
Agenda Item: 7.2.4.1
Source: TCL Communication
Title: Physical Layer Structure for Sidelink
Document for: Discussion and Decision

1 Introduction

Based on the results of the V2X SI [1], the corresponding WI [2] has been approved in RAN Plenary #83. In the following we discuss the physical layer aspects and solutions to enable sidelink unicast, groupcast and broadcast transmission for V2X services.

2 Resource Pool

The following agreements have been reached:

Agreements:

RAN1 #98b

- A slot is the time-domain granularity for resource pool configuration.
 - To down-select:
 - Alt 1. Slots for a resource pool is (pre-)configured with bitmap, which is applied with periodicity
 - Alt 2. Slots for a resource pool is (pre-)configured, where the slots are applied with periodicity.
 - FFS: signaling details
 - FFS: how to apply the above bitmap signaling, e.g., to all slots or only to a set of slots
 - FFS: symbols for sidelink in the slot, how to indicate for the case when not all symbols are for SL

Agreements :**100e-NR-5G_V2X_NRSL-PHYstructure-02**

- For resource pool configuration, slots for a resource pool is (pre-)configured with bitmap, which is applied with periodicity.

Agreements :**100e-NR-5G_V2X_NRSL-PHYstructure-02**

For derivation of the set of slots to be included in the resource pool, the baseline is the derivation with bitmap and periodicity based on Subclause 14.1.5 of TS36.213 with the following modifications.

- FFS: Periodicity and L_bitmap value
- The slot index is relative to slot#0 of the radio frame corresponding to SFN 0 of the serving cell if serving cell timing reference is in use, or DFN 0 otherwise
- The following procedure is used.
 - The set includes all the slots except the following slots:
 - Slots in which SLSS resource is configured,
 - (Working assumption) slots not having at least Y-th,(Y+1)-th,, (Y+X-1)-th symbols in a slot semi-statically for UL as indicated in TDD-UL-DL-ConfigCommon, where
 - X is sl-LengthSymbols
 - Y is sl-StartSymbol
 - (Working assumption) reserved slots which are determined by the similar steps in Subclause 14.1.5 of TS36.213
- (Working assumption) For the number of PRBs for resource pool, allow configuration of all number of PRBs in a SL BWP.
- FFS until RAN1#100bis-e whether/how to deal with remaining PRBs if the configured PRBs for resource pool is not a multiple of subchannel size.

2.1 Periodicity and L_bitmap

Concerning the periodicity, our view is to reuse LTE periodicity of 10240 ms.

Proposal 1: Reuse periodicity of 10240 ms.

In LTE Rel-14 V2X, the parameter `subframeBitmapSL-r14` defines a bit string of size $L_{bitmap} = \{10, 16, 20, 30, 40, 50, 60, 100\}$. This bit string selects subframes within the period of 10240 ms. Given that NR supports various numerologies the number of slots within the period can be much larger than in LTE. Therefore, it is reasonable to add larger values to that list, e.g. until 1000.

Proposal 2: The length of the bitmap L_{bitmap} should increase depending on the numerology.

2.2 Remaining PRBs

One FFS point is what to do with the remaining PRBs if the configured number of PRBs is not a multiple of the subchannel size. In our opinion, those remaining PRBs should be left unused. A proper configuration should ensure that the configured PRBs are a multiple of the sub-channel size.

Proposal 3: Remaining PRBs are left unused.

3 Physical Sidelink Control Channel (PSCCH)

This section discusses the design of the sidelink control channel.

Agreements:

98b-NR-15

- When reservation of a sidelink resource for an initial transmission of a TB at least by an SCI associated with a different TB is disabled, N_{MAX} is 3
 - SCI signaling is designed to allow to indicate 1 or 2 or 3 resources at least of the same number of sub-channels with full flexibility in time and frequency position in a window W of a resource pool
 - FFS: if full flexibility is limited in some cases
 - Value 2 or 3 is (pre-)configured per resource pool
 - FFS size of window W

Agreements:

RAN1 #99

- 1st SCI includes at least
 - Priority (QoS value),
 - PSSCH resource assignment (frequency/time resource for PSSCH),
 - Resource reservation period (if enabled),
 - PSSCH DMRS pattern (if more than one patterns are (pre-)configured),
 - 2nd SCI format (e.g. information on the size of 2nd SCI),
 - [2]-bit information on amount of resources for 2nd SCI (e.g. beta offset or aggregation level)
 - Number of PSSCH DMRS port(s)
 - 5-bit MCS

3.1 Design of 1st-stage SCI

First stage SCI can occupy a fraction of the PRBs in a sub-channel. To fulfill different QoS requirements in different channel conditions, multiple sizes for the transmission of 1st stage SCI should be supported. Each resource pool is configured with the suitable size for the 1st stage SCI to avoid any blind decodes.

Proposal 4: Multiple sizes for the transmission of 1st stage SCI are supported. A resource pool is configured with the 1st stage SCI size to be used in this resource pool.

It would be interesting to investigate the pros and cons of configuring more than one size for the 1st stage SCI transmissions. On the downside, it increases the blind decoding complexity. On the upside, it improves resource and power efficiency by combining the knowledge of QoS and link conditions.

3.2 Compact 2nd Stage SCI for Transmissions with Prior Reservations

It has been agreed that at least an SCI in Mode 2 can indicate up to 3 resources, one current resource and two future reservations. Each 2nd stage SCI in the first transmission and subsequent transmissions, reserved earlier, will have the same source ID and destination ID. As the source ID and the destination ID are at least known to the destination, in case of HARQ enabled SL transmissions, they can be removed from the

transmissions which were reserved in the prior transmissions, thus reducing the SCI overhead without impacting the sensing operation of neighbouring SL devices. This significant advantage can be easily obtained by having a 2nd stage SCI format without the source and destination IDs.

Proposal 5: When the sidelink control information associated to a sidelink transmission carries the indication of resource reservation for a future transmission, the source ID and the destination ID in the 2nd stage SCI of reserved transmission are not transmitted.

4 Conclusion

In this contribution the following proposals and observations have been made:

Proposal 1: Reuse periodicity of 10240 ms.

Proposal 2: The length of the bitmap L_{bitmap} should increase depending on the numerology.

Proposal 3: Remaining PRBs are left unused.

Proposal 4: Multiple sizes for the transmission of 1st stage SCI are supported. A resource pool is configured with the 1st stage SCI size to be used in this resource pool.

Proposal 5: When the sidelink control information associated to a sidelink transmission carries the indication of resource reservation for a future transmission, the source ID and the destination ID in the 2nd stage SCI of reserved transmission are not transmitted.

References

- [1] TSG RAN, “Study on NR Vehicle-to-Everything (V2X),” 3GPP TR 38.885 V2.0.0, Tech. Rep., Mar. 2019.
- [2] —, “Revised WID on 5G V2X with NR sidelink,” 3GPP RP-190984, Tech. Rep., Jun. 2019.
- [3] 3rd Generation Partnership Project, “Physical Channels and Modulation,” 3GPP TS 38.211 V15.3.0, Tech. Rep., Oct. 2018.
- [4] —, “Physical Layer Procedures for Control,” 3GPP TS 38.213 V16.0.0, Tech. Rep., Dec. 2019.
- [5] SA2, “Reply LS on Sidelink HARQ Feedback for Groupcast,” 3GPP TSG RAN1 #98b, Tech. Rep. R1-1911676, Oct. 2019.