**3GPP TSG RAN WG1 #104-e R1-210xxxx**

**e-Meeting, January 25th – February 5th, 2021**

**Agenda item:** 6.1

**Source:** Moderator (Samsung)

**Title:** Summary of [104-e-LTE-6.1CRs-04] on UCI multiplexing for partial PUSCH mode 1

**Document for:** Discussion and Decision

# Introduction

This document is a summary for following email discussion [104-e-LTE-6.1CRs-04] on UCI multiplexing for partial PUSCH mode 1 in FeLAA.

[104-e-LTE-6.1CRs-04] Email discussion/approval R1-2101577 and R1-2101578 (LTE-unlic) by Jan-29 – Jinyoung (Samsung)

# Discussion

According to current TS36.212 specification, as pointed out in [1], UCI is always mapped to the 2nd slot of a subframe.

*5.2.2.7A Data and control multiplexing for Partial PUSCH Mode 1*

*If the control information is channel quality information and the control information is transmitted on the Partial PUSCH Mode 1, the UL-SCH data information and control information are multiplexed such that the CQI/PMI information is present only on the second slot of the subframe.*

…

*5.2.2.8  Channel interleaver*

*The channel interleaver described in this subclause in conjunction with the resource element mapping for PUSCH in [2] implements a time-first mapping of modulation symbols onto the transmit waveform while ensuring that*

*-   if the PUSCH is Partial PUSCH Mode 1, the CQI/PMI and RI information are present only on the second slot of the subframe regardless of the number of actually transmitted slot(s) for the subframe based on the result of the channel access procedure in 4.2.1 defined in [8];*

However, if we follow the step (3a) in Section 5.2.2.8 of TS36.212, there is a case that CQI/PMI information is transmitted in the first slot of a subframe with Partial PUSCH mode 1, which contradicts with the above two descriptions.

|  |
| --- |
| (3a) If CQI/PMI information is transmitted in this subframe with Partial PUSCH mode 1, the vector sequence  is written onto the  matrix by sets of  rows from the column with  to the column with  and rows 0 to  and skipping the matrix entries that are already occupied:    The pseudocode is as follows:  Set i, k to 0.  while k < ,  if  is not assigned to RI symbols in step (3) and    k = k + 1  end if  i = i+1  end while |

More specifically, Table 1 summarizes the first symbol index for CQI/PMI transmission based on the step (3a) for each combination of starting and ending symbol.

Table 1. First symbol index for UCI

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Case |  |  |  | (=) | First symbol index for UCI |
| 1 | 0 |  | 0 | 12 | 6 |
| 2 | 0 |  | 1 | 11 | 5 |
| 3 | 1 |  | 0 | 11 | 5 |
| 4 | 1 |  | 1 | 10 | 5 |

Table 2 shows symbol index in a subframe according to the calculated first symbol index for UCI in Table 1. As shown in Table 2, when and (i.e. Case 2) UCI is mapped from symbol #6 in the first slot of subframe, which should be corrected so that UCI is mapped from symbol #7 in the second slot of the subframe instead.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Symbol index in a subframe | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| Mapping | PUSCH | PUSCH | PUSCH | DM-RS | PUSCH | PUSCH | PUSCH | PUSCH | PUSCH | PUSCH | DM-RS | PUSCH | PUSCH |  |
| Symbol index for UCI | 0 | 1 | 2 |  | 3 | 4 | **5** | 6 | 7 | 8 |  | 9 | 10 | 11 |

Considering the fact that causes this issue and is associated with the first PUSCH symbol index for UCI mapping, the following TP is proposed to TS36.212 in [2]. Note that defined in Section 5.2.2.6 of TS36.212.

================================ Start of TP for TS 36.212 ==================================

5.2.2.8  Channel interleaver

============================== Unchanged Text are omitted ===============================

(3a) If CQI/PMI information is transmitted in this subframe with Partial PUSCH mode 1, the vector sequence  is written onto the  matrix by sets of  rows from the column with to the column with and rows 0 to  and skipping the matrix entries that are already occupied:



where =

The pseudocode is as follows:

Set i, k to 0.

while k < ,

if  is not assigned to RI symbols in step (3) and



k = k + 1

end if

i = i+1

end while

================================ Unchanged Text Omitted ==================================

================================ End of TP for TS 36.212 ==================================

Please provide your comments to the proposed TP.

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Sharp | Support the TP. The issue is valid, and the proposed change solves the issue. |
| LG Electronics | Support the TP. |
| Huawei, HiSilicon | Support the TP. |
| NTT DOCOMO | Support the TP. |
| QC | We are OK with the TP |
|  |  |
|  |  |

Note that if the proposed TP is agreed a shadowing CR for Rel-16 is also necessary.

# Summary

To be added.

# Reference

[1] R1-2101577 Discussion on UCI multiplexing for partial PUSCH mode 1 Samsung, Huawei, HiSilicon

[2] R1-2101578 Draft 36.212 CR on UCI multiplexing for partial PUSCH mode 1 Samsung, Huawei, HiSilicon