[102-e-NR-5G\_V2X\_NRSL-PHYstructure-01] Email discussion/approval w.r.t. “PSCCH and 2nd SCI related issue including their RS”: 1A, 1B, 9F (as in the summary) by 08/21, with potential TPs by 8/26 – Jeongho (Samsung)

This document has the following questions.

1A. Maximum length of 2nd SCI rate matching

1B. Starting symbol, resource, Q\_2ndSCI

-B1

-B2

-B3

9F. Number of PSCCH RBs when sub-channel size is less than 20 PRBs

# **A. Maximum length of 2nd SCI rate matching**

In current specifications (TS38.212), the maximum length (*K*) of 2nd SCI for rate matching is not defined yet.

* The output bit sequence after rate matching is denoted as $g\_{0}^{SCI2}, g\_{1}^{SCI2}, g\_{2}^{SCI2}, g\_{3}^{SCI2},\cdots , g\_{G^{SCI2}-1}^{SCI2}$, where $G^{SCI2}=Q\_{SCI2}^{'}∙Q\_{m}^{SCI2}$ and $Q\_{m}^{SCI2}$ is modulation order of the 2nd-stage SCI. A UE is not expected to have$ G^{SCI2}>K$.

In RAN1#102-e, a number of contributions are submitted [Futurewei], [vivo], [CATT], [Huawei, HiSilicon], [Intel], [Ericsson], [Apple], [Qualcomm] with the following alternatives.

* Alt 1. 2048: Futurewei, Huawei, HiSilicon, Apple
* Alt 2. 4096: vivo, CATT, Intel, Ericsson, Qualcomm
* Alt 3. Other value.

Please provide your views and reason.

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# **B. resource mapping of 2nd SCI**

Regarding the resource mapping of the 2nd SCI, the contributions [Futurewei], [vivo], [Panasonic], [Sharp], [Qualcomm] are submitted to RAN1#102-e.

## *Issue B-1.*

The current specifications define the 2nd SCI mapping from the first PSSCH DMRS symbols as found in Appendix 1.

Two contributions [Futurewei], [Panasonic] proposes to map the 2nd SCI around the first PSSCH DMRS, which means the symbols before/after the first PSSCH DMRS are used for 2nd SCI. One contribution proposes to map the 2nd SCI from the first PSSCH DMRS as the spec is.

* Alt 1-1. Map the 2nd SCI from the first PSSCH DMRS (as the current specifications.)
* Alt 1-2. Map the 2nd SCI around the first PSSCH DMRS
* Alt 1-3. Others

The recommendation is not to change the current specifications unless the spec breaks the systems.

Please share your views.

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## *Issue B-2.*

One contribution [vivo] proposes to use the symbols before the first symbol of PSSCH DMRS as below.

* If after the last PSSCH symbol there are still 2nd SCI REs left, these remaining REs are mapped from the starting symbol of PSSCH (excluding the AGC symbol).

Please share your views (whether to support or not) and reason.

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## *Issue B-3.*

In Appendix 2, the rate matching of 2nd SCI is captured. Two contributions [Qualcomm], [Sharp] propose to consider the number of resources used for PSCCH when calculating the maximum limit $M\_{sc}^{SCI2}(l)$ of the 2nd SCI. It means to replace $M\_{sc}^{SCI2}(l)$ = $M\_{sc}^{PSSCH}(l)$ - $M\_{sc}^{DMRS}(l)$ - $M\_{sc}^{PT-RS}(l)$ with $M\_{sc}^{SCI2}(l)$ = $M\_{sc}^{PSSCH}(l)$ - $M\_{sc}^{DMRS}(l)$ - $M\_{sc}^{PT-RS}(l)$ - $M\_{sc}^{PSCCH}(l)$, where $M\_{sc}^{PSCCH}(l)$ denotes the number of subcarriers in OFDM symbol l that carries PSCCH.

Please share your views (whether to support or not) and reason.

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# **C. Number of PSCCH RBs when sub-channel size is less than 20 PRBs**

The current specifications TS38.214 has the following:

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| 8.2.2 PSSCH DM-RS transmission procedureThe UE selects the DM-RS time domain pattern out of the patterns configured using the higher layer parameter *TimePatternPsschDmrs* for the resource pool on which the PSSCH is to be transmitted. If more than one DM-RS time domain pattern is configured, the selected pattern is indicated by the “*DMRS pattern”* field in the SCI format 0-1 associated with the PSSCH transmission.If PSSCH DMRS and PSCCH are mapped to the same OFDM symbol, then this mapping within a single sub-channel is only supported if higher layer parameter *subchannelsize* >= 20, i.e. the sub-channel size is at least 20 PRBs. |

Regarding the yellow-highlighted part, UE behavior seems unclear in the case of the part.

One contribution [LGE] proposes to remove the above yellow-highlighted part.

One contribution [Qualcomm] proposes to add the restriction on the (pre)-configuration not to allow the case that the number of PRBs for PSCCH is less than the subchannel size if subchannel size < 20.

* Alt 1. Remove the yellow-highlighted part above.
* Alt 2. Introduce a restriction on (pre-)configuration not to allow the case that the number of PRBs for PSCCH is less than the subchannel size if subchannel size < 20.
* Alt 3. Other(s), if any.

Please share your views and reasons.

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Reference

1. R1-2005292 Remaining details on physical layer structure for the sidelink FUTUREWEI
2. R1-2005307 Remaining issues of NR sidelink physical layer structure ZTE, Sanechips
3. R1-2005338 Remaining issues on physical layer structure for NR sidelink vivo
4. R1-2005646 Discussion on sidelink physical layer structure MediaTek Inc.
5. R1-2005667 Remaining issues on physical layer structure for NR sidelink CATT
6. R1-2005740 Discussion on essential corrections in physical layer structure LG Electronics
7. R1-2005761 TP on 1st symbol duplication for AGC NEC
8. R1-2005786 Remaining issues of V2X PHY layer structure Mitsubishi Electric RCE
9. R1-2005796 Remaining details of sidelink physical layer structure Huawei, HiSilicon
10. R1-2005846 Remaining opens for NR-V2X sidelink physical layer structure Intel Corporation
11. R1-2005997 Remaining issues on physical structure for NR sidelink OPPO
12. R1-2006074 Remaining issues on PHY structure for NR V2X InterDigital, Inc.
13. R1-2006099 On Physical Layer Structures for NR Sidelink Samsung
14. R1-2006254 Remaining issues for sidelink physical layer structure Spreadtrum Communications
15. R1-2006433 TPs related to PHY structures Ericsson
16. R1-2006484 On Remaining Issues of Sidelink Physical Layer Structure Apple
17. R1-2006535 Remaining issue on physical layer structure for sidelink in NR V2X Panasonic Corporation
18. R1-2006557 Remaining issues on physical layer structure for NR sidelink Sharp
19. R1-2006584 Remaining issues on sidelink physical layer structure on NR V2X ASUSTeK
20. R1-2006693 Maintenance for sidelink physical layer structure NTT DOCOMO, INC.
21. R1-2006768 Sidelink Physical Layer Structure Qualcomm Incorporated

Appendix 1. 2nd SCI mapping in TS38.211

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| 8.3.1.5 Mapping to virtual resource blocksFor each of the antenna ports used for transmission of the PSSCH, the block of complex-valued symbols $z^{(p)}\left(0\right), …, z^{(p)}(M\_{symb}^{ap}-1)$ shall be multiplied with the amplitude scaling factor $β\_{DMRS}^{PSSCH}$ in order to conform to the transmit power specified in [5, TS 38.213] and mapped to resource elements $(k',l)\_{p,μ}$ in the virtual resource blocks assigned for transmission, where $k^{'}=0$ is the first subcarrier in the lowest-numbered virtual resource block assigned for transmission.- The mapping operation shall be done in two steps:- first, the complex-valued symbols corresponding to the bit for the 2nd-stage SCI in increasing order of first the index $k'$ over the assigned virtual resource blocks and then the index $l$, starting a the first PSSCH symbol carrying an associated DM-RS and meeting all of the following criteria:- the corresponding resource elements in the corresponding physical resource blocks are not used for transmission of the associated DM-RS, PT-RS, or PSCCH;- secondly, the complex-valued modulation symbols not corresponding to the 2nd -stage SCI shall be in in increasing order of first the index $k'$ over the assigned virtual resource blocks, and then the index $l$ with the starting position given by [6, TS 38.214] and meeting all of the following criteria: - the resource elements are not used for 2nd-stage SCI in the first step- the corresponding resource elements in the corresponding physical resource blocks are not used for transmission of the associated DM-RS, PT-RS, CSI-RS, or PSCCH;The resource elements used for the PSSCH in the first OFDM symbol in the mapping operation above shall be duplicated in the OFDM symbol immediately preceding the first OFDM symbol in the mapping. |

Appendix 2. 2nd SCI rate matching length in TS38.212

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| 8.4.4 Rate MatchingFor 2nd-stage SCI transmission on PSSCH with SL-SCH, the number of coded modulation symbols generated for 2nd-stage SCI transmission prior to duplication for the 2nd layer if present, denoted as $Q\_{SCI2}^{'}$, is determined as follows:$$Q\_{SCI2}^{'}=min\left\{\left⌈\frac{\left(O\_{SCI2}+L\_{SCI2}\right)∙β\_{offset}^{SCI2}}{Q\_{m}^{SCI2}∙R}\right⌉, \left⌈α\sum\_{l=0}^{N\_{symbol}^{PSSCH}-1}M\_{sc}^{SCI2}(l)\right⌉\right\}+γ$$where- $O\_{SCI2}$ is the number of the 2nd-stage SCI bits - $L\_{SCI2}$ is the number of CRC bits for the 2nd-stage SCI, which is 24 bits. - $β\_{offset}^{SCI2}$ is indicated in the corresponding 1st-stage SCI. - $M\_{sc}^{PSSCH}(l)$ is the scheduled bandwidth of PSSCH transmission, expressed as a number of subcarriers;- $M\_{sc}^{DMRS}(l)$ is the number of subcarriers in OFDM symbol $l$ that carries DMRS, in the PSSCH transmission.- $M\_{sc}^{PT-RS}(l)$ is the number of subcarriers in OFDM symbol $l$ that carries PT-RS, in the PSSCH transmission.- $M\_{sc}^{SCI2}(l)$ is the number of resource elements that can be used for transmission of the 2nd-stage SCI in OFDM symbol $l$, for $l=0,1,2\cdots ,N\_{symbol}^{PSSCH}-1$ and for $N\_{symbol}^{PSSCH}=N\_{symb}^{sh}-N\_{symb}^{PSFCH}$, in PSSCH transmission, where $N\_{symb}^{sh}$$N\_{symb}^{slot}$ = *sl-lengthSymbols* - 2, where *sl-lengthSymbols* is the number of sidelink symbols within the slot provided by higher layers as defined in [6, TS 38.214]. If higher layer parameter *sl-PSFCH-Period* = 2 or 4, $N\_{symb}^{PSFCH}$ = 3 if "PSFCH overhead indication" field of SCI format 1-A indicates "1", and $N\_{symb}^{PSFCH}$ = 0 otherwise. If higher layer parameter *sl-PSFCH-Period* = 0, $N\_{symb}^{PSFCH}=0$. If higher layer parameter *sl-PSFCH-Period* is 1, $N\_{symb}^{PSFCH}=3$.- $M\_{sc}^{SCI2}(l)$ = $M\_{sc}^{PSSCH}(l)$ - $M\_{sc}^{DMRS}(l)$ - $M\_{sc}^{PT-RS}(l)$ - $γ$ is the number of vacant resource elements in the resource block to which the last coded symbol of the 2nd-stage SCI belongs.- $R$ is the coding rate as indicated by "Modulation and coding scheme" field in SCI format 1-A.- $α$ is configured by higher layer parameter *sl-Scaling*. |