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

**E-meeting, April 20 – April 30, 2020**

**Agenda item:**6.7.4.1 (NR\_IIOT-Core)

**Source:** LG Electronics Inc.

**Title:** Report of [AT109bis-e][029][IIOT] PDCP Duplication and CRs

**Document for:** Discussion and Decision

# 1. Introduction

This document is to report the result of the following email discussion in RAN2#109bis-e Meeting.

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| * [AT109bis-e][029][IIOT] PDCP Duplication and CRs (LG)

Scope: Treat topics in 6.7.4.1, based on [R2-2003772](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_109bis-e%5CDocs%5CR2-2003772.zip), and make CR, Part 1: Determine which issues that need resolution, find agreeable proposals. Deadline: April 24 0700 UTC, For P1 P2 P7 discussion expected to start after on-line session April 21. Discussion on other proposals/issues can start immediately. Part 2: Implement this meetings agreements in CR |

The R2-2003772 has following proposals.

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| **[Potential easy agreement]****Proposal 3: If the *duplicationState* is absent, the initial duplication states are deactivated for all RLC entities.****Proposal 4: Change the PDCP specification, e.g. update the definition of split secondary RLC entity, to specify the setting of the split secondary RLC entity for the PDCP entity associated with only two RLC entities.****Proposal 5: Change the PDCP specification to clearly specify that PDCP duplication is deactivated for the DRB when all secondary RLC entities are deactivated. Actual changes need further discussion.****Proposal 6: Confirm that index i for RLCi field of Rel-16 MAC CE is determined by ascending order of logical channel ID of secondary RLC entities in MCG and SCG.****[Need more discussion]****Proposal 1: Decide whether Rel-15 MAC CE can be used for Rel-16 Duplication configuration.****Proposal 2: If Rel-15 MAC CE is decided to be used for Rel-16 Duplication configuration, further discuss how to set the secondary RLC entities when Rel-15 MAC CE indicates duplication activation.****[Discuss with lower priority]****Proposal 7: Discuss whether the “CA duplication” in *allowedServingCells* description should be changed to “CA-only duplication”, if time permitted.** |

This document further collects the views from companies on the proposals in R2-2003772.

# 2. Part 1 discussions

Whether to allow Rel-15 MAC CE to be used for Rel-16 Duplication configuration is difficult to reach consensus. RAN2 had discussion on this issue many times but failed to conclude. However, this issue has to be concluded in this meeting to finalize the IIOT WI.

If companies cannot converge, the rapporteur think that the only choice is not to support Rel-15 duplication MAC CE for Rel-16 duplication configuration. Thus, the rapporteur proposes following:

**Proposal 1: Rel-15 Duplication MAC CE is *not* used for Rel-16 Duplication configuration.**

**Question 1. Can you accept the proposal 1?**

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| **Company** | **Q1 Yes/No** | **Comment** |
| LG | Yes | Though we see the benefit of using Rel-15 Duplication MAC CE for Rel-16 Duplication configuration, considering the limited time in Rel-16, we are ok not to use Rel-15 Duplication MAC CE for Rel-16 Duplication configuration. |
| Samsung | Yes |  |
| Spreadtrum | No | We think Rel-15 Duplication MAC CE is an efficient way especially for deactivation case. For deactivation, Rel-15 Duplication MAC CE can switch off all secondary RLC entities of one DRB using only one bit.  |
| Sharp | Yes | Agree with LG. |
| Huawei, Hisilicon | Yes | Should be acceptable, as long as Rel-16 duplication MAC CE is workable. |
| Fujitsu | Yes | We have tdoc in R2-2002956. |
| Apple | Yes | We agree with Spreadtrum that it would be feasible to use R15 Duplication MAC CE to deactivate duplication. However, considering the stage of discussions and Rel16, we agree with rapporteur to no use R15 Duplication MAC CE for Rel 16 Duplication configuration. |
| OPPO | No but | Benefit could be seen on using R15 Duplication MAC CE on activation/deactivation of R16 duplication. But we are ok if majority think not to capture the usage in this release. |
| CATT | No | Since we agree the benefit of using Rel-15 Duplication MAC CE and Rel-15 Duplication MAC CE has been applied with the deployment of NR Rel-15 commercial networks, time limitation is a strange reason to block it. We can compromise to a simple way (such as using active RLCs in initial state when Rel-15 MAC CE indicates “1” to a duplication deactivated DRB) for Rel-15 Duplication MAC CE application. |
| Nokia | It depends | We would like to first clarify: When a DRB is configured with two RLC entities only in Rel-16, is this considered as a Rel-16 configuration or a Rel-15 configuration ?From our point of view, Rel-15 MAC CE should be applicable to DRBs configured with only 2 RLC entities at least, even in Rel-16. |
| vivo | Yes | If re-using the Rel-15 MAC CE causes too much change in the specification, maybe this MAC CE can be removed for the multi-leg duplication. |

If it is decided that the Rel-15 MAC CE can be used for Rel-16 Duplication configuration, further issue should be resolved, i.e. what is the status of secondary RLC entity when the Rel-15 MAC CE indicates duplication activation. At the RAN2#109e meeting, companies were quite evenly split, i.e. 7 companies for “activated state” and 6 companies for “initial state”. For the quick resolution of this issue in case that the Rel-15 MAC CE is decided to be used for Rel-16 Duplication configuration, the rapporteur further proposes to go with absolute majority, i.e. set the secondary RLC entity to “activated state”.

**Proposal 2: If Rel-15 MAC CE can be used for Rel-16 Duplication configuration, all secondary RLC entities are activated when Rel-15 MAC CE indicates “duplication activation”.**

**Question 2. Can you accept the proposal 2?**

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| **Company** | **Q2 Yes/No** | **Comment** |
| LG | Yes |  |
| Samsung | Yes |  |
| Spreadtrum | Yes |  |
| Sharp | Yes |  |
| Huawei, Hisilicon | No | Not sure how the network can set the bit for a duplication DRB if the network does not want to modify its current duplication state, e.g. only 2 of 3 RLC channels are activated. |
| Fujitsu | No, but | The number 7 is just a “slight majority” to us, but we can accept P2 if deciding based on strictly “absolute majority”. |
| Apple | No | We prefer to not use Rel15 MAC CE for Rel16 Duplication configuration. In addition, if Rel15 MAC CE is used for activation, for specification simplicity, we would go to the “initial state” in RRC signaling. |
| OPPO | No | Better choice could be made. Activation state set to RRC configured initial state or the most recently configured state seems more reasonable.  |
| CATT | No | It impairs resource efficiency and can be a reason to block the Rel-15 MAC CE actually.First of all, we should keep the duplication state and activated RLCs when Rel-15 MAC CE indicates “1” to a duplication activated DRB. |
| Nokia | Yes | We are okay with both “all legs are activated” and “go to initial state” |
| vivo | Yes |  |

For the potential easy agreement proposals, the rapporteur just asks whether companies are willing to accept the proposal. For the quick progress, the rapporteur also provides text proposals, and companies are asked to check whether the text proposal is ok.

**Proposal 3: If the *duplicationState* is absent, the initial duplication states are deactivated for all RLC entities.**

**Question 3. Can you accept the proposal 3?**

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| **Company** | **Q3 Yes/No** | **Comment** |
| LG | Yes |  |
| Samsung | Yes | Absence means that the uplink duplication is not configured. |
| Spreadtrum | Yes |  |
| Sharp | No | For DRB, Proposal 3 works. But for SRB, proposal 3 conflicts with the following agreement in RAN2\_109e:*─ For SRBs, all secondary RLC entities are activated when configured**─ MAC CE based activation/deactivation of PDCP duplication is not supported for SRBs*The above agreement also has been captured in the endorsed TS38331 running CR as below.***duplicationState****This field indicates the initial uplink PDCP duplication state for the associated RLC entities. If set to true, the initial PDCP duplication state is activated for the associated RLC entity. The index for the indication is determined by ascending order of logical channel ID of all RLC entities other than the primary RLC entity indicated by primaryPath in the order of MCG and SCG, as in clause 6.1.3.Y of TS 38.321 [3]. If the number of associated RLC entities other than the primary RLC entity is two, UE ignores the value in the largest index of this field. The initial PDCP duplication state of the associated RLC entity is always activated for SRB.* So, at least for SRB, if the duplicationState is absent, the initial duplication states should be activated for all RLC entities. This can also be applied to DRB if companies think the same behaviour is preferred for SRB and DRB. |
| Huawei, Hisilicon | Yes | No strong opinion. Also fine to make it mandatory when Rel-16 duplication is configured. |
| Fujitsu | Yes |  |
| Apple | Yes |  |
| OPPO | Yes | Only when *moreThanTwoRLC-r16* IEis absent, the duplication is not configured, which is clearly stated in the TS 38.331. |
| CATT | Yes |  |
| Nokia | Yes |  |
| vivo | Yes |  |

**Question 3-1: If the answer to Q3 is yes, are you ok with the following text proposal?**

| *PDCP-Config* field descriptions |
| --- |
| ***duplicationState***This field indicates the initial uplink PDCP duplication state for the associated RLC entities. If set to *true,* the initial PDCP duplication state is activated for the associated RLC entity. If the field is absent, the initial PDCP duplication states are deactivated for all associated RLC entities. The index for the indication is determined by ascending order of logical channel ID of all RLC entities other than the primary RLC entityindicated by *primaryPath* in the order of MCG and SCG, as in clause 6.1.3.Y of TS 38.321 [3]. If the number of associated RLC entities other than the primary RLC entity is two, UE ignores the value in the largest index of this field. The initial PDCP duplication state of the associated RLC entity is always activated for SRB. |

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| **Company** | **Q3-1 Yes/No** | **Comment** |
| LG | Yes |  |
| Samsung | Yes |  |
| Spreadtrum | Yes |  |
| Sharp | No | The proposed text conflicts with the last sentence in the field description “The initial PDCP duplication state of the associated RLC entity is always activated for SRB.” |
| Huawei, Hisilicon | Yes | As said above, no strong view. |
| Fujitsu | Yes |  |
| Apple | No | Agree with Sharp to account for SRB and the update should be restricted to DRB |
| OPPO | Yes |  |
| CATT | Yes |  |
| Nokia | Yes but | Perhaps some additional text like “this is not applicable to SRB” can resolve some of the concerns. |
| vivo | Yes  | Agree with Nokia’s additional text. |

**Proposal 4: Change the PDCP specification, e.g. update the definition of split secondary RLC entity, to specify the setting of the split secondary RLC entity for the PDCP entity associated with only two RLC entities.**

**Question 4. Can you accept the proposal 4?**

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| **Company** | **Q4 Yes/No** | **Comment** |
| LG | Yes |  |
| Samsung | Yes |  |
| Spreadtrum | Yes |  |
| Sharp | Yes | We agree to update the definition of split secondary RLC entity. |
| Huawei, Hisilicon | Yes |  |
| Fujitsu | Yes |  |
| Apple | Yes |  |
| OPPO | Yes |  |
| CATT | Yes |  |
| Nokia | yes |  |
| vivo | Yes |  |

**Question 4-1: If the answer to Q4 is yes, are you ok with the following text proposal?**

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| **Split secondary RLC entity**: in dual connectivity, the RLC entity other than the primary RLC entity which is responsible for split bearer operation. If the PDCP entity is associated with two RLC entities, the split secondary RLC entity is the RLC entity other than the primary RLC entity. If the PDCP entity is associated with more than two RLC entities, the split secondary RLC entity is configured by upper layers. |

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| **Company** | **Q4-1 Yes/No** | **Comment** |
| LG | Yes |  |
| Samsung | Yes |  |
| Spreadtrum | Yes |  |
| Sharp | Yes |  |
| Huawei, Hisilicon | Yes |  |
| Fujitsu | Yes |  |
| Apple | Yes |  |
| OPPO | Yes  |  |
| CATT | Yes |  |
| Nokia | Yes |  |
| vivo | Yes |  |

**Proposal 5: Change the PDCP specification to clearly specify that PDCP duplication is deactivated for the DRB when all secondary RLC entities are deactivated.**

**Question 5. Can you accept the proposal 5?**

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| **Company** | **Q5 Yes/No** | **Comment** |
| LG | Yes |  |
| Samsung | Yes |  |
| Spreadtrum | Yes |  |
| Sharp | Yes |  |
| Huawei, Hisilicon | No | No strong view. Seems the changes below are not so valuable. |
| Fujitsu | Yes |  |
| Apple | Yes |  |
| OPPO | Yes in principle |  |
| CATT | Yes |  |
| Nokia | Yes |  |
| vivo | Yes |  |

**Question 5-1: If the answer to Q5 is yes, are you ok with the following text proposal?**

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| 5.2.1 Transmit operationAt reception of a PDCP SDU from upper layers, the transmitting PDCP entity shall:- start the *discardTimer* associated with this PDCP SDU (if configured).For a PDCP SDU received from upper layers, the transmitting PDCP entity shall:- associate the COUNT value corresponding to TX\_NEXT to this PDCP SDU;NOTE 1: Associating more than half of the PDCP SN space of contiguous PDCP SDUs with PDCP SNs, when e.g., the PDCP SDUs are discarded or transmitted without acknowledgement, may cause HFN desynchronization problem. How to prevent HFN desynchronization problem is left up to UE implementation.- perform header compression of the PDCP SDU using ROHC as specified in the clause 5.7.4 and/or using EHC as specified in the clause 5.X.4;- perform integrity protection, and ciphering using the TX\_NEXT as specified in the clause 5.9 and 5.8, respectively;- set the PDCP SN of the PDCP Data PDU to TX\_NEXT modulo 2[*pdcp-SN-SizeUL*];- increment TX\_NEXT by one;- submit the resulting PDCP Data PDU to lower layer as specified below.When submitting a PDCP PDU to lower layer, the transmitting PDCP entity shall:- if the transmitting PDCP entity is associated with one RLC entity:- submit the PDCP PDU to the associated RLC entity;- else, if the transmitting PDCP entity is associated with at least two RLC entities:- if the PDCP duplication is activated for the DRB:- if the PDCP PDU is a PDCP Data PDU:- duplicate the PDCP Data PDU and submit the PDCP Data PDU to the associated RLC entities activated for PDCP duplication;- else:- submit the PDCP Control PDU to the primary RLC entity;- else (i.e. the PDCP duplication is deactivated for the DRB):- if the split secondary RLC entity is configured; and- if the total amount of PDCP data volume and RLC data volume pending for initial transmission (as specified in TS 38.322 [5]) in the primary RLC entity and the split secondary RLC entity is equal to or larger than *ul-DataSplitThreshold*:- submit the PDCP PDU to either the primary RLC entity or the split secondary RLC entity;- else:- submit the PDCP PDU to the primary RLC entity.NOTE 2: If the transmitting PDCP entity is associated with two RLC entities, the UE should minimize the amount of PDCP PDUs submitted to lower layers before receiving request from lower layers and minimize the PDCP SN gap between PDCP PDUs submitted to two associated RLC entities to minimize PDCP reordering delay in the receiving PDCP entity.5.6 Data volume calculationFor the purpose of MAC buffer status reporting, the transmitting PDCP entity shall consider the following as PDCP data volume:- the PDCP SDUs for which no PDCP Data PDUs have been constructed;- the PDCP Data PDUs that have not been submitted to lower layers;- the PDCP Control PDUs;- for AM DRBs, the PDCP SDUs to be retransmitted according to clause 5.1.2;- for AM DRBs, the PDCP Data PDUs to be retransmitted according to clause 5.5.If the transmitting PDCP entity is associated with at least two RLC entities, when indicating the PDCP data volume to a MAC entity for BSR triggering and Buffer Size calculation (as specified in TS 38.321 [4] and TS 36.321 [12]), the transmitting PDCP entity shall:- if the PDCP duplication is activated for the DRB:- indicate the PDCP data volume to the MAC entity associated with the primary RLC entity;- indicate the PDCP data volume excluding the PDCP Control PDU to the MAC entity associated with the RLC entity other than the primary RLC entity activated for PDCP duplication;- indicate the PDCP data volume as 0 to the MAC entity associated with RLC entity deactivated for PDCP duplication;- else (i.e. the PDCP duplication is deactivated for the DRB):- if the split secondary RLC entity is configured; and- if the total amount of PDCP data volume and RLC data volume pending for initial transmission (as specified in TS 38.322 [5]) in the primary RLC entity and the split secondary RLC entity is equal to or larger than *ul-DataSplitThreshold*:- indicate the PDCP data volume to both the MAC entity associated with the primary RLC entity and the MAC entity associated with the split secondary RLC entity;- indicate the PDCP data volume as 0 to the MAC entity associated with RLC entity other than the primary RLC entity and the split secondary RLC entity;- else:- indicate the PDCP data volume to the MAC entity associated with the primary RLC entity;- indicate the PDCP data volume as 0 to the MAC entity associated with the RLC entity other than the primary RLC entity.5.11 PDCP duplication5.11.1 Activation/Deactivation of PDCP duplicationFor the PDCP entity configured with *pdcp-Duplication*, the transmitting PDCP entity shall:- for SRBs:- activate the PDCP duplication;- for DRBs:- if the activation of PDCP duplication is indicated:- activate the PDCP duplication for the indicated associated RLC entities;- if the deactivation of PDCP duplication is indicated:- deactivate the PDCP duplication for the indicated associated RLC entities;- if all associated RLC entities other than the primary RLC entity are deactivated for PDCP duplication: - deactivate the PDCP duplication for the DRB./\* Editor’s Note: The text needs to be updated after the roles of Rel-15 Duplication MAC CE and Rel-16 Duplication MAC CE are decided. |

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| **Company** | **Q5-1 Yes/No** | **Comment** |
| LG | Yes |  |
| Samsung | Yes |  |
| Spreadtrum | Yes |  |
| Sharp | Yes |  |
| Huawei, Hisilicon | No | Seems the key part added is the following:- if all associated RLC entities other than the primary RLC entity are deactivated for PDCP duplication: - deactivate the PDCP duplication for the DRB.But in its parent bullet, it already says:- if the deactivation of PDCP duplication is indicated:Not sure there is any value for this addition. |
| Fujitsu | Yes |  |
| Apple | Yes |  |
| OPPO | No | Agree with Huawei |
| CATT | No | Agree with HW. |
| Nokia | Yes/No | We agree with the changes in Section 5.2.1 and Section 5.6 as it makes the specification more clear.But we do have the similar concern as Huawei on the changes in Section 5.11.1.Perhaps we can change the parent bullet to something like:if the deactivation of PDCP duplication for at least one associated RLC entities is indicated: |
| vivo | No | Agree with Huawei. |

**Proposal 6: Confirm that index I for RLCi field of Rel-16 MAC CE is determined by ascending order of logical channel ID of secondary RLC entities in MCG and SCG.**

**Question 6. Can you accept the proposal 6, and remove the Editor’s Note from the MAC specification?**

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| **Company** | **Q6 Yes/No** | **Comment** |
| LG | Yes |  |
| Samsung | Yes |  |
| Spreadtrum | Yes |  |
| Sharp | Yes |  |
| Fujitsu | Yes |  |
| Apple | Yes |  |
| OPPO | Yes |  |
| CATT | Yes |  |
| Nokia | Yes |  |
| vivo | Yes |  |

One issue was brought up by CATT (R2-2002757) that the meaning of “CA duplication” in the description of *allowedServingCells* is the “CA-only duplication”, and propose to change the MAC specification, as follows:

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| 2> *allowedServingCells*, if configured, includes the Cell information associated to the UL grant. Does not apply to logical channels associated with a DRB configured with PDCP duplication within only one~~the same~~ MAC entity (i.e. CA-only duplication) for which PDCP duplication is deactivated; and |

**Proposal 7: Clarify in MAC specification that, when configured, *allowedServingCells* always applies, except when the logical channel is associated with a DRB configured with PDCP duplication within only one MAC entity (i.e. CA-only duplication) for which PDCP duplication is deactivated.**

**Question 7. Can you accept the proposal 7?**

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| **Company** | **Q7 Yes/No** | **Comment** |
| LG | No | We don’t see any critical problem with current behavior, i.e. remove the restriction at duplication deactivation only for “CA duplication”. |
| Samsung | Yes | It seems that there is no technical change of the existing behavior. |
| Spreadtrum | No | We think the current “CA duplication” is clear enough and no change is needed. |
| Huawei, Hisilicon | No | We think we need to first understand clearly how to define CA duplication now. |
| Fujitsu | No | The key point in the tdoc R2-2002757 is the terminology “CA duplication” is ambiguous. i.e. it may include both cases “CA-only duplication” and “DC+CA duplication”. The consequence is that the logical channel restriction may be wrongly applied to “DC+CA duplication”.However, we think that definition of “CA duplication” is already clear in TS38.300 Section 16.1.3 as shown below. Therefore, there is no ambiguity in the current MAC spec i.e. the logical channel restriction is only applied to “CA duplication”.TS38.300 16.1.3 Packet Duplication(omit)When duplication is activated, the original PDCP PDU and the corresponding duplicate(s) shall not be transmitted on the same carrier. The primary and secondary logical channels can either belong to the same MAC entity (referred to as CA duplication) or to different ones (referred to as DC or DC+CA duplication). CA duplication can be configured together with DC duplication when duplication over more than two legs is configured in the UE. In CA duplication, logical channel mapping restrictions are used in MAC to ensure that the primary and secondary logical channels are not sent on the same carrier. When CA duplication is configured for an SRB, one of the logical channels associated to the SRB is mapped to SpCell.==================== |
| Apple | No | For the proposed change, CA-only duplication is a new term and should be defined first |
| OPPO | Yes | OK to clarification |
| CATT | Yes | It is aligned with NR Rel-15 operation for ***allo****wedServingCells* application for both CA duplication and DC duplication. If we don’t want to discuss any optimization for LCH-to-cell restriction, P7 is a safest way. |
| Nokia | No | We don’t think it is appropriate to trigger discussion on defining new terms at this stage. |
| vivo | No strong view | We are ok to add some clarifications if most companies consider the term CA duplication is not clear. |

**Question 7-1: If the answer to Q7 is yes, are you ok with the above text proposal?**

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| **Company** | **Q7-1 Yes/No** | **Comment** |
| LG | No | We don’t want to introduce a new terminology “CA-only duplication”. It is still not clear. |
| Samsung | Yes | It seems that there is no technical change. The proposed TP looks clear. |
| Spreadtrum | No | We think no change is needed. |
| Huawei, Hisilicon | No | We also don’t like the new terminology “CA-only duplication”.  |
| OPPO | NO | Agree with LG that new terminology is no need to be introduced. Suggest deleting ‘(i.e. CA-only duplication)’. Other modifications to the sentence are OK. |
| CATT | Yes | Again, taking below figure as an example, the question is when RLC2 and RLC3 are deactivated, whether ***allo****wedServingCells* is applied to RLC1.According to the agreement of LCH-to-cell restriction on DC duplication in NR Rel-15, the answer is yes.Note we are not so strong on “CA-only”, we think we could remove the whole parenthesis to avoid any confusion. But we are strong on fixing “PDCP duplication within only one~~the same~~ MAC entity”, as it definitely clarifies that above configuration does not meet this condition. |
| Nokia | No |  |
| vivo | Yes |  |

# 3. Summary of Part 1 discussions