**3GPP TSG-RAN WG1 Meeting #115 R1-23xxxxx**

**Chicago, USA, November 13 – 17, 2023**

**Agenda Item: 7.1**

**Source: Huawei,** **HiSilicon**

**Title: Summary of discussion on the HARQ-ACK Multiplexing in Multi-PUSCH scheduling**

**Document for: Discussion and Decision**

# Introduction

In RAN1#114bis meeting, HARQ-ACK multiplexing in multiple-PUSCH scheduling was discussed. For the usage of UL DAI for multi-PUSCH scheduling, the following agreement was captured in the Chair’s Note.

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| If the PUSCH transmission over the multiple slots is scheduled by a DCI format that includes a DAI field, or if the multiple PUSCHs over **the** multiple slots are scheduled by a DCI format that includes a DAI field, the value of the DAI field is applicable for multiplexing HARQ-ACK information in the PUSCH transmission in any slot from the multiple slots where the UE multiplexes HARQ-ACK information. |

For different HARQ-ACK CB size for PUSCH repetitions and multi-PUSCH scheduling, the following proposal were discussed but not agreed in RAN1#114bis.

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| **Proposal for conclusion**  For a PUSCH over N slots or N PUSCHs over multiple slots that are scheduled by a DCI format 0\_1, when HARQ-ACK is multiplexed on more than one PUSCH transmission from the PUSCH over N slots or the N PUSCHs, the size of HARQ-ACK CB is determined per PUSCH transmission.   * No spec change is necessary. |

# Discussion

During the online discussion, there is one concern on the case of PUSCH repetition type B and the proposed conclusion in was not endorsed.

In R1-2311668, Apple proposed to capture following conclusion

***Proposal 1: It must be concluded in RAN1 that***

* ***For a PUSCH repetition Type-A or Type-B over N slots or N PUSCHs over multiple slots that are scheduled by a DCI format 0\_1, when HARQ-ACK is multiplexed on more than one PUSCH transmission from the PUSCH over N slots or the N PUSCHs, the size of HARQ-ACK CB is determined per PUSCH transmission.***
* ***No spec change is necessary.***

In R1-2312222, Huawei, HiSilicon proposed to capture following conclusion

***Proposal 1: Capture the following conclusion in Chair’s Note***

***For a PUSCH over N slots or N PUSCHs over multiple slots that are scheduled by a DCI format 0\_1, when HARQ-ACK is multiplexed on more than one PUSCH transmission from the PUSCH over N slots or the N PUSCHs, the size of HARQ-ACK CB is determined per PUSCH transmission.***

* ***A PUSCH transmission is an (actual) repetition of a PUSCH over N slots or a PUSCH of N PUSCHs over multiple slots***
* ***No specification change is needed***

According to current specification in clause 9 of TS38.213, the text of “If a UE transmits a PUSCH over multiple slots or multiple PUSCHs over multiple slots that are scheduled by a DCI format 0\_1” include both PUSCH repetition type A and type B. Thus, the size of HARQ CB in different slots of a PUSCH are calculated individually, irrespective of the repetition type. Furthermore, if a PUCCH in a slot overlaps with multiple actual repetition of a PUSCH in a slot for repetition type B, the earliest actual repetition of PUSCH in a slot overlapped with PUCCH would be used to multiplex the UCI. Thus, the following conclusion are proposed to be captured in Chair’s Note.

**FL Proposal: Capture the following conclusion in Chair’s Note**

**For a PUSCH repetition Type-A or Type-B over N slots or N PUSCHs over multiple slots that are scheduled by a DCI format 0\_1, when HARQ-ACK is multiplexed on more than one PUSCH transmission from the PUSCH over N slots or the N PUSCHs, the size of HARQ-ACK CB is determined per PUSCH transmission.**

* **A PUSCH transmission is an (actual) repetition of a PUSCH over N slots or a PUSCH of N PUSCHs over multiple slots**
* **No specification change is needed**

Companies please provide your views on the FL proposal in the following table.

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| Company | Y/N | Comment |
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# Conclusion