**3GPP TSG RAN WG1 Meeting #107-e R1-21xxxxx**

**e-Meeting, November 11th – 19th, 2021**

**Agenda Item: 7.1**

**Source: Moderator (Huawei)**

**Title: Summary of [107-e-NR-7.1CRs-03]: Correction on data and control multiplexing**

**Document for: Discussion and Decision**

# Introduction

This document is created to collect company views on the proposed changes in [1].

# Background

According to [1], in section 6.2.7 of TS 38.212 on Data and control multiplexing, if the number of HARQ-ACK bits is less than or equal to 2, and only HARQ-ACK and CSI part 1 are present for transmission on the PUSCH without UL-SCH, the reserved resource for potential HARQ-ACK transmission is not subtracted when calculating the number of coded bit for CSI part 1.

- if only HARQ-ACK and CSI part 1 are present for transmission on the PUSCH without UL-SCH, let

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- ;

- ; and

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# Discussion

During the preparation phase, two companies raised similar comments as follows

**Comment 1:** CR is not needed since it was already specified in clause 6.3.2.1.1 in TS 38.212 that UE always assume 2 bits AN transmission when there is no more than 2 bits AN if UCI is transmitted on PUSCH without UL-SCH and the UCI includes CSI part 1 without CSI part 2, which means that G-ACK equals to G-rvd-ACK for such case.

**Comment 2:** According to section 6.3.2.1.1 in 212, the number of HARQ-ACK bits is set to 2 if the number of HARQ-ACK bits < 2 bits. With this condition, G^ACK(1) = G^ACK\_rvd(1) in case of the number of HARQ-ACK bits = 2 bits (according to section 6.2.7). Therefore, the end result is the same even without the proposal.

From the moderator’s point of view, it is true that one can infer that G-ACK equals to G-rvd-ACK for such case if one looks at both section 6.3.2.1.1 and section 6.2.7. Therefore, it may be good to collect company views on whether the other companies share the same view and whether there is a need to adopt the change to make the specification clearer.

# Company views

**Q1: Do you agree that according to section 6.3.2.1.1 in TS 38.212, a UE always assume 2 HARQ-ACK bits when there is no more than 2 HARQ-ACK bits if UCI is transmitted on PUSCH without UL-SCH and the UCI includes CSI part 1 without CSI part 2, which means that in section 6.2.7, G-ACK equals to G-rvd-ACK for such case? If not, why?**

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| --- | --- | --- |
| **Company** | **Agree or not** | **Comment** |
| Samsung | Agree | G-ACK and G-rvd-ACK is the same by specification.  In Rel-15, the basic design principle is that all reserved REs for potential HARQ-ACK transmission (assuming 2bits) is used for actual HARQ-ACK transmission when only HARQ-ACK and CSI part 1 are present on the PUSCH without UL-SCH.  Also, if G-ACK is not equal to G-rvd-ACK, it means that there are some ‘EMPTY’ REs not mapped to HARQ-ACK and CSI part 1 but the specification does not describe how to fill the “EMPTY” REs, e.g., 0s or dummy bits.  Detail descriptions in the specification are shown below:  In section 6.3.2.1.1, if the number of HARQ-ACK is less than 2 bits (i.e., 0bit or 1bit), add 0s to generate 2 bits  6.3.2.1.1 HARQ-ACK  If HARQ-ACK bits are transmitted on a PUSCH, the UCI bit sequence  is determined as follows:  - If UCI is transmitted on PUSCH without UL-SCH and the UCI includes CSI part 1 without CSI part 2,   * - if there is no HARQ-ACK bit given by Clause 9.1 of [5, TS 38.213], set , , and ; * - if there is only one HARQ-ACK bit  given by Clause 9.1 of [5, TS 38.213], set , , and ;   - otherwise, set  for  and , where the HARQ-ACK bit sequence  is given by Clause 9.1 of [5, TS 38.213].  In section 6.3.2.4.1.1, the number of symbols, Q’\_ACK is determined by the number of HARQ-ACK bits, where the number of HARQ-ACK bits is O\_ACK = A and A = 2 in this case. Note that O\_ACK = A is not described in the specification clearly, so we suggest to clarity it (see the potential conclusion below).  6.3.2.4.1.1 HARQ-ACK  […]  For HARQ-ACK transmission on PUSCH without UL-SCH, the number of coded modulation symbols per layer for HARQ-ACK transmission, denoted as , is determined as follows:    where  -  is the number of HARQ-ACK bits;  - if , ; otherwise  is the number of CRC bits for HARQ-ACK defined according to Clause 6.3.1.2.1;;  In section 6.2.7, G\_rvd^ACK is derived by setting O\_ACK = 2 so that we can arrive at G\_rvd^ACK = G^ACK.  6.2.7 Data and control multiplexing  […]  - if only HARQ-ACK and CSI part 1 are present for transmission on the PUSCH without UL-SCH, let  - ;  - ;  - ; and  - ;  […]  if the number of HARQ-ACK information bits to be transmitted on PUSCH is 0, 1 or 2 bits  the number of reserved resource elements for potential HARQ-ACK transmission is calculated according to Clause 6.3.2.4.2.1, by setting ;  denote  as the number of coded bits for potential HARQ-ACK transmission using the reserved resource elements;  if frequency hopping is configured for the PUSCH, let  and ;  if frequency hopping is not configured for the PUSCH, let ;  One thing to be clarified here, we assume OACK = A when determining Q’\_ACK in 6.3.2.4.1.1. So, we suggest to make a conclusion to avoid any potential confusion.  **Potential conclusion:**  In section 6.3.2.4.1.1 in TS38.212, when determining Q’\_ACK, O\_ACK is the number of HARQ-ACK bits derived in section 6.3.2.1.1 in TS38.212. |
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**Q2: Do you think the changes in section 6.2.7 as proposed in [1] is necessary? If not, why?**

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| **Company** | **Agree or not** | **Comment** |
| Samsung | Not | As we commented in Q1, it is obvious that G^ACK = G\_rvd^ACK. So, the current specification is not broken. |
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# Conclusions

To be updated based on the discussion

# References

1. R1-2110870, Correction on data and control multiplexing, Huawei, HiSilicon

# Appendix: Proposed CR in R1-2110870

6.2.7 Data and control multiplexing

< Unchanged part is omitted >

If frequency hopping is configured for the PUSCH,

- denote  as the OFDM symbol index of the first OFDM symbol after the first set of consecutive OFDM symbol(s) carrying DMRS in the first hop;

- denote  as the OFDM symbol index of the first OFDM symbol after the first set of consecutive OFDM symbol(s) carrying DMRS in the second hop.

- denote  as the OFDM symbol index of the first OFDM symbol that does not carry DMRS in the first hop;

- denote  as the OFDM symbol index of the first OFDM symbol that does not carry DMRS in the second hop;

- if HARQ-ACK is present for transmission on the PUSCH with UL-SCH, let

-  and ;

- if CSI is present for transmission on the PUSCH with UL-SCH, let

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- ; and

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- if only HARQ-ACK and CSI part 1 are present for transmission on the PUSCH without UL-SCH, let

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- if the number of HARQ-ACK information bits is more than 2, ; otherwise,

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- if HARQ-ACK, CSI part 1 and CSI part 2 are present for transmission on the PUSCH without UL-SCH, let

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- if the number of HARQ-ACK information bits is more than 2, ; otherwise, 

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-  if the number of HARQ-ACK information bits is no more than 2, and  otherwise; and

-  if the number of HARQ-ACK information bits is no more than 2, and  otherwise;

- if only CSI part 1 and CSI part 2 are present for transmission on the PUSCH without UL-SCH, let

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- ;

- ; and

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- let , and denote ,  as the number of OFDM symbols of the PUSCH in the first and second hop, respectively;

-  is the number of transmission layers of the PUSCH;

-  is the modulation order of the PUSCH;

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< Unchanged part is omitted >