**3GPP T****SG-RAN WG3 Meeting #107bis-e R3-202507**

**Electronic Meeting, April 20th – 30th, 2020**

**Agenda item: 15.4.3**

**Source: Intel Corporation**

**Title:** **Summary for CB: # 25\_Email\_Mob\_Enh\_Data\_fwd\_E1**

**Document for: Discussion and Decision**

# 1 Introduction

This is to discuss the following CB: #25:

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| **CB: #** **25\_Email\_Mob\_Enh\_Data\_fwd\_E1** **- Need to provide COUNT:****introduce new IE to request and signal DL COUNT value over E1 exclusively for early data forwarding purpose, fixing description for PDCP SN Stat Req IE? (Intel,ZTE,Gg,CATT)****Do not introduce new IEs in Bearer Context Modification messages to retrieve/provide UL/DL COUNT when early data forwarding is applied? (E///)****Introduce a new class-2 procedure, that in the source node can transfer the last successfully received PDCP PDU from source CU-UP to source CU-CP and also in the target node can transfer this information from target CU-CP to target CU-UP; periodicity handling details proposed? (E/// 2373,2377)****Extend the enumerated value of the IE PDCP SN Status Request to indicate that this request is for early data forwarding usage for DAPS/CHO; introduce a new IE carrying either DL COUNT Value or DL Discarding between gNB-CU-CP? (HW 2416)****- TX Stop:****Do not involve the DL TX Stop IE which has nothing to do with transmission behaviors during HO or change of CU-UP. This IE was originally designed for stop/resume control of DL PDCP duplication and thus better to leave it there to be used exclusively for that purpose? (Intel,ZTE,Gg,CATT)****Add an optional IE in BEARER CONTEXT MODIFICATION REQUEST indicating that the CU-UP shall continue transmitting DL PDCP packets from source CU-UP to source DU? (E/// 2374,2375)****- go for minimum agreeable set; if agreeable, merge and check details**(Intel - moderator)Summary of offline disc |

# 2 For the Chairman’s Notes

**Agreements to be captured:**

**FFS autonomous report for Discarding DL COUNT from the source CU-UP is needed.**

**To be continued:**

**Whether to use new IE(s) or reuse existing IE(s) when enhancing Bearer Context Modification procedure to retrieve/provide DL COUNT values related for early data forwarding with the source/target CU-UPs.**

# 3 Discussion

Two issues were identified from Intel/ZTE/Google/CATT[2297-98], Ericsson[2373,2377,2374-75], and Huawei[2416].

## 3.1 Early forwarding support over E1

For the support of early forwarding involving CU-UPs, the source CU-CP should be able to retrieve DL COUNTs from the source CU-UP over E1. The target CU-CP should also be able to provide the transferred DL COUNT values to the target CU-UP over E1. Both of which are agreed to be done by the Bearer Context Modification procedure in the last RAN3-107-e meeting:

**RAN3 adopts a new class-2 “EARLY FORWARDING TRANSFER” message for DAPS HO. This message is also used for CHO early data forwarding.**

**Bearer Context Modification procedure is enhanced to retrieve/provide DL COUNT values related for early data forwarding with the source/target CU-UPs; FFS whether to have a new IE or reuse an existing one**

FFS is on whether we introduce new IEs or re-use existing IEs while using the Bearer Context Modification procedure.

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From the contributions, Intel/ZTE/Google/CATT[2297-98], E///[2373,2377,2374-75]. HW[2416], so far there are three solutions on the table:

* **Solution 1 (Intel/ZTE/Google/CATT)**
	1. Introduce new IE (other than the exisiting *PDCP SN Status Request* IE) for the source CU-CP to request the source CU-UP to provide first DL COUNT or DL COUNT for discarding purpose.
	2. Do not involve *DL TX Stop* IE as this was defined for stop/resume control of DL PDCP duplication which has nothing to do with transmission behaviors during HO or change of CU-UP.

Instead, fix the description of the *PDCP SN Status Request* IE to the stage-2 TS 38.401, so that the use of this IE is confined for the transfer of PDCP SN status where the source CU-UP should freeze PDCP and stop transmission.

* 1. Introduce new IE (other than the exisiting *PDCP SN Status Information* IE) for the source CU-UP to provide the requested DL COUNT values to the source CU-CP.

This IE is also used when the target CU-CP provides the transferred DL COUNT values to the target CU-UP.

* **Solution 2 (Huawei)**
	1. Extend the existing *PDCP SN Status Request* IE for the source CU-CP to request the source CU-UP to provide first DL COUNT or DL COUNT for discarding purpose.
	2. Same as Option 1-b for *DL TX Stop* IE.
	3. Same as Option 1-c.
* **Solution 3 (Ericsson)**
	1. Re-use the existing *PDCP SN Status Request* IE for the source CU-CP to request the source CU-UP to provide first DL COUNT or DL COUNT for discarding purpose.

To make the source CU-UP distinguish that this request is for early forwarding transfer (not for SN status transfer), introduce another new IE (*Early Data Forwarding* IE = “continue DL transmission”) in the BEARER CONTEXT MODIFICATION REQUEST message.

* 1. *DL TX Stop* IE (=”stop”) is used to stop data transmission and freeze PDCP when the source CU-CP requests to retrieve UL/DL COUNT values for SN status transfer.
	2. Re-use the existing *PDCP SN Status Information* IE (which contains both UL/DL COUNTs as mandatory) for the source CU-UP to provide the requested DL COUNT values to the source CU-CP, although UL COUNT is useless for early forwarding transfer.

This IE is also re-used when the target CU-CP provides the transferred DL COUNT values to the target CU-UP (with a meaningless UL COUNT value that shall be ignored by the target CU-UP). But, it was not clearly described how the target CU-UP distinguishes, whether the information received in the *PDCP SN Status Information* IE is for early forwarding or for SN status transfer.

### **Question 1: Please provide any views or comments for each solution, and your preference.**

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| **Company** | **Preference** | **Comments** |
| Samsung | Solution 1 | Introducing new IE to request the first DL COUNT or the DL Discarding is simpler and clear. And if then, we think the new DL TX Stop IE is not necessary, but some description change may be enough. |
| CATT | Solution 1 | It is more clear |
| ZTE | Solution 1 | For DAPS, it is more clear to use decoupled IE from legacy.  |
| QC | Solution 3 | Solution 3 has least standard impact:* In the source side, a new indicator is added for Tx continue
* In the target side, the DL COUNT is reused. For this, I don’t see the behavior difference in the target CU-UP between early forwarding scenario and SN status transfer scenario.
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| Google | Solution 1 | Btter not involving the DL TX Stop IE as it was for other purpose. |
| Nokia | Solution 1 or 2 | We do not have strong opinion, but we would prefer to avoid reusing IEs that were designed for different purposes.  |
| Ericsson | Solution 3 | I can’t see why Cell Group Information that contains DL Tx Stop should be solely defined for duplication. For instance from the Bearer Context Modification in 38.463: For each successfully established DRB, the gNB-CU-UP shall provide, in the respective *UL UP Parameters* IE of the BEARER CONTEXT MODIFICATION RESPONSE, one UL UP Transport Layer Information Item per cell group entry contained in the respective *Cell Group Information* IE of the BEARER CONTEXT MODIFICATION REQUEST message.Also, 1b is non backward compatible. We should not change how legacy signalling works (i.e. DL TX Stop IE is not mentioned in stage-2, but the stage-3 description is quite clear on what to do if you receive it). On the new IE vs use existing ones, we do not see what is precluding us to reuse the existing ones, but this issue may be linked to the next issue. Please check my answer below containing a proposed way forward . |
| HW | Solution 2 | We think this is the simplest way which has less spec impact. On one hand, to reuse existing IE (this IE serves the same purpose of request); on the other hand, a new numerated value would indicate the request and continue DL transmission at the same time. Soluiton 1&2 is similar, except for how to indicate the request; solution 3 makes things complicated, and confuses the use of DL Stop IE, more spec impact foreseen as well. |

Different views, if any, please add to the above.

### **Summary**

* Solution 1 (6) : Intel, Samsung, CATT, ZTE, Google, Nokia
* Solution 2 (2) : HW, Nokia
* Solutoin 3 (2) : E///, QC

Option 1 could not be agreed. A possible compromise below was also discussed, which was not agreed in the end. We continue technical discussions further.

**Proposal 1: To be continued, whether to use new IE(s) or reuse existing IE(s) when enhancing Bearer Context Modification procedure to retrieve/provide DL COUNT values related for early data forwarding with the source/target CU-UPs.**

FYI, the behavior difference in the target CU-UP between early forwarding transfer and SN status transfer:

* First DL COUNT from EARLY FORWARDING TRANSFER is used to enable encrypting the forwarded PDCP SDUs, and also to make the target aware which PDCP SDU is the first one to start with, given that in-order delivery is not guaranteed for forwarding over GTP-U. Note that this applies only to the forwarded PDCP SDUs with SNs already assigned by the source.
* Discard DL COUNT from EARLY FORWARDING TRANSFER is used to discard buffered PDCP SDUs forwarded from the source. This also applies only to those with SNs already assigned by the source.
* DL COUNT from SN STATUS TRANSFER is used to start assigning PDCP SNs to the PDCP SDUs forwarded without SN assigned by the source. There is no discarding of anything.

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## 3.2 New class-2 procedure for efficient transfer of DL COUNTs for discarding?

The following were observed and porposed in E///[2373,2377]:

*Examining further the* *early data forwarding applied to CHO, we see that there might be a long time between the start of data forwarding and the HO, where the UE is still connected to the source, while the source is forwarding PDCP PDUs to the target at the same time. This means that the target PDCP buffer can get full very quickly.*

***Observation 1: In early data forwarding, the target PDCP buffer can get full very quickly***

*So there needs to be a way to ameliorate this and tackle the buffer overflow.*

*One way to empty the PDCP buffer would be to know what PDCP PDUs have been successfully received by the UE via the source. For that, a message must be sent from source to target, containing the PDCP SN of the last PDCP PDU successfully sent to the UE would be used by the target to discard the PDCP PDUs already received by the UE via the source.*

***Observation 2:*** ***intermediate EARLY FORWARDING TRANSFER message are beneficial to the target node to empty the PDCP buffer, and are not precluded***

*In case of disaggregated gNB, the information about the PDCP PDUs is in the CU-UP. So, in essence the source CU-UP should send the information about the last successfully received PDCP PDU to source CU-CP in order to build an intermediate EARLY FORWARDING TRANSFER message. Today the triggering of multiple Bearer Context Modification procedures between the source CU-CP and the source CU-UP is the only way to get this information. But triggering periodically a class-1 procedure is burdensome for both nodes. Thus, we propose the introduction of a new class-2 procedure,* *that in the source node can transfer the last successfully received PDCP PDU from source CU-UP to source CU-CP periodically. The periodicity of these messages could be requested in the first BEARER CONTEXT MODIFICATION REQUEST triggered by the Handover Preparation. The same new class-2 message could be reused from target CU-CP to target CU-UP, if the target node is also disaggregated, to transfer this information from target CU-CP to target CU-UP.*

***Proposal 2: Introduce a new class-2 procedure, that in the source node can transfer the last successfully received PDCP PDU from source CU-UP to source CU-CP and also in the target node can transfer this information from target CU-CP to target CU-UP.***

***Proposal 3: The periodicity of these reports is signalled to the source CU-UP in the 1st BEARER CONTEXT MODIFICATION REQUEST triggered by the Handover Preparation***

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### **Question 2: Please provide comments or views for the above proposals.**

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| **Company** | **Agree?** | **Comments** |
| Samsung | Disagree | We think the procedure for Early Forwarding Transfer may not happen many times. And how many and how often can be optimized at CU-CP by the implementation. We don’t think the periodical report is required, and if the periodicity needs to be changed, it would require the additional E1 signalling. |
| CATT | Disagree | Both New IE and new message could work. But the frequent of the information transfer is not clear. May not need to set periodicity report.when the COUNT information transfer is needed, the modification procedure can be triggered. So use New IE solution is better. |
| ZTE |  | No strong mind. It looks like optimization over basic “SN status retrieval” means |
| QC | Disagree | Last meeting agreed to use BEARER CONTEXT MODIFICATION procedure. If there is evidence showing that the BEARER CONTEXT MODIFICATION procedure will have efficiency issue, we can consider the new class-2 procedure. |
| Google |  | Periodical report seems not necessary.  |
| Nokia | Not this way | We may see some benefit in communicating how often the SN update is needed, but it should rather be the target CU-UP to tell the source CU-UP (via CPs) how often it needs to be updated to avoid buffer overload. And it may rather be amount of data, not time. |
| Ericsson | Agree | First of all, I disagree with the fact that this will not happen often. Buffer can be full very quickly and time between CHO configuration and execution can be long. That said, and looking at the above comments, I’d like to propose the following way forward: leave out the signalling for periodical reporting for now. But keep the new class-2 procedure for DL COUNT transfer. As Nokia said, the CU-UP may know better. Therefore, the actual mechanism, where the CU-CP requests the COUNT, might not be enough. The CU-UP should be able to autonomously report the DL COUNT, via a new class-2 procedure. This would also solve part of the first issue (i.e. CU-CP requests for early COUNT in first bearer context modification request message, and DL COUNT is transferred via the new class-2 procedure, which can be repeated if needed by the CU-UP, without receiving a new bearer context modif request message) |
| HW | Disagree | Similar view as Samsung, we think the existing procedure is enough. |

### **Summary**

* Yes (1) : E///
* No (7) : Samsung, CATT, ZTE, QC, Google, Nokia, Huawei

There is a clear majority not to seek this autonomous and periodic reporting from CU-UP via new class-2.

However, a way forward from E/// to allow autonomous report from CU-UP (via new class-2) also seems to make sense, given that it is the source CU-UP who forwards PDCP packets and currently we only have a mechanism that the source CU-CP requests.

So, the rapporteur would like to propose to further discuss on this aspect.

**Proposal 2: FFS autonomous report for Discarding DL COUNT from the source CU-UP is needed.**

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# 4 Conclusion

**Proposal 1: To be continued, whether to use new IE(s) or reuse existing IE(s) when enhancing Bearer Context Modification procedure to retrieve/provide DL COUNT values related for early data forwarding with the source/target CU-UPs.**

**Proposal 2: FFS autonomous report for Discarding DL COUNT from the source CU-UP is needed.**

# 5 Reference

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| * + 1. **15.4.3 NR**
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| [R3-202297](file:///C%3A%5CUsers%5Cbsbae.CORP%5CDesktop%5C202004_RAN3%5CEmail_discussion%5CeMob%5CCB%20%23%2025_Email_Mob_Enh_Data_fwd_E1%5CDocs%5CR3-202297.zip) | Early Forwarding support for DAPS/CHO over E1 (Intel Corporation, ZTE, Google, CATT) | discussion |
| [R3-202298](file:///C%3A%5CUsers%5Cbsbae.CORP%5CDesktop%5C202004_RAN3%5CEmail_discussion%5CeMob%5CCB%20%23%2025_Email_Mob_Enh_Data_fwd_E1%5CDocs%5CR3-202298.zip) | (TP for NR\_Mob\_enh-Core BL CR for TS 38.463): Early Forwarding support for DAPS/CHO over E1 (Intel Corporation, ZTE, Google, CATT) | other |
| [R3-202373](file:///C%3A%5CUsers%5Cbsbae.CORP%5CDesktop%5C202004_RAN3%5CEmail_discussion%5CeMob%5CCB%20%23%2025_Email_Mob_Enh_Data_fwd_E1%5CDocs%5CR3-202373.zip) | Optimizing multiple SN STATUS TRANSFER for disaggregated gNB (Ericsson) | discussion |
| [R3-202377](file:///C%3A%5CUsers%5Cbsbae.CORP%5CDesktop%5C202004_RAN3%5CEmail_discussion%5CeMob%5CCB%20%23%2025_Email_Mob_Enh_Data_fwd_E1%5CDocs%5CR3-202377.zip) | Optimizing multiple SN STATUS TRANSFER for disaggregated gNB (Ericsson) | CR0490r1, TS 38.463 v16.1.1, Rel-16, Cat. B |
| [R3-202374](file:///C%3A%5CUsers%5Cbsbae.CORP%5CDesktop%5C202004_RAN3%5CEmail_discussion%5CeMob%5CCB%20%23%2025_Email_Mob_Enh_Data_fwd_E1%5CDocs%5CR3-202374.zip) | Early data forwarding and CU-UP DL transmission start/stop (Ericsson) | discussionMove to 15.4.3 |
| [R3-202375](file:///C%3A%5CUsers%5Cbsbae.CORP%5CDesktop%5C202004_RAN3%5CEmail_discussion%5CeMob%5CCB%20%23%2025_Email_Mob_Enh_Data_fwd_E1%5CDocs%5CR3-202375.zip) | Early data forwarding and CU-UP DL transmission start/stop (Ericsson) | CR0497r, TS 38.463 v16.1.1, Rel-16, Cat. BMove to 15.4.3 |
| [R3-202416](file:///C%3A%5CUsers%5Cbsbae.CORP%5CDesktop%5C202004_RAN3%5CEmail_discussion%5CeMob%5CCB%20%23%2025_Email_Mob_Enh_Data_fwd_E1%5CDocs%5CR3-202416.zip) | (TP for NR\_Mob\_enh-Core BL CR for TS 38.463): Early Forwarding support over E1 (Huawei) | otherMove to 15.4.3 |