**3GPP TSG RAN WG1 #101 R1-2004932**

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

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**Source:** Moderator (LG Electronics)

**Title:** Text proposal from Email discussion thread #2 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-02] Email discussion/approval regarding prioritization. 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 the prioritization in the sidleink operations. The text proposal is to implement these agreements.
* Summary of change:
* Consequences if not approved: The specification is incomplete in prioritizing uplink and sidelink transmissions.

# **Text proposal**

* 1. Text proposal for TS 38.213

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

16.2.4.3.1 Prioritizations for sidelink and uplink transmissions

**<Unchanged text is omitted>**

A PUCCH transmission with a sidelink HARQ-ACK information report has higher priority than a SL transmission if a priority value of the PUCCH is smaller than a priority value of the SL transmission. The priority value of the PUCCH transmission is as described in Clause 16.5 ~~and is the smallest priority value for a PSFCH with HARQ-ACK information included in the HARQ-ACK information report~~. If the priority value of the PUCCH transmission is larger than the priority value of the SL transmission, the SL transmission has higher priority.

============================<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 ~~is the same as the PSFCH~~ to report in a PUCCH or PUSCH transmission. ~~, t~~The UE can be indicated by higher layers to perform one of the following and the UE constructs a HARQ-ACK codeword with HARQ-ACK information, when applicable.

- 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

- 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 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 , as determined in Clause 16.3, for every identity of the UEs expected to receive the PSSCH, as indicated by higher layers; otherwise, generate NACK.

When a UE has transmitted a PSSCH and performed PSFCH reception in the associated PSFCH resource occasion, the priority value of the generated HARQ-ACK information is the same as the priority value of the PSSCH transmission which is associated with a number of PSFCH reception occasions from which the HARQ-ACK information is generated.

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 priority value of the generated NACK is the same as the priority value of the PSSCH transmission.

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 priority value of the generated NACK is the same as the priority value of the PSSCH not transmitted due to prioritization.

The UE generates ACK if the UE does not transmit a PSCCH with a SCI format ~~0\_1~~ 1\_A 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. The priority value of the generated ACK is the same as the largest priority value among the possible values for the configured grant.

**<Unchanged text is omitted>**

A UE does not expect to multiplex HARQ-ACK information for more than one SL configured grants in a same PUCCH.

The priority value of the PUCCH transmission with one or more sidelink HARQ-ACK information report is the smallest priority value for the HARQ-ACK information included in it.

In the following, the CRC for DCI format 3\_0 is scrambled with a SL-RNTI or a SL-CS-RNTI.

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

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

9.2.5 UE procedure for reporting multiple UCI types

**<Unchanged text is omitted>**

A UE multiplexes DL HARQ-ACK information, with or without SR, and CSI resport(s) in a same PUCCH if the UE is provided *simultaneousHARQ-ACK-CSI*; otherwise, the UE drops the CSI report(s) and includes only DL HARQ-ACK information, with or without SR, in the PUCCH. If the UE would transmit multiple PUCCHs in a slot that include DL HARQ-ACK information and CSI report(s), the UE expects to be provided a same configuration for *simultaneousHARQ-ACK-CSI* each of PUCCH formats 2, 3, and 4.

**<Unchanged text is omitted>**

Set  to the set of resources for transmission of corresponding PUCCHs in a single slot without repetitions where

- a resource with earlier first symbol is placed before a resource with later first symbol

- for two resources with same first symbol, the resource with longer duration is placed before the resource with shorter duration

- for two resources with same first symbol and same duration, the placement is arbitrary

- the above three steps for the set  are according to a subsequent pseudo-code for a function 

- a resource for negative SR transmission that does not overlap with a resource for HARQ-ACK or CSI transmission is excluded from set 

- if the UE is not provided *simultaneousHARQ-ACK-CSI* and resources for transmission of HARQ-ACK information include PUCCH format 0 or PUCCH format 2, resources that include PUCCH format 2, or PUCCH format 3, or PUCCH format 4 for transmission of CSI reports are excluded from the set  if they overlap with any resource from the resources for transmission of HARQ-ACK information

- if the UE is not provided *simultaneousHARQ-ACK-CSI* and at least one of the resources for transmission of HARQ-ACK information includes PUCCH format 1, PUCCH format 3, or PUCCH format 4

- resources that include PUCCH format 3 or PUCCH format 4 for transmission of CSI reports are excluded from the set 

- resources that include PUCCH format 2 for transmission of CSI reports are excluded from the set  if they overlap with any resource from the resources for transmission of HARQ-ACK information

Set  to the cardinality of 

Set to be the first symbol of resource  in the slot

Set  to be the number of symbols of resource  in the slot

Set  - index of first resource in set 

Set  - counter of overlapped resources

while 

if  and resource  overlaps with resource 





else

if 

determine a single resource for multiplexing UCI associated with resources  as described in Clause 9.2.5.0, Clauses 9.2.5.1 and 9.2.5.2

set the index of the single resource to 



 % start from the beginning after reordering unmerged resources at next step



 % function that re-orders resources in current set 

Set  to the cardinality of 

else



end if

end if

end while

The function  performs the following pseudo-code

{



while  % the next two while loops are to re-order the unmerged resources



while 

if  OR 







end if



end while



end while

}

For each PUCCH resource in the set  that satisfies the aforementioned timing conditions, when applicable,

- the UE transmits a PUCCH using the PUCCH resource if the PUCCH resource does not overlap in time with a PUSCH transmission after multiplexing UCI following the procedures described in Clauses 9.2.5.0, Clauses 9.2.5.1 and 9.2.5.2

- the UE multiplexes HARQ-ACK information and/or CSI reports in a PUSCH if the PUCCH resource overlaps in time with a PUSCH transmission, as described in Clause 9.3, and does not transmit SR. In case the PUCCH resource overlaps in time with multiple PUSCH transmissions, the PUSCH for multiplexing HARQ-ACK information and/or CSI is selected as described in Clause 9. If the PUSCH transmission by the UE is not in response to a DCI format detection and the UE multiplexes only CSI reports, the timing conditions are not applicable

- the UE does not expect the resource to overlap with a second resource of a PUCCH transmission over multiple slots if the resource is obtained from a group of resources that do not overlap with the second resource.

Clauses 9.2.5.0, Clauses 9.2.5.1 and 9.2.5.2 assume the following

- resources for transmissions of UCI types or SL HARQ reporting, prior to multiplexing or dropping, overlap in a slot

- multiplexing conditions of corresponding UCI types or SL HARQ reporting in a single PUCCH are satisfied, and

- the UE does not transmit any PUSCH time-overlapping with PUCCH in the slot.

9.2.5.0 UE procedure for prioritization between SL HARQ-ACK reporting in a PUCCH and UCI in a PUCCH

The priority value of the PUCCH transmission is as described in Clause 16.2.4.3.1.

For prioritization between SL HARQ reporting in a PUCCH and UCI in a PUCCH

- if the PUCCH carrying UCI is with priority index 1,

- if *sl-PriorityThresholdULURLLC* is provided

- the UE transmits the PUCCH carrying SL HARQ reporting if a smallest priority value of the PUCCH carrying SL HARQ reporting is smaller than *sl-PriorityThresholdULURLLC*;otherwise, the UE transmits the PUCCH carrying UCI

- else

- the UE transmits the PUCCH carrying UCI

- else

- the UE transmits the PUCCH carrying SL HARQ reporting if the smallest priority value of the PUCCH carrying SL HARQ reporting is smaller than *sl-PriorityThreshold*;otherwise, the UE transmits the PUCCH carrying UCI

When UE determines to transmit the PUCCH carrying UCI, the UE determines a single resource for multiplexing UCI as described in Clauses 9.2.5.1 and 9.2.5.2

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

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

16.2.4.3.1 Prioritizations for sidelink and uplink transmissions

A UE shall perform prioritization between SL transmissions and UL transmissions after performing UE procedure described in Clause 9.2.5 and in Clause 6.1 in [6, TS 38.214].

PSFCH transmissions in a slot have a same priority value as the smallest priority value among PSSCH receptions with corresponding HARQ-ACK information provided by the PSFCH transmissions in the slot.

A priority of S-SS/PSBCH block transmission is provided by *sl-SSB-PriorityNR.*

For prioritization between PSFCH/S-SS/PSBCH block transmission and UL transmission other than a PRACH, or a PUSCH scheduled by an UL grant in a RAR, or a PUCCH with sidelink HARQ-ACK information report

- if the UL transmission is for a PUSCH or for a PUCCH with priority index 1,

- if *sl-PriorityThresholdULURLLC* is provided

- the SL transmission has higher priority than the UL transmission if a smallest priority value of the SL transmission(s) is smaller than *sl-PriorityThresholdULURLLC*;otherwise, the UL transmission has higher priority than the SL transmission

- else

- the UL transmission has higher priority than the SL transmission

- else

- the SL transmission has higher priority than the UL transmission if the smallest priority value of the SL transmission(s) is smaller than *sl-PriorityThreshold*;otherwise, the UL transmission has higher priority than the SL transmission

A PRACH transmission, or a PUSCH scheduled by an UL grant in a RAR, has higher priority than a PSFCH or a S-SS/PSBCH block transmission.

A PUCCH transmission with a sidelink HARQ-ACK information report has higher priority than a SL transmission if a priority value of the PUCCH is smaller than a priority value of the SL transmission. The priority value of the PUCCH transmission is as described in Clause 16.5 and is the smallest priority value for a PSFCH with HARQ-ACK information included in the HARQ-ACK information report. If the priority value of the PUCCH transmission is larger than the priority value of the SL transmission, the SL transmission has higher priority.

When one or more SL transmissions overlaps with multiple UL transmissions not overlapping with each other in time, the UE should transmit SL transmissions if at least one SL transmission is prioritized over all the UL transmissions subject to UE processing timeline with respect to the first SL/UL transmission.

When one or more UL transmissions overlaps with multiple SL transmissions not overlapping with each other in time, the UE should transmit UL transmissions if at least one UL transmission is prioritized over all the SL transmissions subject to UE processing timeline with respect to the first SL/UL transmission.

When one SL transmission overlaps with one or more UL transmissions overlapping with any UL transmission in time, the UE transmits SL transmission if the SL transmission is prioritized over all the UL transmissions subject to both UE multiplexing and processing timeline with respect to the first SL/UL transmission, where the UE processing timeline with respect to the first SL/UL transmission is the same as that for the case when one or more SL transmissions overlaps with multiple UL transmissions not overlapping with each other in time.

When one SL transmission overlaps with one or more UL transmissions overlapping with any UL transmission in time, the UE transmits UL transmission if at least one UL transmission is prioritized over the SL transmission subject to both UE multiplexing and processing timeline with respect to the first SL/UL transmission, where the UE processing timeline with respect to the first SL/UL transmission is the same as that for the case when one or more SL transmissions overlaps with multiple UL transmissions not overlapping with each other in time.

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

# **Appendix: Agreements made in the email discussion [101-e-NR-5G\_V2X\_NRSL-SL\_PHY\_Procedure-02]**

Agreements:

* For configured grant, the TX UE reports ACK to gNB in case no PSCCH/PSSCH is transmitted in a set of resources
* the priority of the “PUCCH carrying SL HARQ reporting” is defined as the largest priority value (i.e. the least important one) among the possible values for the grant.

Agreements:

* When a UE does not transmit PSCCH/PSSCH or receive PSFCH due to intra-UE prioritization,
* the priority of the corresponding “PUCCH carrying SL HARQ reporting” is defined as the priority value of the dropped PSSCH or PSFCH

Agreements:

* When the SL transmission does not use SL HARQ feedback (if supported by RAN2) and the UE reports NACK to request further resources for blind retransmission and ACK otherwise,
* the priority of the “PUCCH carrying SL HARQ reporting” is defined as the priority value of the associated PSSCH

Agreements:

* When the maximum number of HARQ re-transmissions is reached for a TB and the UE sends one bit on the UL resources for SL HARQ-ACK reporting
  + the priority of the “PUCCH carrying SL HARQ reporting” is defined as the priority value of the associated PSSCH

Agreements:

* When PUCCH with SL HARQ overlaps with one or more UL TXs, the processing order of addressing UCI multiplexing is reused, i.e. the prioritization between PUCCHs is performed first, then followed by multiplexing/prioritization with PUSCH.

Agreements:

* When PUCCH carrying SL HARQ reporting overlaps with another UL TX other than PUSCH and PRACH, UL/SL prioritization rule agreed for PSFCH and UL TX other than PUCCH carrying SL HARQ reporting is reused by replacing PSFCH with PUCCH carrying SL HARQ reporting, i.e.,
  + when UL TX is associated with a DCI indicating “high” in “priority field” or configured with “high priority” by higher layers (i.e., URLLC case)
    - If SL-threshold for URLLC case is configured, LTE rule is used (i.e., UL TX is down-prioritized if the priority value of PUCCH carrying SL HARQ reporting is smaller than SL-threshold, otherwise prioritized)
    - Otherwise, UL TX is prioritized
  + Otherwise, LTE rule is used with another SL-threshold configured for non-URLLC case

Agreements:

* When one or more SL transmissions overlaps with multiple UL transmissions not overlapping with each other in time, the UE should transmit SL transmissions if at least one SL transmission is prioritized over all the UL transmissions subject to UE processing timeline w.r.t. the first SL/UL transmission.
* When one or more UL transmissions overlaps with multiple SL transmissions not overlapping with each other in time, the UE should transmit UL transmissions if at least one UL transmission is prioritized over all the SL transmissions subject to UE processing timeline w.r.t. the first SL/UL transmission.
* These replace the following working assumption made in RAN1#100bis:
  + **(Working assumption) For handling the case where more than one SL and UL transmissions overlap, adopt the following principle**
  + **For more than one SL transmissions overlapping with a UL transmission, the highest priority of SL transmissions is used for the prioritization.**
  + **For more than one UL transmissions overlapping with a SL transmission, the highest priority of UL transmissions is used for the prioritization.**

Agreements:

* When one SL transmission overlaps with one or more UL transmissions overlapping with any UL transmission in time,
  + multiplexing/prioritization defined on Uu, if any applicable, apply to the overlapping UL transmissions before the prioritization with the SL transmission.
    - If the SL transmission still overlaps with more than one UL transmission,
      * the UE transmits SL transmission if the SL transmission is prioritized over all the UL transmissions subject to both UE multiplexing and processing timeline w.r.t. the first SL/UL transmission.
      * the UE transmits UL transmission if at least one UL transmission is prioritized over the SL transmission subject to both UE multiplexing and processing timeline w.r.t. the first SL/UL transmission.
      * UE processing timeline w.r.t. the first SL/UL transmission is the same as in proposal 8.