  - PDCP SN is in the space of 0 to 99, RRC Config (HFN = 2, SN = 80)  - Received packet (HFN = x, SN = 70).  - if RX\_NEXT is set to (HFN = 3, SN = 70) to keep the rule of RX\_DELIV <= RX\_NEXT, then RX\_REORD might be set to (HFN = 3, SN = 70) later which might be way too aggressive.  therefore we might have to follow option A to set the initial value of the HFN part of RX\_NEXT to the HFN configured by RRC.  and we say no to Proposal 1 in section 2.2. actually in current spec, it does not limit itself to follow the principle that RX\_NEXT < RX\_DELIV, e.g.:  "- if t-Reordering is not running (includes the case when t-Reordering is stopped due to actions above), and RX\_DELIV < RX\_NEXT:" in section 5.2.2 Receive operation. // it is a condition, but not something always there  [Rapp] In the example given above, the RX\_NEXT is finally set to (HFN = 3, SN = 70) according to the processing of the PDCP data PDU in Section 5.2.2. Then the t-Reordering will be started. |
| MediaTek | Yes | To be clear, if a PDU is received, section 5.2.2(HFN+1/HFN-1) will be applied if the HFN of the received PDU has been wrap-around, to further correct the HFN of RX\_NEXT.  @ZTE For the example, we think the NW can prevent this happened by setting the proper value of HFN+SN in RRC indicator, e.g.set to the next/first PDU which will be transmitted to UE.  So that within a proper SN length(e.g. 212 ), it is very rare for UE to receive the RRC with SN=X but the SN of the first received PDU is slightly smaller than X, since the SN range is enough to prevent this happening. |
| Lenovo | No | We would prefer to keep the previous agreement for RX\_NEXT  [Rapp] This is aligned with the previous agreement that “the initial value of HFN is indicated by the gNB”, which is also applicable for RX\_NEXT .The initial SN of the RX\_NEXT is still based on the first received PDCP data PDU. |
| Qualcomm | Yes |  |
| Ericsson | Yes |  |
| Samsung | Yes | In case of SN boundary, initial HFN for RX\_NEXT could be different from that of RX\_DELIV.  < Example >  - PDCP SN is in the space of 0 to 99, RRC Config (HFN = 2, SN = 98) for RX\_DELIV.  - Received packet (HFN = x, SN = 0).  🡪 HFN for RX\_NEXT shall be 3. (HFN for RX\_DELIV is 2)  In this case, HFNs for RX\_NEXT and RX\_DELIV are different.  Anyway, HFN of RX\_NEXT shall be set such that RX\_DELIV <= RX\_NEXT and RX\_NEXT – RX\_DELIV < 2^(SN size). It can be automatically determined by the first received SN and the initial RX\_DELIV value. No separate signalling of HFN of RX\_NEXT is not needed.  A simple exression (alternative wording) is to set initial RX\_NEXT = RX\_DELIV. Then, the current PDCP behaviour will update RX\_NEXT to the first received SN + 1 when it receive the first packet. |
| Huawei, HiSilicon | Yes (only works when COUNT RX\_NEXT is set to RX\_DELIV, not only the HFN part)  Or  No (RX\_NEXT is set to 0) | **Problem：**  Simply setting the HFN part of RX\_NEXT to the HFN configured by RRC may not work, considering lower layer retransmissson and  the delay of RRC configuration, especially when near the SN wrapping around.  For example, in HFN=0 and SN=4000, network wants to configure the *multicastHFN-AndRefSN* for a UE, there may be two cases:   * Case 1: network configures *multicastHFN-AndRefSN*（HFN=0, SN=4000 or 3000）to the UE, the SN of the first received PDCP data PDU by UE is 10, UE can determine the HFN of the first received PDCP data PDU is 1 according to clause 5.2.2.1. * Case 2: network configures *multicastHFN-AndRefSN*（HFN=1, SN=0）to the UE, the SN of the first received PDCP data PDU by UE is 4050, UE can determine the HFN of the first received PDCP data PDU is 0 according to clause 5.2.2.1.   If the initial value of the HFN part of RX\_NEXT is set to the HFN configured by RRC:   * for case 1, the initial HFN of RX\_NEXT is 0 and the initial SN of RX\_NEXT is 11, UE will update RX\_NEXT to the COUNT of the first received PDCP data PDU + 1 (i.e., HFN=1,SN=11) according to clause 5.2.2.1. Ane then, PDCP window can work properly. * for case 2, the HFN of RX\_NEXT is 1 and the SN of RX\_NEXT is 4051, in this case, (RX\_NEXT-RX\_DELIV) will be larger than PDCP Window size, which is not allowed and will cause that PDCP window cannot work properly.     **Solution：**  Actually if we check PDCP receiving procedure, the initial value of RX\_NEXT is not useful for determining the COUNT of the first PDCP packet (i.e. RCVD\_COUNT).  The first time RX\_NEXT is used in PDCP receiving procedure is after the reception of the first PDCP packet within the receiving window as follows:  **- if RCVD\_COUNT >= RX\_NEXT:**  **- update RX\_NEXT to RCVD\_COUNT + 1.**  After that, RX\_NEXT will be instantly updated to RCVD\_COUNT + 1. So the simplest way is to set initial RX\_NEXT to 0 or RX\_DELIV (indicated by Samsung). It doesn’t matter if initial RX\_NEXT is smaller than RX\_DELIV as it will be updated to a larger value than RX\_DELIV after the first update.  [Rapp] We would agree that if the initial SN part of RX\_NEXT is set to the SN of the first received PDCP data PDU, we could have RX\_DLIV > RX\_NEXT. However the t-reordering will start anyway, as RX\_NEXT will be updated to RCVD\_COUNT + 1. We also understand that the gNB may want to have a simplified solution to align the initial values of the state variable. Setting RX\_NEXT = RX\_DELIV seems to be the simplest way for both the UE implementation and the network implementation.  [Samsung] Agree with Huawei’s analysis. Consdiering initial value signalling of RX\_DELIV, RX\_NEXT = RX\_DELIV is a straightforward way. It’s related to P1 of Q2. This makes P1 naturally achieved. |
| Nokia | Yes | Agree with Huawei, either set RX\_NEXT = RX\_DELIV or set RX\_NEXT = 0 |
| OPPO | - | In general, the reference SN is smaller than the SN of the first received packet.  If refernce HFN and reference SN is a previous packet Count of first received paket.  So if reference SN is smaller than SN of the first received packet, then the HFN of the first received paket is the configured HFN.  Otherwise, the HFN of the first received paket should be configfured HFN+1 |
| Futurewei | Yes | Agree with Huawei. |
| Intel | Yes | Our understanding is that RX\_NEXT is only determined after receiving the first PDU. HFN is signalled (same as the HFN for RX\_DELIV), and SN is (x +1) modulo (2[*PDCP-SN-Size*]), where x is the SN of the first received PDCP Data PDU. After that it might be updated due to  - if RCVD\_COUNT >= RX\_NEXT:  - update RX\_NEXT to RCVD\_COUNT + 1.  We don’t think there is a issue regarding SN wrap around.  As for Case 2 from Huawei, our understanding is that network should not configure in that way since it results in that RCVD\_COUNT < RX\_DELIV, and the packet is dropped by UE according to following rule in clause 5.2.2.1:  - if RCVD\_COUNT < RX\_DELIV; or  - if the PDCP Data PDU with COUNT = RCVD\_COUNT has been received before:  - discard the PDCP Data PDU; |
| vivo | Yes |  |
| CMCC | Yes |  |
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| **Summary:**  16 companies provided feedbacks. One company provided the answer No, and prefers to keep the previous RAN2 agreement. However it seems that there are some misunderstanding for this feedback, as the proposal is actually aligned with the previous RAN2 agreement. 4 companies consider that if we only set the initial HFN of RX\_NEXT to *multicastHFN-AndRefSN*, we may have RX\_DELIV > RX\_NEXT. To simplify the network implementation, we should set RX\_NEXT = RX\_DELIV or set RX\_NEXT = 0. From the rapporteur’s understanding, setting RX\_NEXT = 0 is not aligned with feedbacks from the majority view, as the majority (14/16) providing the answer “Yes” prefer to set the initial value of the HFN part of RX\_NEXT to *multicastHFN-AndRefSN*. As such, the rapporteur considers that we could take a small step forward to have the aligned initial value for both RX\_NEXT and RX\_DELIV. Since not every company provided feedbacks for the following proposal. If this proposal is not agreeable, we could go for online discussion. |

**Proposal 6: Set initial RX\_NEXT to initial RX\_DELIV, i.e. *multicastHFN-AndRefSN*.**

# 3. Conclusion

According to the feedbacks provided by companies, we could have the following proposals for approval

**Observation: RX\_DELIV <= RX\_NEXT should be guaranteed for initial variable selection (13/16).**

**Proposal 1: MRB is clarified as not applicable for cyphering/deciphering and integrity protection/verification. Details can be discussed at CR implementation. (14/16)**

**Proposal 2: UDC is not supported for MRB. (15/16)**

**Proposal 3: MRB is added for Window\_Size (16/16)**

**Proposal 4: PDCP-SN-Size is updated to PDCP-SN-SizeDL. (16/16)**

**Proposal 5: It is left to the network implementation for the prevention of the PDCP COUNT wrap-around of multicast MRB. No specification change is needed. (16/16)**

**Proposal 6: Set initial RX\_NEXT to initial RX\_DELIV, i.e. *multicastHFN-AndRefSN*.**

# 4. Reference

[1] [R2-2205455](file:///C:\Users\mtk65284\Documents\3GPP\tsg_ran\WG2_RL2\TSGR2_118-e\Docs\R2-2205455.zip) Miscellaneous corrections for MBS 38.323 Xiaomi Communications CR Rel-17 38.323 17.0.0 0090 - F NR\_MBS-Core