**3GPP TSG RAN WG1 #101 R1-2004933**

**e-Meeting, May 25th – June 5th, 2020**

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**Source:** Moderator (LG Electronics)

**Title:** Text proposal from Email discussion thread #3 for AI 7.2.4.5 Physical layer procedures for sidelink

**Document for:** Discussion and decision

# **Introduction and proposal**

RAN1 made the agreements copied in Appendix in [101-e-NR-5G\_V2X\_NRSL-SL\_PHY\_Procedure-03] Email discussion/approval regarding HARQ operation + Sidelink CSI. This contribution includes the text proposal endorsed. It is proposed to adopt the text proposal in Section 2 for the following reasons

* Reason for change: RAN1 made the agreements to complete the UE procedure for sidelink HARQ operation and CSI reporting. The text proposal is to implement these agreements.
* Summary of change: SCI formats 2-A and 2-B and the related UE procedure are updated to introduce the fields for HARQ feedback enabling/disabling indication and the cast type indication. CQI table determination is introduced based on the indicated MCS table.
* Consequences if not approved: The specification is incomplete in supporting sidelink HARQ and CSI report.

# **Text proposal**

* 1. Text proposal for TS 38.212

===========================<Start of change #1>=======================

8.4 Sidelink control information on PSSCH

< Unchanged parts are omitted >

8.4.1 2nd-stage SCI formats

< Unchanged parts are omitted >

8.4.1.1 SCI format 2-A

SCI format 2-A is used for the decoding of PSSCH, with HARQ operation when HARQ-ACK information includes ACK or NACK, or when there is no feedback of HARQ-ACK information.

The following information is transmitted by means of the SCI format 2-A:

- HARQ Process ID – [x] bits as defined in clause 16.4 of [5, TS 38.213].

- New data indicator – 1 bit as defined in clause 16.4 of [5, TS 38.213].

- Redundancy version – 2 bits as defined in clause x.x.x of [6, TS 38.214].

- Source ID – 8 bits as defined in clause x.x.x of [6, TS 38.214].

- Destination ID – 16 bits as defined in clause x.x.x of [6, TS 38.214].

- HARQ feedback enabling/disabling indicator – 1 bit as defined in clause 16.3 of [5, TS 38.213].

- Cast type indicator – 2 bits as defined in Table 8.4.1.1-1.

- CSI request – 1 bit as defined in clause 8.2.1 of [6, TS 38.214].

**Table 8.4.1.1-1: Cast type indicator**

|  |  |
| --- | --- |
| **Value of Cast type indicator** | **Cast type** |
| 00 | Broadcast |
| 01 | Groupcast |
| 10 | Unicast |
| 11 |  |

8.4.1.2 SCI format 2-B

SCI format 2-B is used for the decoding of PSSCH, with HARQ operation when HARQ-ACK information includes only NACK, or when there is no feedback of HARQ-ACK information.

The following information is transmitted by means of the SCI format 2-B:

- HARQ Process ID – [x] bits as defined in clause 16.4 of [5, TS 38.213].

- New data indicator – 1 bit as defined in clause 16.4 of [5, TS 38.213].

- Redundancy version – 2 bits as defined in clause x.x.x of [6, TS 38.214].

- Source ID – 8 bits as defined in clause x.x.x of [6, TS 38.214].

- Destination ID – 16 bits as defined in clause x.x.x of [6, TS 38.214].

- HARQ feedback enabling/disabling indicator – 1 bit as defined in clause 16.3 of [5, TS 38.213].

- Zone ID – 12 bits as defined in clause x.x.x of [9, TS 38.331].

- Communication range requirement – 4 bits as defined in clause x.x.x of [9, TS 38.331]

< Unchanged parts are omitted >

============================<End of change #1>=======================

* 1. Text proposal for TS 38.213

===========================<Start of change #1>=======================

16.3 UE procedure for reporting HARQ-ACK on sidelink

A UE can be indicated by an SCI format scheduling a PSSCH reception, in one or more sub-channels from a number of $N\_{subch }^{PSSCH}$ sub-channels, to transmit a PSFCH with HARQ-ACK information in response to the PSSCH reception. The UE provides HARQ-ACK information that includes ACK or NACK, or only NACK.

A UE can be provided, by *periodPSFCHresource*, a number of slots in a resource pool for a period of PSFCH transmission occasion resources. If the number is zero, PSFCH transmissions from the UE in the resource pool are disabled.

A UE may be indicated by higher layers to not transmit a PSFCH in response to a PSSCH reception [11, TS 38.321].

If a UE receives a PSSCH in a resource pool and ~~a ZYX~~ the HARQ feedback enabling/disabling indicator field = 1 in the associated ~~a~~ SCI format ~~0\_~~2-A or SCI format 2-B ~~scheduling the PSSCH reception indicates to the UE to report HARQ-ACK information for the PSSCH reception~~ [5, TS 38.212], the UE provides the HARQ-ACK information in a PSFCH transmission in the resource pool. The UE transmits the PSFCH in a first slot that includes PSFCH resources and is at least a number of slots, provided by *MinTimeGapPSFCH*, of the resource pool after a last slot of the PSSCH reception.

< Unchanged parts are omitted >

A UE determines an index of a PSFCH resource for a PSFCH transmission in response to a PSSCH reception, as $\left(P\_{ID}+M\_{ID}\right)modR\_{PRB, CS}^{PSFCH}$ where $P\_{ID}$ is a physical layer source ID provided by SCI format 0\_2 [5, TS 38.212] scheduling the PSSCH reception, $M\_{ID}$ ~~is zero or~~ $M\_{ID}$ is the identity of the UE receiving the PSSCH as indicated by higher layers layers if the UE receives a SCI format 2-A with Cast type indicator field is 01, or $M\_{ID}$ is zero otherwise.

A UE determines a $m\_{0}$ value, for computing a value of cyclic shift $α$ [4, TS 38.211], from a cyclic shift pair index corresponding to a PSFCH resource index and from $N\_{CS}^{PSFCH}$using Table 16.3-1.

**Table 16.3-1: Set of cyclic shift pairs**

|  |  |
| --- | --- |
| $$N\_{CS}^{PSFCH}$$ | $$m\_{0}$$ |
| **Cyclic Shift Pair Index 0** | **Cyclic Shift Pair Index 1** | **Cyclic Shift Pair Index 2** | **Cyclic Shift Pair Index 3** | **Cyclic Shift Pair Index 4** | **Cyclic Shift Pair Index 5** |
| 1 | 0 | - | - | - | - | - |
| 2 | 0 | 3 | - | - | - | - |
| 3 | 0 | 2 | 4 | - | - | - |
| 6 | 0 | 1 | 2 | 3 | 4 | 5 |

A UE determines a $m\_{cs}$ value, for computing a value of cyclic shift $α$ [4, TS 38.211], as in Table 16.3-2 if the UE receives a SCI format 2-A with Cast type indicator field is 01 or 10 or Table 16.3-3 if the UE receives a SCI format 2-B ~~as indicated by a SCI format scheduling a PSSCH reception~~. The UE applies one cyclic shift from a cyclic shift pair to a sequence used for the PSFCH transmission [4, TS 38.211].

**Table 16.3-2: Mapping of HARQ-ACK information bit values to a cyclic shift, from a cyclic shift pair, of a sequence for a PSFCH transmission when HARQ-ACK information includes ACK or NACK**

|  |  |  |
| --- | --- | --- |
| **HARQ-ACK Value** | **0 (NACK)** | **1 (ACK)** |
| **Sequence cyclic shift** | 0 | 6 |

**Table 16.3-3: Mapping of HARQ-ACK information bit values to a cyclic shift, from a cyclic shift pair, of a sequence for a PSFCH transmission when HARQ-ACK information includes only NACK**

|  |  |  |
| --- | --- | --- |
| **HARQ-ACK Value** | **0 (NACK)** | **1 (ACK)** |
| **Sequence cyclic shift** | 0 | N/A |

============================<End of change #1>=======================

===========================<Start of change #2>=======================

16.5 UE procedure for reporting HARQ-ACK on uplink

A UE can be provided PUCCH resources or PUSCH resources [12, TS 38.331] to report HARQ-ACK information that the UE generates based on HARQ-ACK information that the UE obtains from PSFCH receptions, or from absence of PSFCH receptions.

For SL configured grant Type 1 or Type 2 PSSCH receptions by a UE within a time period provided by *periodSlCG*, the UE generates one HARQ-ACK information bit in response to the PSFCH receptions to multiplex in a PUCCH transmission occasion that is after a last time resource, in a set of time resources.

For each PSFCH reception occasion, from a number of PSFCH reception occasions that the UE generates HARQ-ACK information to report in a PUCCH or PUSCH transmission, the UE can be indicated by ~~higher layers~~ SCI to perform one of the following and the UE constructs a HARQ-ACK codeword with HARQ-ACK information, when applicable.

If the UE receives PSFCH associated with a SCI format 2-A with Cast type indicator = 10,

- generate HARQ-ACK information with same value as a value of HARQ-ACK information the UE determines from a PSFCH reception in the PSFCH reception occasion and, if the UE determines that a PSFCH is not received at the PSFCH reception occasion, generate NACK

If the UE receives PSFCH associated with a SCI format 2-A with Cast type indicator = 01,

~~- generate ACK when the UE determines ACK from each PSFCH reception for the number of PSFCH reception occasions; otherwise, generate NACK if the UE determines absence of PSFCH reception or determines a NACK value from a PSFCH reception at a corresponding PSFCH reception occasion~~

- generate ACK when the UE determines ACK from at least one PSFCH reception for the number of PSFCH reception occasions of a PSFCH resource with an index with $M\_{ID}$, as determined in Clause 16.3, for every identity $M\_{ID}$ of the UEs expected to receive the PSSCH, as indicated by higher layers; otherwise, generate NACK.

If the UE receives PSFCH associated with a SCI format 2-B,

- generate ACK when the UE determines absence of PSFCH reception for each PSFCH reception occasion from the number of PSFCH reception occasions; otherwise, generate NACK

~~- generate ACK when the UE determines ACK from at least one PSFCH reception for the number of PSFCH reception occasions of a PSFCH resource with an index with~~ $M\_{ID}$~~, as determined in Clause 16.3, for every identity~~ $M\_{ID}$ ~~of the UEs expected to receive the PSSCH, as indicated by higher layers; otherwise, generate NACK.~~

The UE generates NACK when, due to prioritization, as described in Clause 16.2.4, the UE does not receive PSFCH in any PSFCH reception occasion associated with a PSSCH transmission in a resource provided by a DCI format 3\_0 with CRC scrambled by a SL-RNTI or, for a configured grant, in a resource provided in a single period and for which the UE is provided a PUCCH resource to report HARQ-ACK information.

The UE generates NACK when, due to prioritization as described in Clause 16.2.4, the UE does not transmit a PSSCH in any of the resources provided by a DCI format 3\_0 with CRC scrambled by SL-RNTI or, for a configured grant, in any of the resources provided in a single period and for which the UE is provided a PUCCH resource to report HARQ-ACK information. The UE generates ACK if the UE does not transmit a PSCCH with a SCI format 0\_1 scheduling a PSSCH in any of the resources provided by a configured grant in a single period and for which the UE is provided a PUCCH resource to report HARQ-ACK information.

============================<End of change #2>=======================

* 1. Text proposal for TS 38.214

===========================<Start of change #1>=======================

8.1 UE procedure for transmitting the physical sidelink shared channel

Each PSSCH transmission is associated with an PSCCH transmission.

That PSCCH transmission carries the 1st stage of the SCI associated with the PSSCH transmission; the 2nd stage of the associated SCI is carried within the resource of the PSSCH.

If the UE transmits SCI format 1-A on PSCCH according to a PSCCH resource configuration in slot *n* and PSCCH resource *m*, then for the associated PSSCH transmission in the same slot

- one transport block is transmitted with up to two layers;

- The number of layers (ʋ) is determined according to the “Number of DMRS port” field in the SCI

- The set of consecutive symbols within the slot for transmission of the PSSCH is determined according to clause 8.1.2.1;

- The set of contiguous resource blocks for transmission of the PSSCH is determined according to clause 8.1.2.2;

Transform precoding is not supported for PSSCH transmission.

Only wideband precoding is supported for PSSCH transmission.

The DM-RS antenna ports  in Clause 8.4.1.1.1 of [4, TS38.211] are determined according to the ordering of DM-RS port(s) given by Tables 8.3.1.1-1 in Clause 8.3.1.1 of [5, TS 38.212].

The UE shall set the contents of the SCI formats 2-A and 2-B as follows:

- the UE shall determine “Zone ID” field as indicated by higher layers.

- the UE shall set the "Communication range requirement" field as indicated by higher layers.

- the UE shall set value of the “HARQ process ID” field as indicated by higher layers.

- the UE shall set value of the “NDI” field as indicated by higher layers.

- the UE shall set value of the “HARQ feedback enabling/disabling indicator” field as indicated by higher layers.

- the UE shall set value of the “Cast type indicator” field as indicated by higher layers.

============================<End of change #2>=======================

===========================<Start of change #2>=======================

8.5.2 Channel state information

8.5.2.1 CSI reporting quantities

8.5.2.1.1 Channel quality indicator (CQI)

The UE shall derive CQI as specified in section 5.2.2.1, with the following changes

- PDSCH replaced by PSSCH

- uplink slot replaced by sidelink slot

- downlink physical resource blocks replaced by sidelink physical resource blocks

- Transport Block Size determination according to Clause 8.1.3.2

- CSI reference resource according to ~~TODO~~ Clause 8.5.2.3

- interference measurements are not supported

- sub-band differential CQI is not supported

- cqi-Table is determined as follows

- cqi-Table = ‘table1’ if Table 5.1.3.1-1 is determined as the MCS table according to Clause 8.1.3.1 of [6, 38.214],

- cqi-Table = ‘table2’ if Table 5.1.3.1-2 is determined as the MCS table according to Clause 8.1.3.1 of [6, 38.214],

- cqi-Table = ‘table3’ if Table 5.1.3.1-3 is determined as the MCS table according to Clause 8.1.3.1 of [6, 38.214]

============================<End of change #2>=======================

# **Appendix: Agreements made in the email discussion [101-e-NR-5G\_V2X\_NRSL-SL\_PHY\_Procedure-03]**

Agreements:

* SCI format 2-A includes an explicit indication of HARQ feedback enabled/disabled.
* SCI format 2-B includes an explicit indication of HARQ feedback enabled/disabled.

Agreements:

* SCI format 2-A includes a 2-bit information field providing an explicit indication for the cast type

**Conclusion:**

* It is feasible from L1 signaling perspective to use Groupcast option 1 (i.e., NACK only feedback) when Zone ID or Communication range requirement is not provided, if RAN2 decides to support this operation.
	+ No action in RAN1 unless RAN2 informs RAN1 about their decision (to support or not)
	+ Note that if RAN2 decides to support it, RAN1 needs to further discuss

Agreemensts:

* Send an LS to RAN2 in response to R1-2003255 to inform
	+ The conclusion on Groupcast option 1 when Zone ID or Communication range requirement is not provided.
	+ The agreement as above

Agreements:

* The CQI table is derived based on the indicated MCS table
	+ No separate configuration