**3GPP TSG RAN WG1 #102-e R1-20xxxxx**

**e-Meeting, August 17th – 28th, 2020**

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**Source:** Moderator (LG Electronics)

**Title:** Text proposal from Email discussion thread #1 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 [102-e-NR-5G\_V2X\_NRSL-SL\_PHY\_Procedure-01] Email discussion/approval regarding the following aspects for HARQ operation

* Issue 3-1: Details of indicating groupcast HARQ feedback option
* Issue 3-2: Capturing PSFCH reception behavior in the specifications
* Issue 3-3: Exact location of PSFCH slots in the time domain: power control.

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 operations. The text proposal is to implement these agreements.
* Summary of change: A state is added to the cast type indicator of SCI format 2-A to indicate NACK only feedback for groupcast to support it without Zone ID and Communication range requirement fields in SCI. Physical layer behavior of receiving PSFCH and report the result to the higher layer is added. The location of slots including PSFCH is determined.
* Consequences if not approved: The specification is incomplete in supporting sidelink HARQ operations.

# **Text proposal**

* 1. Text proposal for TS 38.211

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

8.2.9 Resource pool

The slot pools and resource block pools are defined in [6, TS 38.214].

For sidelink, the index of the current slot in the slot pool fulfils with equal to the subscript of , defined in clauses 8 [6, TS 38.214] and μ is subcarrier spacing configuration.

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

* 1. Text proposal for TS 38.212

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

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, 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-A:

- HARQ process number – 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 16.4 of [6, TS 38.214].

- Source ID – 8 bits as defined in clause 8.1 of [6, TS 38.214].

- Destination ID – 16 bits as defined in clause 8.1 of [6, TS 38.214].

- HARQ feedback enabled/disabled 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 when HARQ-ACK information includes ACK or NACK |
| 10 | Unicast |
| 11 | Groupcast when HARQ-ACK information includes only NACK |

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

* 1. Text proposal for TS 38.213

===========================<Start of change #3>=======================

16.3 UE procedure for reporting HARQ-ACK on sidelink

**<Unchanged part is omitted>**

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 expects a slot ) has PSFCH transmission occasion resource if , where is defined in Clause 8 [6, TS 38.214], is the number of slots which belong to the resource pool within 10240msec according to Clause 8 [6, TS 38.214], and is provided by *periodPSFCHresource*.

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 the HARQ feedback enabled/disabled indicator field in an associated SCI format 2-A or a SCI format 2-B has value 1 [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.

A UE is provided by *rbSetPSFCH* a set of PRBs in a resource pool for PSFCH transmission in a PRB of the resource pool. For a number of sub-channels for the resource pool, provided by *numSubchannel*, and a number of PSSCH slots associated with a PSFCH slot which is less than or equal to , the UE allocates the PRBs from the PRBs to the (*i+*1)-th slot among the PSSCH slots associated with the PSFCH slot and sub-channel , where , , , and the allocation starts in an ascending order of and continues in an ascending order of . The UE expects that isa multiple of *.*

**<Unchanged part is omitted>**

A UE determines a value, for computing a value of cyclic shift [4, TS 38.211], as in Table 16.3-2 if the UE detects a SCI format 2-A with Cast type indicator field value of "01" or "10", or as in Table 16.3-3 if the UE detects a SCI format 2-B or a SCI format 2-A with Cast type indicator field value of "11". The UE applies one cyclic shift from a cyclic shift pair to a sequence used for the PSFCH transmission [4, TS 38.211].

**<Unchanged part is omitted>**

16.3.1 UE procedure for receiving HARQ-ACK on sidelink

A UE that has transmitted a PSSCH with SCI format 2-A or SCI format 2-B indicating HARQ feedback enabled shall attempt to receive the associated PSFCH(s) according to the PSFCH resource determined in Clause 16.3. The UE shall determine ACK or NACK in each PSFCH resource in accordance with [10, TS 38.133]. The UE is not required to determine both ACK and NACK at the same time for a PSFCH resource.

For each PSFCH reception occasion, from a number of PSFCH reception occasions, the UE generates HARQ-ACK information to report to the higher layer. The UE can be indicated by a SCI format to perform one of the following and the UE constructs HARQ-ACK information, when applicable

- if the UE receives a PSFCH associated with a SCI format 2-A with Cast type indicator field value of "10"

- report to the higher layer HARQ-ACK information with same value as a value of HARQ-ACK information the UE determines from the PSFCH reception

- if the UE receives a PSFCH associated with a SCI format 2-A with Cast type indicator field value of "01"

- report to the higher layer ACK if the UE determines ACK from at least one PSFCH reception occasion, from the number of PSFCH reception occasions, in PSFCH resources corresponding to every identity of the UEs that the UE expects to receive the PSSCH, as described in Clause 16.3; otherwise, report NACK to the higher layer

- if the UE receives a PSFCH associated with a SCI format 2-B or a SCI format 2-A with Cast type indicator field value of "11"

- report to the higher layer NACK when the UE determines NACK in the PSFCH reception occasion; otherwise, report ACK to the higher layer

The UE reports Discontinuous Transmission (DTX) to the higher layer if it does not detect HARQ-ACK information in a PSFCH associated with its transmitted PSSCH.

**<Unchanged part is omitted>**

16.5 UE procedure for reporting HARQ-ACK on uplink

**<Unchanged part is omitted>**

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

- if the UE receives a PSFCH associated with a SCI format 2-A with Cast type indicator field value of "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 a PSFCH associated with a SCI format 2-A with Cast type indicator field value of "01"

- generate ACK if the UE determines ACK from at least one PSFCH reception occasion, from the number of PSFCH reception occasions, in PSFCH resources corresponding to every identity of the UEs that the UE expects to receive the PSSCH, as described in Clause 16.3; otherwise, generate NACK

- if the UE receives a PSFCH associated with a SCI format 2-B or a SCI format 2-A with Cast type indicator field value of "11"

- 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

**<Unchanged part is omitted>**

============================<End of change #3>=======================

* 1. Text proposal for TS 38.214

===========================<Start of change #4>=======================

8 Physical sidelink shared channel related procedures

A UE can be configured by higher layers with one or more sidelink resource pools. A sidelink resource pool can be for transmission of PSSCH, as described in Clause 8.1, or for reception of PSSCH, as described in Clause 8.3 and can be associated with either sidelink resource allocation mode 1 or sidelink resource allocation mode 2.

In the frequency domain, a sidelink resource pool consists of *numSubchannel* contiguous sub-channels. A sub-channel consists of *subchannelsize* contiguous PRBs, where *numSubchannel* and *subchannelsize* are higher layer parameters.

The set of slots that belongs to a sidelink resource pool is denoted by where

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- the slot index is relative to slot#0 of the radio frame corresponding to SFN 0 of the serving cell or DFN 0,

- the set is initialized to include all the slots except the following slots,

- slots in which S-SS/PSBCH block (S-SSB) is configured,

- slots in each of which at least one of *Y-th*, *(Y+1)-th*, …, *(Y+X-1)-th* OFDM symbols are not semi-statically configured as UL as per the higher layer parameter *TDD-UL-DL-ConfigCommon*, where *Y* and *X* are set by the higher layer parameters *sl-StartSymbol* and *sl-LengthSymbols*, respectively.

- The reserved slots which are determined by the following steps.

1) the remaining slots excluding slots and slots from the set of all the slots are denoted by arranged in increasing order of slot index.

2) a slot belongs to the reserved slots if , here and where denotes the length of bitmap configured by higher layers.

 - The slots in the set are arranged in increasing order of slot index.

- The UE determines the set as follows:

- a bitmap associated with the resource pool is used where the length of the bitmap is configured by higher layers.

- a slot is excluded from the set if where .

- The remaining slots in the set are re-indexed such that the subscripts *i* of the remaining slots are successive {0, 1, …, where is the number of the slots remaining in the set.The UE determines the set of resource blocks assigned to a sidelink resource pool as follows:

- The resource block pool consists of PRBs.

- The sub-channel *m* for consists of a set of contiguous resource blocks with the physical resource block number for , where and are given by higher layer parameters *sl\_StartRB-Subchannel* and *sl-SubchannelSize*, respectively

A UE is not expected to use the last PRBs in the resource pool.

**<Unchanged part is omitted>**

============================<End of change #4>=======================

# **Appendix: Agreements made in the email discussion [102-e-NR-5G\_V2X\_NRSL-SL\_PHY\_Procedure-01]**

Agreements:

* HARQ feedback Option 1 (i.e., NACK only) without distance-based feedback is supported from the physical layer perspective.
	+ A value of Cast type indicator in SCI format 2-A is used to indicate groupcast HARQ feedback option 1 without distance-based feedback

Agreements:

* Prepare a TP to capture UE behavior that physical layer reports HARQ-ACK information of the received PSFCH to higher layer. Detailed wording will be discussed during the TP phase with the following principle:
	+ Groupcast option 1: UE reports ACK when the UE determines absence of PSFCH reception for the PSFCH reception occasion; otherwise, reports NACK.
	+ Groupcast option 2: UE reports ACK if the UE determines ACK in PSFCH resources corresponding to every identity M\_ID of the UEs that the UE expects to receive the PSSCH, as described in Clause 16.3; otherwise reports NACK;
	+ Unicast: UE reports HARQ-ACK information with same value as a value of HARQ-ACK information the UE determines from the PSFCH reception
	+ Discuss during the TP phase whether or not a clarification is necessary to separately handle the potential collision case if any

Agreements:

* Prepare a TP to define the logical slot index of a resource pool.
	+ The wording in LTE V2X is the baseline and details will be discussed during the TP phase.

Agreements:

* Option B is agreed for the number of logical slots in a resource pool.
	+ Option A: UE is not expected to be configured with a resource pool where the number of logical slots of the resource pool, counted within 10240 ms period, is not an integer multiple of the PSFCH resource period
	+ Option B: It is clarified in the specification that a PSFCH slot is associated with up to N PSSCH slots where N is the PSFCH resource period.
* Option 1 is agreed for the location of PSFCH slots where the PSFCH resource period is N.
	+ Option 1: Logical slot index #0, #N, #2N, …. within 10240 ms period
	+ Option 2: Logical slot index #N-1, #2N-1, #3N-1, … within 10240 ms period
	+ Option 3: Logical slot index …, #M-2N, #M-N, #M within 10240 ms period, where logical slot #M is the last slot of a resource pool